DRAFT

Environmental Assessment for the Reconstitution and Enhancement of Space Launch Complex 20 Multi-User Launch Operations at Cape Canaveral Air Force Station Florida

Prepared for

Space Florida

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Acronyms and Abbreviations

^oC	degree Celsius
^oF	degree Fahrenheit
45 SW	45th Space Wing
AASHTO	American Association of State Highway and Transportation Officials
ACHP	Advisory Council on Historic Preservation
AFI	Air Force Instruction
AFSPCI	Air Force Space Command Instruction
AFSPCMAN	Air Force Space Command Manual
AIRFA	American Indian Religious Freedom Act
ANSI	American National Standards Institute
ARPA	Archaeological Resources Protection Act
ASME	American Society of Mechanical Engineers
AST	Aboveground Storage Tank
ASW	Aquifer Storage Wells
ATDC	Advanced Technology Development Center
BA	Biological Assessment
BDC	Bulk Destruct Charges
BMP	Best Management Practices
BO	Biological Opinion
BRL	Banana River Lagoon
BRRC	Blue Ridge Research and Consulting, LLC
CAA	Clean Air Act
CCAFS	Cape Canaveral Air Force Station
CCBIC	Cape Canaveral Barrier Island Complex
CCS	Cape Canaveral Spaceport
CDNL	C-Weighted Day-Night Level
CES/CEIE	Civil Engineering Squadron/Installation Management and Environmental Element
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CH4	Methane
cm	centimeter
CNS	Canaveral National Seashore
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon-Dioxide Equivalent
COPV	composite overwrapped pressure vessel
CRA	Cultural Resource Assessment
CRM	Cultural Resource Manager
CSEL	C-Weighted Sound Exposure Level
CZMA	Coastal Zone Management Act
dB	Decibel

dBA	A-weighted Decibels
dBC	C-weighted Decibels
DEM	Digital Elevation Model
DNL	Day-Night Average Noise Level
DoD	Department of Defense
DOT	Department of Transportation
EA	Environmental Assessment
EBS	Environmental Baseline Survey
EELV	Evolved Expendable Launch Vehicle
EFH	Essential Fish Habitat
EIAP	Environmental Impact Analysis Process
EIS	Environmental Impact Statement
EO	Executive Order
EPCRA	Environmental Planning and Community Right-to-Know Act
ERP	Environmental Resource Permit
ESA	Endangered Species Act
EWR	Eastern and Western Range
FAA	Federal Aviation Administration
Fac	Facility
FAC	Florida Administrative Code
FCMP	Florida Coastal Management Plan
FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FNAI	The Florida National Area Inventory
FONSI	Finding of No Significant Impact
FPL	Florida Power & Light
ft	feet/foot
FWC	Florida Fish and Wildlife Commission
g	gram
gal	gallon
gal/d	gallon per day
GCTL	Groundwater Cleanup Target Level
GHG	Greenhouse Gases
H_2O	Water
ha	hectares
HAP	Hazardous Air Pollutant
HIF	Horizontal Integration Facility
Hz	Hertz
IBD	Inhabited Building Distance
ICRMP	Installation Cultural Resource Management Plan
ILD	Intraline Distance
IM	interim measure

INRMP	Integrated Natural Resources Management Plan
IRL	Indian River Lagoon
IRP	Installation Restoration Program
ISOPAR	isoparaffinic hydrocarbon fluid
kg	kilogram
KHB	KSC Handbook
km	kilometer
kN	kilonewton
KSC	Kennedy Space Center
KV	Kilovolt
kW	Kilowatt
L	liter
L/d	liters per day
LAea	Level Equivalent A-Weighted
LAmax	A-weight Maximum Sound Level
lbf	pound-force
lb	pounds
LBS	Load Break Switch
LCH4	liquid methane
LMP	Light Management Plan
LMU	Land Management Unit
LOX	liquid oxygen
LSOL	Launch Site Operators License
m	meter
MBTA	Migratory Bird Treaty Act
MGD	Million Gallons per Day
MINWR	Merritt Island National Wildlife Refuge
MMPA	Marine Mammal Protection Act
MSFCMA	Magnuson-Stevens Fishery Conservation & Management Act
MSL	Mean Sea Level
MVA	Mega Volt/Amperes
MWH	Mega Watt/Hour
N2O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NAGRA	Native American Graves Protection Act
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NFA	No Further Action
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO2	Nitrogen Dioxide
NOAA	National Oceanic and Atmospheric Administration
NOTAM	Notice to Airmen
NOx	Oxides of Nitrogen

NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCS	National Resources Conservation Service
NRHP	National Register of Historic Places
NOTMAR	Notice to Mariners
O3	Oxone
ODC	Ozone Depleting Chemical
ODS	Ozone Depleting Substance
OLV	Orbital Launch Vehicle
OSHA	Occupational Safety and Health Administration
Pb	Lead
PAFB	Patrick Air Force Base
PCB	Polychlorinated Biphenyls
PM	Particulate Matter
PO	Potentially Occupied
ppb	parts per billion
ppm	parts per million
PRL	Potential Release Location
psf	pounds per square foot
PTR	Public Transport Route
RCRA	Resource Conservation and Recovery Act
REC	Record of Environmental Consideration
RFI	Resource Conservation and Recovery Act Facility Investigation
RLV	Reusable Launch Vehicle
ROI	region of influence
RP-1	Rocket Propellant 1
RPA	Real Property Agreement
SAA	Space Act Agreement
SAS	Surficial Aquifer System
SCTL	Soil Cleanup Target Level
SEL	Sound Exposure Level
SF6	Sulfur Hexafluoride
SFHA	Special Flood Hazard Area
SHPO	State Historic Preservation Office
SJRWMD	St. Johns River Water Management District
SLC	Space Launch Complex
SO2	Sulfur Dioxide
SO_x	Sulfur Oxides
SPCCP	Spill Prevention, Control, and Countermeasure Plan
SR	State Road
SSC	Species of Special Concern
STD	Standard
SW	Space Wing
SWI	Space Wing Instruction

SWMU	Solid Waste Management Unit
SWPPP	Stormwater Erosion and Pollution Prevention Plan
T&E	Threatened and Endangered
TCP	Traditional Cultural Properties
TEA/TEB	triethylaluminum/triethylborane
TEL	transport erector launcher
THPO	Tribal Historic Preservation Officer
TM	Technical Memorandum
TSCA	Toxic Substances Control Act
US	United States Highway
USACE	United States Army Corps of Engineers
USAF	United States Air Force
USC	United States Code
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USSF	United States Space Force
UST	Underground Storage Tank
VOC	Volatile Organic Compound
WMD	Water Management Districts
WMO	World Meteorological Organization
WWTP	Waste Water Treatment Plant

EXECUTIVE SUMMARY

Space Florida has prepared this Environmental Assessment (EA) to evaluate the potential environmental impacts associated with the Real Property transfer, via an agreement, of approximately 220 acres (89 hectares [ha]) of land, to include Space Launch Complex 20 (SLC-20) and all facilities contained thereon, at Cape Canaveral Air Force Station (CCAFS) by the US Air Force (USAF) to Space Florida. Space Florida would develop and provide for use the 220 acres (89 ha) to meet current and future commercial, national, and state space transportation needs through the expansion and modernization of space transportation facilities within Space Florida's Cape Canaveral Spaceport (CCS) territories to include areas within CCAFS.

This EA focuses on the Real Property Agreement (RPA) to transfer the 220 acres (89 ha), to include SLC-20 and transportation routes, from USAF to Space Florida, to develop a multi-user launch capability that includes the refurbishment and enhancement of an existing launch pad, the operation of small- and medium-lift launch vehicles by commercial users such as Firefly Aerospace, Inc., under an agreement with Space Florida, and the transportation of vehicle stages from Exploration Park to SLC-20. The majority of customers for rocket launch missions from this site are expected to be from the commercial sector and government agencies such as the National Aeronautics and Space Administration (NASA) and the Department of Defense (DoD).

The Federal Aviation Administration (FAA) is a cooperating agency due to their launch licensing authority, and NASA is a cooperating agency because of their space vehicle expertise and the construction of an associated manufacturing facility at Exploration Park on NASA property and because NASA is a potential customer for SLC-20 operators. The manufacturing facility is a separate action from this EA previously addressed in a 2008 NASA Environmental Assessment (EA)and a 2019 Kennedy Space Center (KSC) Environmental Checklist/Record of Environmental Consideration (REC).

PURPOSE AND NEED

The purpose of the Proposed Action is to provide multiple launch pads for commercial users in support of Space Florida's CCS Master Plan in accordance with Florida Statutes Section 331 (Space Florida 2017). Specifically, Space Florida must meet current and future commercial, national, and state space transportation requirements through expansion and modernization of space transportation facilities within its Spaceport territories. The territories include, but are not limited to, areas within CCAFS. The Proposed Action would allow commercial launch providers such as Firefly to assemble, process, test, and launch vehicles to meet the demand for lower cost access to space. The Proposed Action would provide the continued capability of space exploration by commercial users and improve the return on taxpayer investment of CCAFS facilities through expanded use and improved utilization. The Proposed Action would also continue to provide economic and technical benefits to the government and the private sector following the retirement of the Space Shuttle Program in 2011. On November 27, 2018, the Space Florida Board of Directors approved the request to proceed with negotiations and agreements for the redevelopment of SLC-20 to meet Florida's commercial space transportation industry needs.

The Proposed Action is needed to test and launch vehicles efficiently in the United States for use by commercial space launch enterprises. The Proposed Action will contribute to meeting the goals of the CCS Master Plan consistent with the National Space Transportation Policy, NASA's Space Act Agreement (SAA), and DoD policy pursuant to DoD Directive 3230.3.

The FAA expects to receive a license application from Space Florida to operate a commercial space launch site at SLC-20. Also, the FAA expects to receive a license application from Firefly to conduct launch operations at SLC-20. Therefore, the FAA's proposed actions of issuing a launch site operator license to Space Florida and a launch license to Firefly for launch operations at SLC-20 are considered part of the Proposed Action analyzed in this EA. The FAA's purpose of its action is to fulfill the FAA's responsibilities as authorized by the Commercial Space Launch Act (51 U.S.C. Subtitle V, ch. 509, §§ 50901-50923) 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 Act, 51 U.S.C 50901(b), to, in part, "protect the public health and safety, safety of property, and national security and foreign policy interests of the United States" while "strengthening and [expanding] 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."

PROPOSED ACTION

The Proposed Action is to transfer, by an RPA, approximately 220 acres (89 ha) of land, to include SLC-20 and all facilities contained thereon, at CCAFS by USAF to Space Florida (Figure 1-1); provide use of 33 acres (13.3 ha) of the 220 acres, to include the existing launch site infrastructure to a commercial user on a dedicated basis; refurbish and enhance existing SLC-20 facilities; test and operate small- and medium-lift launch vehicles; and transport vehicle stages from a proposed manufacturing facility at Exploration Park, KSC to SLC-20. The proposed manufacturing facility was analyzed in a previous NASA KSC Environmental Impact Statement (EIS) and environmental checklist/REC. In addition to the agreement noted above, this EA will include in the cumulative analysis section that Space Florida will be requesting, at some point in the future, that USAF provide an access road easement to allow entry to SLC-20 from the south via SLC-19 (refer to cross-hatched area shown in Figure 1-2). The details of this access into SLC-20 via the SLC-19 access road are not sufficiently developed at this time to be analyzed in this EA and will be analyzed when additional site development is planned.

Space Florida proposes to establish a multi-user launch capability at SLC-20. Firefly, one of the potential launch providers, proposes to launch Alpha, a small-lift class launch vehicle, and future Beta, a small- to medium-lift class launch vehicle, from SLC-20. Firefly's Alpha and Beta launch vehicles will be used as representative vehicles for the Proposed Action and are referred to as Concept A and Concept B, respectively. Both representative launch vehicles are expendable and provide satellite delivery services with the future opportunity for lunar surface delivery services. The major elements of the Proposed Action are Concept A and B launch pads and horizontal integration facilities.

ALTERNATIVE ACTIONS CONSIDERED BUT REMOVED FROM FURTHER CONSIDERATION

In accordance with the statutory constraints of Space Florida's charter, other launch sites within Florida were considered; however, none of these sites were considered reasonable as they did not meet the screening criteria. Specifically, Space Florida has a statutory constraint to provide service within the territory of Florida and the unique requirements to access orbital launch range assets (Space Florida 2018). Therefore, space launch sites located in states other than Florida were not considered. In addition, operational support facilities and personnel are required to be close to the space launch site. Exploration Park, a dedicated aerospace manufacturing and research office park, is outside the gates at KSC, has 48 engineers per 1,000 workers, and ranks in the top 30-most engineer-populated metros in the country, providing commercial aerospace users with a uniquely skilled work-force to support their missions close to their actual launch sites (Space Florida 2019).

Other launch sites within the CCAFS territory were considered, such as SLC-15 and SLC-16; however, these sites were dismissed because they do not meet the availability screening criteria (planned or potential development by other users) and cannot as readily meet the schedule criteria as SLC-20, as this complex has been used to support NASA programs in recent years.

NO ACTION ALTERNATIVE

Under the No Action Alternative, USAF would not transfer by an RPA approximately 220 acres (89 ha) of land to include SLC-20 and all facilities contained thereon at CCAFS, and Space Florida would not reuse SLC-20 for the testing of rocket engines and would not redevelop SLC-20 into a launch facility. Space Florida would not be able to test engines for future use by the government or commercial users and would not be able to launch vehicles from SLC-20 at CCAFS. Space Florida and any tenants would not apply for a commercial space launch license from the FAA for launch operations at SLC-20. Thus, the National Space Transportation Policy of 2005 stated goal of *assuring reliable and affordable access to space through U.S. space transportation capabilities* would also be limited. The No Action Alternative does not meet the Purpose and Need.

SUMMARY OF POTENTIAL ENVIRONMENTAL EFFECTS

This EA assesses the following 15 resource areas, which were considered to provide a context for understanding the potential environmental effects of the Proposed Action and alternatives: land use/visual resources (including coastal resources), noise, biological resources, cultural resources, air quality, climate, hazardous materials/hazardous waste (including solid waste and pollution prevention), water resources, geology and soils, transportation, utilities, health and safety, socioeconomics, environmental justice, and Section 4(f) properties. Additional resources required to be assessed in accordance with FAA Order 1050.1F, including natural resources and energy supply, farmlands, and children's environmental health and safety risks, are considered but dismissed from detailed evaluation as impacts to these resources are not expected. The environmental consequences associated with the Proposed Action and the No Action Alternative were analyzed for the appropriate Region of Influence (ROI) for each resource area. The following table summarizes the resources considered and the potential impacts that may result from the Proposed Action on those resources. Section 4 provides additional information regarding the environmental effects of the construction and operation of the Proposed Action.

TABLE E-1: Summary of Potential Environmental Effects from the Proposed Action	
Resource Category	**Potential Environmental Effects**
Land Use / Visual Resources	**Construction: Negligible adverse impacts** are expected to land use (including coastal resources) and visual resources. The Proposed Action is consistent with the land use and visual character of the ROI given the other numerous launch complexes nearby. No significant impacts are expected to land use compatibility as a result of the renovation and construction of launch facilities since CCAFS and SLC-20 land use is and has historically been used for launch operations. **Operations: Negligible adverse impacts** are expected to land use (including coastal resources) and visual resources. No significant impacts are expected to land use compatibility since CCAFS and historically SLC-20 uses include launching space launch vehicles. Visual impacts would only include the normally seen and short-lived vehicle contrails that result from each launch event.
Noise	**Construction:** There would be **minor adverse impacts** at CCAFS from the operation of construction equipment; however, these impacts would be limited to the immediate vicinity of SLC-20. There would be **no impacts** to communities near CCAFS due to noise associated with construction activities. **Operations:** Noise impacts to biological resources are discussed below. Sonic booms would occur from launches at SLC-20 but only over the ocean, so no impacts on the mainland from sonic booms would occur. The Proposed Action is not expected to generate propulsion noise impacts greater than what the surrounding community has been exposed to as a result of previous launches from CCAFS and KSC. Therefore, there would be **minor adverse impacts** to the surrounding environment as a result of the proposed launches at SLC-20.
Biological Resources	**Construction:** Clearing of land would impact approximately 0.3 acre of low-quality potential scrub-jay habitat. The renovation of the Blockhouse and other existing structures, construction of new facilities, and site clearing would also impact southeastern beach mouse, indigo snake, and gopher tortoise habitat. Impacts would be mitigated by funding restoration/enhancement of southeastern beach mouse habitat as discussed in the attached Biological Assessment (BA) and the subsequent US Fish and Wildlife Service (USFWS) Biological Opinion (BO). As a result, **minor adverse impacts** would occur. **Operations:** The Proposed Action has the potential to result in adverse impacts to five species of marine turtles. However, a Light Management Plan would be developed and approved by USAF and USFWS to reduce or eliminate night-time impact to the sea turtle nesting/hatchling process. Other than the sea turtles, noise from the operation of the Proposed Action would elicit a common "startle response." **Minor adverse impacts** on wildlife and vegetation (including federal and state-listed wildlife species) are expected due to the need to relocate numerous gopher tortoises and the associated impact on their habitat.
Cultural Resources	**Construction**: The 45th Space Wing (45 SW) Cultural Resources Manager evaluated the areas that would be affected by the Proposed Action, and no historical or cultural resource issues were found within the Proposed Action boundaries or surrounding areas with the exception of the Blockhouse. The Blockhouse was determined to be potentially eligible for listing but the Proposed Action to use that facility as it was originally intended and to maintain the exterior similar to its original construction was determined to be a **beneficial impact**. **Operations: Negligible adverse to beneficial impacts** are expected due to the lack of historical and cultural resources in the ROI.

TABLE E-1: Summary of Potential Environmental Effects from the Proposed Action	
Resource Category	**Potential Environmental Effects**
Air Quality	**Construction:** Construction activities associated with the Proposed Action would cause a minor increase in emissions of particulate matter (PM) due to demolition and related activities. Minor emissions related to CO, CO2, hydrocarbons, and NOx would occur due to equipment and vehicular emissions. As such, **negligible adverse impacts** would occur. **Operations:** The Proposed Action is not considered to be a major source of air pollutants and does not require a Title V permit. Brevard County is in attainment for all criteria pollutants; therefore, a General Conformity analysis is not required. As documented in numerous EAs and EISs performed for launch vehicles at CCAFS and elsewhere, emissions from nominal launches, catastrophic failures, or spills of liquid propellants would not significantly alter ambient air conditions. Air emissions for the LOX/RP-1 version of the Beta concept launch vehicle would have the maximum potential for air quality impacts; however, these impacts on air quality are expected to have **minor adverse impacts** on air quality.
Climate	Emissions of greenhouse gases (GHGs) from the construction, operations, and launches at SLC-20 would not cause any appreciable global effects. The incremental emissions for the Proposed Action would be similar to the Falcon 1 and have **negligible adverse impacts** on global climate change.
Water Resources	**Construction: No impacts** to groundwater resources or groundwater quality would occur. No US Army Corps of Engineers (USACE) or St. Johns River Water Management District (SJRWMD) wetlands occur within the Proposed Action site and **no impacts** to wetlands would occur. A 0.19-acre upland cut surface water would remain or be regraded and additional surface water treatment areas will be constructed. Therefore, **negligible adverse impacts** to surface water are expected. **Operations:** Operations would result in **negligible adverse impacts** to surface water, groundwater resources, groundwater quality, wetlands, or floodplains. A 45 SW approved Spill Prevention, Control, and Countermeasures Plan (SPCCP) would be implemented by the tenant, which would minimize the potential for adverse impacts to water resources.
Geology and Soils	**Construction:** Contaminated soils in excess of the industrial SCTs have been removed from the site; however, contaminated soil in excess of the residential SCTLs is still present. Soils would be disturbed for site construction activities. Normal hazardous material and/or waste management processes, including solid waste, would prevent impact to the environment. Pollution prevention BMPs would also be used to prevent potential impacts. **Negligible adverse impacts** would occur to geology and soils. **Operations:** Daily operations and launches would not affect existing geology and soils; therefore, **no adverse impacts** are expected.
Transportation	**Construction:** Vehicle and truck traffic would increase slightly during facility construction and renovations. However, it would result in **negligible adverse impacts** to CCAFS traffic and roadways. **Operations:** Operational traffic associated with Proposed Action would increase slightly as a result of up to 24 launch vehicle transports and employee trips. Transporting launch vehicles would slow KSC and CCAFS traffic but would occur during non-peak hours. Therefore, the Proposed Action would result in **minor adverse impacts** to transportation.

TABLE E-1: Summary of Potential Environmental Effects from the Proposed Action	
Resource Category	**Potential Environmental Effects**
Hazardous Materials/ Waste	**Construction:** SLC-20 is part of Solid Waste Management Unit (SWMU) C043, which contains known soil-contaminated areas. Soil investigations identified polychlorinated biphenyls (PCBs), metals, and dioxin/furans in site soils in excess of FDEP industrial Soil Cleanup Target Level (SCTL) and in some areas the residential SCTL. Also, a small area exists where the soil exceeded the leachability of the Groundwater Cleanup Target Level (GCTL). A study was also performed for dioxin/furan compounds that occur when PCBs are heated or burned. Several Interim Measure (IM) soil removals were performed in 1995 and 1998 to remove contaminated soil and sediment at SLC-20. Additional sampling for PCBs in soil around the site was conducted concurrently with removal of water and debris at the SLC-20 actuator pit in 2012. From 2015 to 2016, a Data Gap Investigation was performed to laterally and vertically delineate PCB contamination in soil in excess of the industrial SCTL along with sampling at one substation location to determine if PCBs had leached to groundwater. A temporary groundwater monitoring well was installed and sampled at the location and all results were less than the FDEP GCTLs for PCBs, thus No Further Action for groundwater was warranted. In addition, a study was performed for dioxin/furan compounds at the site. Dixon/furans compounds were suspected to co-exist with PCB soil contamination at the site based on heating/burning activities during launches. A soil removal was completed in 2019 to address remaining concentrations of PCBs and dioxin/furans in excess of the FDEP industrial SCTLs. Remaining soils are now safe for re-use under industrial land-use scenarios. Remediation was performed and completed in mid-2019. By working with the USAF Installation Restoration Program (IRP) and the Florida Department of Environmental Protection (FDEP) during construction, impacts to locally contaminated soils would be limited. If contaminated soils are determined to be present at SLC-20, all construction debris, root balls, etc. determined to contain contaminated soils above regulatory thresholds will be retained onsite or properly disposed of at an off-site facility in accordance with all federal and state regulations. Normal hazardous material and/or waste management processes, including solid waste, would prevent impact to the environment. Pollution prevention Best Management Practices (BMPs) would also be used to prevent potential impacts. Therefore, **negligible adverse impacts** to the environment are expected to result from hazardous materials or waste management as a result of the construction of the Proposed Action. **Operations:** Operations supporting the Concept A and B launch program would continue to use products containing hazardous materials, paints, solvents, oils, lubricants, acids, and batteries, which are routinely used at CCAFS. Hazardous materials such as propellants, ordnance, chemicals, and other hazardous material payload components would be transported to the facilities in accordance with Florida Department of Transportation (FDOT) regulations and would be handled and disposed of in accordance with the Resource Conservation and Recovery Act (RCRA) and the Occupational Safety and Health Administration (OSHA). Continued implementation of existing material and waste management and handling procedures currently used during the operation of other similar launch vehicles would limit or eliminate the potential for impacts. A pollution prevention management plan would also be developed and implemented to prevent potential impacts. Therefore, **negligible adverse impacts** would be associated with hazardous materials and hazardous waste.
Utilities	**Construction:** No draw on local utilities would occur since potable water and electrical needs would be supplied by portable sources; wastewater disposal services would not be needed until project completion; construction-related debris would be removed and landfilled at an approved facility. **Negligible adverse impacts** on utilities would occur during construction. **Operations:** USAF is the electrical power, potable water, and fire water provider for SLC-20 at CCAFS. Water and electric supplies and distribution capacities are estimated to be sufficient for new Space Florida tenant(s) requirements at SLC-20. Existing septic systems would be used for wastewater disposal and would be rehabilitated if needed. Therefore, the Proposed Action would result in **negligible adverse impacts** to utilities.

TABLE E-1: Summary of Potential Environmental Effects from the Proposed Action

Resource Category	Potential Environmental Effects
Health and Safety	**Construction:** Space Florida tenant(s) would follow all USAF and OSHA and applicable USAF regulations (as determined by 45 SW/SE and or 45 SW/CONS) during construction activities; therefore, negligible adverse impact to the health and safety of workers is expected. In addition, Space Florida tenant(s) would follow all USAF and OSHA regulations during construction activities; therefore, **negligible adverse impact** to the health and safety of workers is expected. **Operations:** The operation and launch of Concept A and B vehicles would be in compliance with all current and standard health and safety local, state, and federal procedures during operation and launch; therefore, no significant impact to the health and safety of workers is expected. Operational safety of the nearby airfield (Skid-Strip) should not be affected by the Proposed Action as SLC-20 is approximately 14,000 feet from the edge of the Skid-Strip. Lightning protection at the Proposed Action site will be less than the 1:20 conical surface height restrictions. However, a waiver from FAA, in coordination with USAF, will be obtained for any unexpected objects exceeding the 14 CFR Part 77 surfaces from the Skid-Strip. Accordingly, **negligible adverse impacts** are expected. Explosive Site Safety was also assessed. Like all launch and hazardous operations at CCAFS, operations must account for public safety clear distances and may require temporary road closures and evacuation of some CCAFS facilities on launch days. Space Florida tenant(s) will implement engineering design controls to minimize road closures to occur only on launch days. The launch pad site design would be developed to locate explosive hazards so as to minimize the impacts to inhabited buildings on CCAFS when the launch vehicle is fueled and ready for launch. Accordingly, **negligible adverse impacts** are expected.
Socioeconomics	**Construction:** Construction and rehabilitation activities conducted in support of the Proposed Action would generate employment opportunities for the local workforce. Construction and workforce increases would not significantly affect the local housing market or economy. Therefore, the Proposed Action would not result in significant impacts to socioeconomics in the region and may generate a **negligible positive impact**. **Operations: T**he negligible workforce increase expected as a result of the operation of the Proposed Action would not significantly affect the local housing market or economy. Therefore, the Proposed Action would not result in significant impacts to socioeconomics in the region and may generate a **negligible positive impact.**
Environmental Justice	**Construction:** Construction would occur in the SLC-20 area. Since the Proposed Action would be constructed within existing facilities at CCAFS, **negligible adverse impacts** are expected. **Operations:** Since the Proposed Action would operate from the existing facilities at CCAFS, **negligible adverse impacts** are expected.
4(f) Properties	**Construction:** No designated 4(f) properties, including public parks, recreation areas, or wildlife refuges, exist within the boundaries of CCAFS. Therefore, **no impact** is expected to result from construction. **Operations:** No designated 4(f) properties, including public parks, recreation areas, or wildlife refuges, exist within the boundaries of CCAFS. Although several public parks, recreation areas, and wildlife refuges are outside CCAFS, operation and launches would not result in a use or change in use of a Section 4(f) property. Therefore, **negligible adverse impacts** are expected to result from operation.

CUMULATIVE IMPACTS

Cumulative impacts are defined by the Council on Environmental Quality (CEQ) in 40 CFR §1508.7 as impacts on the environment that result from the incremental impact of the action 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. The CEQ regulations further require that National Environmental Policy Act (NEPA) environmental analyses address connected, cumulative, and similar actions in the same document (40 CFR 1508.25). The cumulative impact analysis for this EA focuses on the incremental interaction the Proposed Action may have with other past, present, and reasonably foreseeable future actions and evaluates cumulative impacts potentially resulting from these interactions. Implementation of the Proposed Action would not cause any significant cumulative impacts to the resource areas analyzed in this EA.

1.0 PURPOSE AND NEED FOR THE PROPOSED ACTION

1.1 INTRODUCTION

Space Florida was created pursuant to Chapter 331, Part II, Florida Statutes as an independent special district and subdivision of the State of Florida. The purpose of Space Florida is to foster the growth and development of a sustainable and world-leading aerospace industry in Florida. Space Florida leverages Florida's highly skilled workforce and existing infrastructure to attract and expand the next generation of space industry businesses. The Cape Canaveral Spaceport (CCS), in which Space Florida has an operational spaceport authority role, is the premiere transportation hub for global space commerce. Space Florida oversees management and operation of key elements of Florida's existing space transportation capability.

Space Florida has prepared this Environmental Assessment (EA) to evaluate the potential environmental impacts associated with obtaining a commercial launch site operator license from the Federal Aviation Administration (FAA) and supporting the Real Property transfer, via an agreement, of approximately 220 acres (89 hectares [ha]) of land, to include Space Launch Complex 20 (SLC-20) and all facilities contained thereon, at Cape Canaveral Air Force Station (CCAFS) by the US Air Force (USAF) to Space Florida. Space Florida would develop and provide for use the 220 acres (89 ha) to meet current and future commercial, national, and state space transportation needs through the expansion and modernization of space transportation facilities within Space Florida's CCS territories to include areas within CCAFS.

This EA focuses on the transfer, via a Real Property Agreement (RPA), of 220 acres (89 ha), to include SLC-20 and transportation routes, from USAF to Space Florida to develop a multi-user launch capability that includes the refurbishment and enhancement of an existing launch pad, the operation of small- and medium-lift launch vehicles by commercial users such as Firefly Aerospace, Inc., under an agreement with Space Florida, and the transportation of vehicle stages from Exploration Park to SLC-20. The majority of customers for rocket-launch missions from this site are expected to be from the commercial sector and government agencies such as the National Aeronautics and Space Administration (NASA) and the Department of Defense (DoD).

Space Florida cannot predict with any fidelity regarding the timing of other emerging commercial launch vehicle operators or prospective developers for the entire 220-acre (89-ha) parcel; therefore, potential future development and use of this property by other entities are assessed qualitatively in the Cumulative Impacts section of this EA. Future environmental review for use of the property by other entities will be required once more specific construction and operational details are defined.

This EA was prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended (Title 42 of the United States Code [USC] 4321–4347), the Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 Code of Federal Regulations [CFR] Parts 1500–1508), USAF's Environmental Impact Analysis Process (32 CFR Part 989), and Federal Aviation Administration (FAA) Order 1050.1F, *Environmental Impacts: Policies and Procedures*. In accordance with agreements between USAF, NASA, and FAA, USAF is the lead agency for the preparation and coordination of the EA (40 CFR §1501.5), and NASA and FAA are acting as cooperating agencies (40 CFR §1501.6). As noted below in Section 1.4.1, the FAA's role is licensing commercial space launch operations.

1.2 LOCATION AND BACKGROUND

CCAFS occupies approximately 15,800 acres (6,394 ha) of land on Florida's Cape Canaveral barrier island (Figure 1-1).

The Cape Canaveral barrier island is on the east coast of Brevard County, Florida, approximately 150 miles (241 kilometers [km]) south of Jacksonville, 210 miles (337 km) north of Miami, and 60 miles (97 km) east of Orlando. The island is 4.5 miles (7 km) wide at its widest point. CCAFS has 81 miles (130 km) of paved roads connecting various launch support facilities with the centralized Industrial Area. The north boundary of CCAFS adjoins the Kennedy Space Center (KSC) boundary on the Merritt Island barrier island. As defined in Florida Statute 313.304, the Space Florida Spaceport territory includes areas within KSC and CCAFS; this territory is referred to as the CCS.

The Banana River separates CCAFS from KSC to the west. Port Canaveral adjoins CCAFS to the south. CCAFS's east boundary is the Atlantic Ocean. The base is accessible primarily from State Road 528 to the south and from KSC to the west and north.

Thirty-three launch complexes have been constructed and used at CCAFS; however, there are currently four active and 12 inactive launch pads at 12 launch complexes. Along with the various launch and support facilities, CCAFS maintains a centralized industrial complex to support the technical, mechanical, and administrative needs of each launch program. USAF's 45th Space Wing (45 SW) is currently the host wing, under the USAF's United States Space Force (USSF), and conducts east coast military, civil, and commercial launch operations.

The existing SLC-20 developed launch site is approximately 33 acres (13 ha), consists of 14 facilities, and is within the northeast portion of CCAFS, off ICBM Road, between SLC-19 and SLC-34. SLC-20 is surrounded by dense live oak/saw palmetto (Figure 1-2). The facility was constructed in 1958 and 1959 for the *Titan* Missile Program, modified in 1964 for the *Titan III* Missile Program, and deactivated in 1966. Following deactivation, site responsibilities were transferred to NASA. In addition to launch activities, the south portion of SLC-20 (area occupied near Facility [Fac] 15531; (Figure 1-3) was reportedly the location of a drum-crushing operation and a waste-liquid storage area for approximately 10 years from the late 1970s to the late 1980s. Following abandonment of the site in the late 1980s, site responsibilities reverted back to USAF. SLC-20 as a whole is not considered a historic complex, and no known archeological sites are inside or outside the complex boundary (USAF 2015a). Although the entire SLC-20 complex is not considered historic, the Blockhouse may be eligible for listing on the National Register of Historic Places (NRHP).

The Proposed Action boundary consists of the 33acre (13 ha) developed launch site and the RPA boundary consists of approximately 220 acres (89 ha) (see Figures 1-2 and 1-3). The areas outside the Proposed Action boundary are not contemplated for development at this time and any proposed future development outside the Proposed Action boundary will be reviewed under NEPA.

SLC-19, immediately south of SLC-20, is a historic site. In 1999, SLC-20 was reactivated to be operated under the direction of Space Florida for commercial launches. This reactivation included upgrades to Launch Pad A (Fac 15540) and the construction of a new building along the perimeter road, northeast of the Blockhouse (Fac 15500A). In 2000, three Super Loki flights were launched from SLC-20.

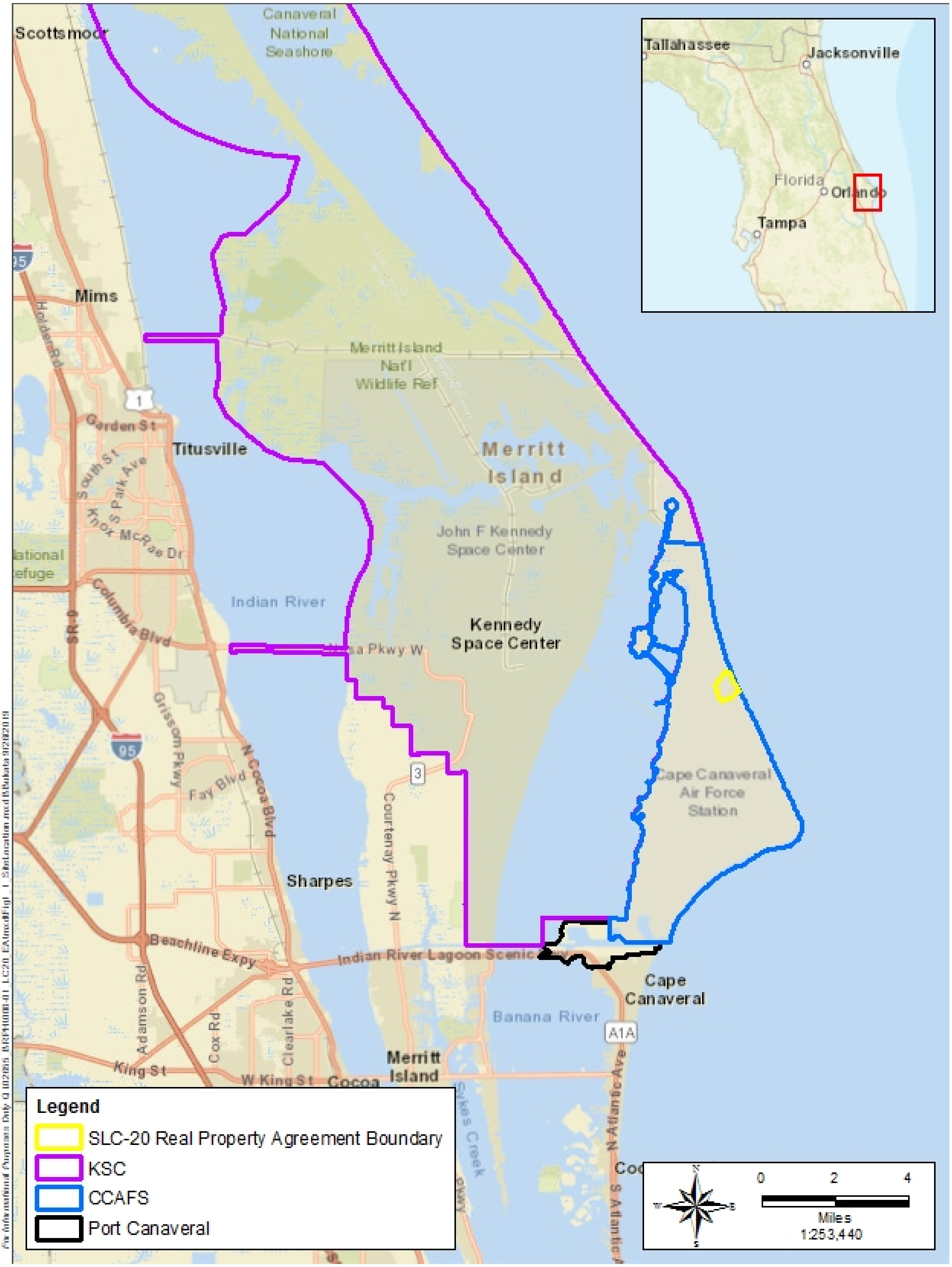


Figure 1-1 Site Location Map

Figure 1-2 Proposed SLC-20 Total RPA Boundary Map

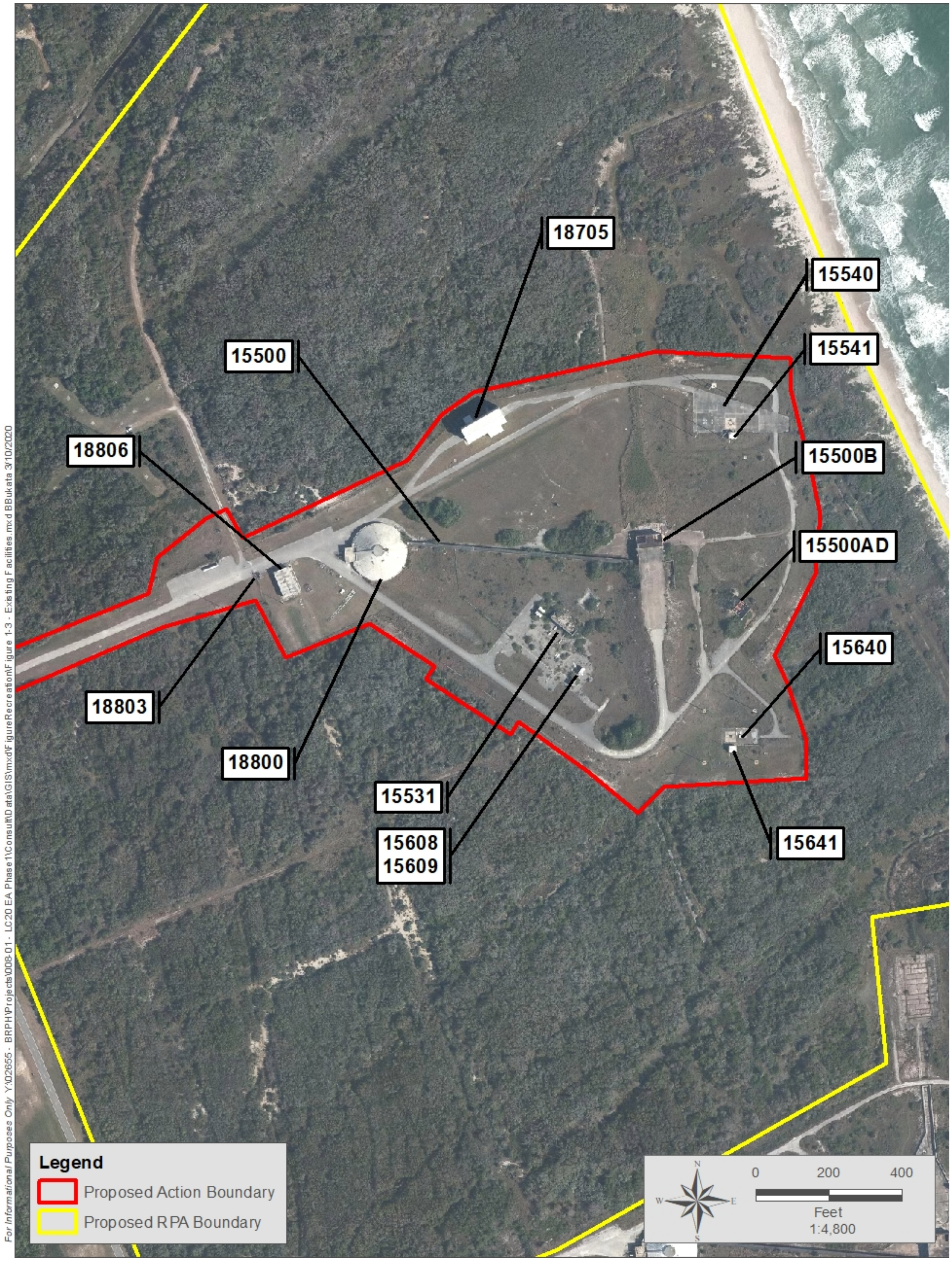


Figure 1-3 Existing SLC-20 Facilities

Facilities 22101 (215-foot WINDS Tower 006) and 22100 (006 Support Building) are located outside the RPA Boundary but inside the Proposed Action Boundary. As part of the Proposed Action, 45 SW Weather would continue to be provided access through the RPA to these two facilities.

In 2001, NASA prepared the *Environmental Assessment for the Advanced Technology Development Center at Cape Canaveral Spaceport, Florida* for the proposed development of an Advanced Technology Development Center (ATDC) at SLC-20 to provide a test area for Spaceport technologies including Cryogenic systems, launch structures, umbilicals, sensors and electronics, integrated vehicles, and process engineering and range systems (NASA 2001a). NASA issued a Finding of No Significant Impact (FONSI) in 2001 and construction of the ATDC Phase 1 facility was completed in 2002 (NASA 2001b). ATDC used the Blockhouse for office space and data acquisition. The complex reverted to USAF in the 2010-timeframe (Space Florida and 45 SW 2019).

In December 2008, NASA prepared the *Final Environmental Assessment for Exploration Park – Phase 1 for Space Florida and Kennedy Space Center* to analyze the impacts associated with the development and operation of approximately 60 acres (24 ha) of land leased from KSC and referred to as Exploration Park Phase 1 (NASA 2008). NASA issued a Record of Environmental Consideration (REC) for the additional construction at Exploration Park Phase 1 on August 20, 2019, which includes the area to be used for the launch vehicle manufacturing facility associated with the SLC-20 development (Appendix A). Therefore, Exploration Park Phase 1 construction and operation activities for the manufacturing facility are not included in this EA. However, the transportation of manufactured stages from the Exploration Park Phase 1 manufacturing facility to the SLC-20 launch site for assembly, processing, and launch is included in this EA.

1.3 PURPOSE AND NEED FOR THE PROPOSED ACTION

The purpose of the Proposed Action is to provide multiple launch pads for commercial users in support of Space Florida's CCS Master Plan in accordance with Florida Statutes Section 331 (Space Florida 2017). Specifically, Space Florida must meet current and future commercial, national, and state space transportation requirements through expansion and modernization of space transportation facilities within its Spaceport territories. The territories include, but are not limited to, areas within CCAFS. The Proposed Action would allow commercial launch providers, such as Firefly, to assemble, process, test, and launch vehicles to meet the demand for lower-cost access to space. The Proposed Action would provide the continued capability of space exploration by commercial users and improve the return on taxpayer investment of CCAFS facilities through expanded use and improved utilization. The Proposed Action would also continue to provide economic and technical benefits to the government and the private sector following the retirement of the Space Shuttle Program in 2011. On November 27, 2018, the Space Florida Board of Directors approved the request to proceed with negotiations and agreements for the redevelopment of SLC-20 for the purposes of meeting Florida's commercial space transportation industry needs.

The Proposed Action is needed to test and launch vehicles efficiently in the United States for use by commercial space launch enterprises. The Proposed Action would contribute to meeting the goals of the CCS Master Plan consistent with the National Space Transportation Policy; NASA's

Space Act Agreement (SAA); and DoD policy pursuant to DoD Directive 3230.3, *DoD Support for Commercial Space Launch Activities.*

The FAA expects to receive a license application from Space Florida to operate a commercial space launch site at SLC-20. Also, the FAA expects to receive a license application from Firefly to conduct launch operations at SLC-20. Therefore, the FAA's proposed actions of issuing a launch site operator license to Space Florida and a launch license to Firefly for launch operations at SLC-20 are considered part of the Proposed Action analyzed in this EA. The FAA's purpose of its action is to fulfill the FAA's responsibilities as authorized by the Commercial Space Launch Act (51 U.S.C. Subtitle V, ch. 509, §§ 50901-50923) 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 Act, 51 U.S.C 50901(b), to, in part, "protect the public health and safety, safety of property, and national security and foreign policy interests of the United States" while "strengthening and [expanding] 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."

1.4 SCOPE OF THE ENVIRONMENTAL ASSESSMENT

This EA addresses the potential environmental impacts from the RPA to transfer approximately 220 acres (89 ha) from USAF to Space Florida, the refurbishment and enhancement of SLC-20 facilities, the operation of small- and medium-lift launch vehicles on 33 (13 ha) of the 220 acres (89 ha), and the proposed transportation of vehicle stages from Exploration Park to SLC-20. For the reasons stated in Section 1.2, the proposed construction and operation of the manufacturing facility in Exploration Park Phase 1 are not included in the scope of this EA.

1.4.1 Lead and Cooperating Agency Actions

This EA was prepared by Space Florida as the proponent of the Proposed Action. Space Florida is the dedicated state governmental authority for launch and landing operations at CCS. USAF is the lead federal agency for the Proposed Action. If, after the public's review of the EA, USAF determines the Proposed Action would not individually or cumulatively result in significant impacts on the human or natural environments, USAF would issue a final FONSI and proceed with implementing the Proposed Action.

The FAA is a cooperating agency because of its role in licensing commercial space launch operations in the United States. The FAA intends to adopt this EA to support its environmental review when evaluating the license applications. If, after reviewing a license application and this EA, the FAA determines that the proposed operations fall within the scope of this EA and the action would not individually or cumulatively result in significant impacts on the human environment, the FAA would adopt this EA and issue its own FONSI to support the issuance of the license to Space Florida and/or Firefly. 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 NEPA compliance.

NASA is also a cooperating agency because of its special expertise and potential need to rely on the analysis contained in this EA to support its environmental review process as a potential future Firefly customer.

2.0 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

This section describes the Proposed Action (which is the Preferred Alternative), the No Action Alternative, and alternatives considered but not carried forward for further analysis.

2.1 PROPOSED ACTION

The Proposed Action is to transfer, by a Real Property Agreement (RPA, likely in the form of a long-term lease) , approximately 220 acres (89 ha) of land, to include SLC-20 and all facilities contained thereon, at CCAFS by USAF to Space Florida; provide use of 33 acres (13 ha) of the 220 acres (89 ha), to include the existing launch site infrastructure to Firefly on a dedicated basis; refurbish and enhance existing SLC-20 facilities; test and operate small- and medium-lift launch vehicles by Firefly; and transport vehicle stages from Exploration Park to SLC-20. The Proposed Action is the preferred alternative.

In addition to the agreement noted above, this EA includes in the cumulative analysis section that Space Florida will be requesting, at some point in the future, that USAF provide an access road easement to allow entry to SLC-20 from the south via SLC-19 (refer to the blue area shown in Figure 1-2). The details of this access into SLC-20 via the SLC-19 access road are not sufficiently developed at this time to be analyzed in detail in this EA and will be analyzed in the future when additional site development is planned.

2.1.1 Proposed Location

The project location consists of existing SLC-20 and surrounding areas, an area totaling 220 acres (89 ha). The existing SLC-20 developed launch site is in the northeast portion of CCAFS, off ICBM Road, between SLC-19 and SLC-34 and contains numerous existing facilities (Figure 1-3). Most of the 220 acres (89 ha) is covered in relatively dense live oak/saw palmetto with scattered herbaceous wetlands. Table 2-1 describes the facilities.

Table 2-1 Existing SLC-20 Facilities

Original Site Facility Name	Current Name	Year Built	Status
Fac 15500, Control Cableway	15500, Control Cableway	1959	The structure's setting and design remains intact.
Fac 15500AD, Fuel Holding Area	15500AD, Liquid Hydrogen Holding Area	1963	All that remains today is the earthen berm, concrete walls, aboveground storage tank (AST) holding area, and truck parking area.
Fac 15500AF, Oxidizer Holding Area	15531, Retaining Wall	1962	All that remains of the original facility is the earthen berms and concrete retaining walls.
Fac 15500B, Launch Stand and Ramp	15500B, Launch Stand and Ramp	1959	Very little of the original components remain.
Fac 15540, Launch Pad A – Ballistic Missile Development Office	15540, Launch Pad A – Ballistic Missile Development Office	1989	The facility is now abandoned in-place and essentially unchanged. The launch rail has been removed and only the mounting ring remains.
Fac 15541, Equipment Building Pad A	15541, Equipment Building	1989	The facility remains abandoned in-place and essentially unchanged.
Fac 15608, Power Center	15608, Power Center	2003	

Original Site Facility Name	Current Name	Year Built	Status
Fac 15609, Control Center	15609, Control Center	2003	Both structures served as instrumentation facilities until they were abandoned in-place in 2010.
Fac 15640, Launch Pad B – Ballistic Missile Development Office	15640, Launch Pad B – Ballistic Missile Development Office	1989	The facility remains abandoned in-place and essentially unchanged. The launch rail has been removed and only the mounting ring remains.
Fac 15641, Equipment Building Pad A	15641, Equipment Building	1989	The facility remains intact.
Fac 18705, HIF	18705, HIF	1999	The building remains intact.
Fac 15500A, Blockhouse	18800, Blockhouse	1959	Although abandoned in-place in 2012, the building remains intact.
Fac 18803, Guard House	18803, Guard House	1999	This structure is in a ruinous state of condition.
Fac 15500C, Ready Building	18806, Payload Assembly Building	1959	This building is abandoned and in disrepair.

Source: USAF 2015b.

2.1.2 Launch Vehicles

Space Florida proposes to establish multi-user launch capability at SLC-20. Firefly, one of the potential launch providers, proposes to launch Alpha, a small-lift class launch vehicle, and future Beta, a small- to medium-lift class launch vehicle, from SLC-20. Firefly's Alpha and Beta launch vehicles are used as representative vehicles for the Proposed Action and are subsequently referred to as Concept A and Concept B, respectively. Both representative launch vehicles are expendable and provide satellite delivery services with the future opportunity for lunar surface delivery services. Table 2-2 lists the general specifications for both launch vehicles. Table 2-3 lists maximum potential propellant quantities. Specific details of each launch vehicle, to include first and second stages and flight termination system, are included in subsequent sections.

Table 2-2 Launch Vehicle Specifications

Specification	Concept A	Concept B (Future)
Length	95 ft (29 m)	140 ft (43 m)
Diameter	6 ft (2 m)	10 ft (3.1 m)
Stages	2	2
Recoverable First Stage?	No	No
Parachute Required?	No	No
First Stage Propellant	LOX/RP-1	LOX/RP-1/LCH4
Total Wet Mass	120,000 lb (54,000 kg)	470,000 lb (214,000 kg)
First Stage Thrust	730 kN (163,888 lbf)	2,760 kN (620,000 lbf)

Notes: ft = feet; kg = kilogram; kN = kilonewtons; lbf = pound-force; lb = pounds; LCH4 = liquid methane; LOX = liquid oxygen; m = meter; RP-1 = Rocket Propellant 1
Source: 30 CES 2018.

Table 2-3 Maximum Potential Propellant Quantities – Central Pad

Launch Vehicle	Storage Type	Propellant Type	Max Quantity
Concept A	Oxidizer Storage	LOX	180,000 lb (81,647 kg)
	Fuel Storage	RP-1	83,000 lb (37,648 kg)
	Combined Vehicle	LOX/RP-1	109,000 lb (49,442 kg)
Concept B	Oxidizer Storage	LOX	570,000 lb (258,548 kg)
	Variant 1 Fuel Storage	RP- 1	170,000 lb (77,111 kg)
	Variant 1 Combined Vehicle	LOX/RP-1	435,000 lb (197,312 kg)
	Variant 2 Fuel Storage	RP-1 (Stage 1)	126,000 lb (57,153 kg)
	Variant 2 Fuel Storage	LCH4 (Stage 2)	36,000 lb (16,329 kg)
	Variant 2 Combined Vehicle	LOX/RP-1 & LOX/LCH4 (Stage 2)	419,000 lb (190,055 kg)
	Variant 3 Fuel Storage	LCH4	170,000 lb (77,111 kg)
	Variant 3 Combined Vehicle	LOX/LCH4	402,000 lb (182,344 kg)

Concept A Launch Vehicle

The Concept A launch vehicle is a small, unmanned, light-lift, two-stage, liquid-fueled launch vehicle with a gross lift-off weight of approximately 120,000 lb (81,647 kg) that can carry payloads of between 1,323 lb (600 kg) and 2,205 lb (1,000 kg), depending on the orbit. The first and second stages use only liquid propellants (liquid oxygen [LOX] and RP-1; highly refined kerosene).

The first stage consists of a cylindrical structure containing LOX and RP-1 tanks separated by an intertank. This first stage is powered by four, 182-kN (40,972-lbf) thrust LOX/RP-1 engines. Roll control and thrust vector control use hydraulic actuators and use the on-board RP-1 for its fuel. The propellant tanks can hold 6,715 gallons (gal) (25,419 liters [L]) of LOX and 4,346 gal (16,451 L) of RP-1. The second stage consists of a cylindrical structure containing LOX and RP-1 tanks separated by an intertank. The engine is a 70-kN (15,714-lbf) thrust engine with hot helium attitude control and hydraulic actuators for thrust vector control. The propellant tanks hold 1,065 gal (4,031 L) of LOX and 670 gal (2,536 L) of RP-1.

Concept A may carry small payloads of up to 2,205 lb (1,000 kg) consisting mostly of non-hazardous materials. Some payloads may use small amounts of hazardous propellants for on-orbit maneuvering. These payload propellants may include hypergolic fuels such as hydrazine, pressurized gases including helium and nitrogen, and some solid propellants. Hazardous material quantities would vary. In addition, a small amount of ordnance, such as small explosive bolts and on-board batteries are typical. Payload propellants will be stored before use in a certified facility near the payload processing facility where the loading will occur. Residual propellants for payloads will be returned to the storage facilities. Payload plans do not currently include radioactive materials but, if future plans for payloads were to include radioactive materials, they would be in de minimis amounts.

Commercial launch providers would develop a Preliminary Flight Data Package before any launch, which takes into consideration a trajectory that avoids over-flights of known structures and establishes a potential debris corridor for the vehicle. The reliability of the Concept A vehicle is expected to be above 95 percent (30 CES 2018).

Two potential paths for flight termination exist. If the Concept A launch vehicle varies from its planned trajectory, the launch vehicle will be equipped with a destructive flight termination system. The Preliminary Flight Safety analysis will determine the flight termination system type. The expected destructive termination system includes one Bulk Destruct Charges (BDC) that is intended to rupture the vehicle tanks when commanded to destruct, thereby dispersing propellants and breaking up the vehicle to minimize the impact to ground assets. The total weight of the ordnance charges for either vehicle would be small and total approximately 0.1 lb (200 grams [g]). Commercial space entities licensed to use SLC-20 will have agreements in place with 45 SW, which allows ordnance to be stored at the 45 SW Ordnance Storage Area and delivered on a real-time basis to the launch complex during vehicle integration to avoid the need for long-term storage of this type of hazardous material on site.

A thrust termination system is activated by an autonomous on-board command and disables power to the vehicle engines. Upon activation of the thrust termination system, the Concept A launch vehicle would fall to the ocean intact and may explode upon impact, depending on the circumstances and time in the flight of the termination.

The Proposed Action includes non-destructive software and telemetry testing of the flight termination systems. No ascent abort testing of the launch vehicle or destructive testing of the ordnance flight termination system or thrust termination system is proposed.

Concept B Launch Vehicle

Concept B shares the same basic design as the Concept A launch vehicle with higher thrust, providing a higher payload capacity that can carry between 7,275 lb (3,300 kg) and 12,787 lb (5,800 kg) depending on orbit. Estimated propellant quantities for the Concept B launch vehicle are provided in Table 2-4, Table 2-5, and Table 2-6.

Table 2-4 Maximum Potential Propellant Quantities – Concept B Variant 1

Name	Concept B Stage 1 (RP-1)	Concept B Stage 2 (RP-1)	Payload
Fuel Volume (RP-1)	16,000 gal (60,567 L)	2,900 gal (10,978 L)	-
Fuel Mass (RP-1)	109,000 lb (49,442 kg)	20,000 lb (9,072 kg)	-
Oxidizer Volume (LOX)	26,000 gal (98,421 L)	7,100 gal (26,876 L)	-
Oxidizer Mass (LOX)	240,000 lb (108,862 kg)	67,000 lb (30,391 kg)	-
Hydrazine Volume	-	-	78 gal (295 L)
Hydrazine Mass	-	-	650 lb (295 kg)

Table 2-5 Maximum Potential Propellant Quantities – Concept B Variant 2

Name	Concept B Stage 1 (RP-1)	Concept B Stage 2 (LCH4)	Payload
Fuel Volume (RP-1/LCH4)	16,000 gal (60,567 L)	5,300 gal (20,063 L)	-
Fuel Mass (RP-1/LCH4)	105,000 lb (47,627 kg)	19,000 lb (8,618 kg)	-
Oxidizer Volume (LOX)	25,000 gal (94,635 L)	6,800 gal (25,741 L)	-
Oxidizer Mass (LOX)	231,000 lb (104,780 kg)	65,000 lb (29,483 kg)	-
Hydrazine Volume	-	-	78 gal (295 L)
Hydrazine Mass	-	-	650 lb (295 kg)

Table 2-6 Maximum Potential Propellant Quantities – Concept B Variant 3

Name	Concept B Stage 1 (LCH4)	Concept B Stage 2 (LCH4)	Payload
Fuel Volume (LCH4)	21,000 gal (79,494 L)	5,100 gal (19,306 L)	-
Fuel Mass (LCH4)	74,000 lb (33,566 kg)	18,000 lb (8,165 kg)	-
Oxidizer Volume (LOX)	27,000 gal (10,221 L)	6,500 gal (24,605 L)	-
Oxidizer Mass (LOX)	250,000 lb (113,398 kg)	62,000 lb (28,123 kg)	-
Hydrazine Volume	-	-	78 gal (295 L)
Hydrazine Mass	-	-	650 lb (295 kg)

2.1.3 Launch Site Operations

Payload preparation activities would be conducted in parallel with most launch vehicle preparations. Payload activities include payload checkout, spacecraft propellant loading (if required), and payload encapsulation in the fairings. The encapsulated payload would then be transported to SLC-20. Non-hazardous and hazardous payload processing and encapsulation would take place in the existing Horizontal Integration Facility (HIF) for the Concept A launch vehicle. However, following construction of the new HIF, hazardous payload processing would transition to the new facility.

All launch vehicle stages would arrive from the manufacturing facility in Exploration Park via truck and would be placed in the HIF for storage. There, the stages will be checked out and prepared for mating. When ready, the encapsulated payload will be in a horizontal orientation and mated to the launch vehicle that is already installed on the transport erector launcher (TEL). Approximately 7 days before launch, the launch vehicle will be moved to and connected to the launch stand using an aircraft tug or tractor with an internal combustion engine. The launch vehicle will then undergo an additional series of tests while horizontal or vertical at the pad, such as wet dress rehearsal and static fire. The launch vehicle may be erected and de-erected several times before launch; the TEL is designed to streamline this operation. On the day of launch, the vehicle will be erected and final checks completed. For cargo or satellite missions, the payload accommodations would have been pre-loaded in the HIF. Approximately 20 to 25 people would be involved in launch preparation activities.

LOX would be trucked in and stored on SLC-20 in multiple tanks with a maximum storage of 60,000 gal (227,125 L). RP-1 would be trucked in and stored on SLC-20 in multiple tanks with a maximum storage of 22,000 gal (83,279 L). LCH4 would be trucked in and stored on SLC-20 in multiple tanks with a maximum storage of 33,000 gal (124,919 L). All tanks and containment systems will be inspected before use; as required, all tanks and containment systems will be tested for adherence to American Society of Mechanical Engineers (ASME) Section VIII, Boiler and Pressure Vessel Code.

A nitrogen and proposed helium pipeline are not expected to be required to support the proposed actions; however, tie-ins to these systems may be constructed in the future under a separate initiative should an opportunity become available. Liquid nitrogen would be trucked in and stored on SLC-20 in 15,000 gal (56,781 L) cryogenic liquid-nitrogen tanks. Gaseous nitrogen would be transferred to the site and stored in ASME storage vessels on SLC-20. Helium would be trucked in using standard DOT tube trailers then pumped and stored in ASME storage vessels on

SLC-20. Permanent over-ground lines will be installed at the launch pad area to connect the new launch pad infrastructure. These piping systems will be designed, installed, and tested in accordance with ASME B31.3 Piping Code requirements.

After final systems checkout, a mission rehearsal will typically be performed without propellants on board (dry) plus a mission rehearsal with propellants loaded on the vehicle (wet) to verify full launch readiness. Two dress rehearsals are typical in the launch preparation schedule to allow for team training and coordination of activities between the launch vehicle crew and CCAFS. As required, wet dress rehearsals, which include fully fueling the launch vehicle, may be conducted. Static fire tests may be conducted at the launch site, where the vehicle is fully fueled and the engine ignited and ran for up to 5 seconds as a thorough test of all systems. Static fire tests may be discontinued as the program matures. In addition, two-stage acceptance testing would occur at SLC-20 approximately once or twice per month. Stage 1 would occur with four Reaver engines for 30 seconds, and Stage 2 would occur with one lighting engine for 60 seconds.

First- and second-stage propellant loading of fuel and oxidizer would be done with standard zero-leak quick disconnect fittings typically used in the aircraft industry. Gaseous nitrogen would be used for pneumatics and purges. Gaseous helium would be used to fill the launch vehicle composite overwrapped pressure vessels (COPVs) for pneumatics and purges during flight. Up to 45 gal (170 L) of triethylaluminum-triethylborane (TEA/TEB), used for engine ignitions, would be stored in an ASME-approved storage tank. In addition, 55-gal (208 L) of isopropyl alcohol would be available onsite for cleaning operations; however, only 5 gal (19 L) are estimated to be required for various cleaning operations during the launch preparation. Lastly, 55-gal (208 L) of isoparaffinic hydrocarbon fluid (ISOPAR) would be available onsite for flushes of the TEA/TEB ignition system.

On a per-mission basis, launch campaigns (preparation for and launch) are expected to last from 2 to 4 weeks initially. During a launch campaign, an average of 20 to 25 launch-provider employees, with a peak of 35 personnel for about 1 week, would be present at SLC-20, not including payload support personnel. Ground transportation support during a launch campaign would be minimal, consisting of three trucks to deliver the first stage, second stage, and payload and four trucks to deliver RP-1, LOX, liquid nitrogen, and helium. Between launch campaigns, 20 to 25 employees would be present at the site, using personal vehicles to commute on and off site.

All launch operations would continue to comply with the necessary notification requirements, including issuance of Notices to Airmen (NOTAMs) and Local Notices to Mariners (NOTMARs), consistent with current procedures. A NOTAM provides notice of unanticipated or temporary changes to components of, or hazards in, the National Airspace System (FAA Order JO 7930.2S, Notices to Airmen). A NOTMAR provides notice of temporary changes in conditions or hazards in navigable waterways. Eastern Range operations (which include the proposed launches from SLC-20) currently follow the procedures stated in a Letter of Agreement (LOA) (dated May 1, 2020) between the 45th SW and FAA. The LOA establishes responsibilities and describes procedures for the 45th SW, Eastern Range operations, within airspace common to the Miami Center, Jacksonville Center, New York Center, San Juan Center Radar Approach Control, Central Florida Terminal Radar Approach Control, NASA Shuttle Landing facility, Fleet Area Control and

Surveillance Facility Jacksonville, Air Traffic Control System Command Center, and Central Altitude Reservation Function areas of jurisdiction. The LOA defines responsibilities and procedures applicable to operations, which require the use of Restricted Areas, Warning Areas, Air Traffic Controlled Assigned Airspace, and/or altitude reservations within Eastern Range airspace.

The Proposed Action does not include altering the dimensions (shape and altitude) of the airspace. However, temporary closures of existing airspace and navigable waters would be necessary to ensure public safety during launch operations. Advance notice via NOTAMs and NOTMARs would assist general aviation pilots and mariners in scheduling around any temporary disruption of flight or shipping activities in the area of operation. Launches would be of short duration and scheduled in advance to minimize interruption to airspace and waterways. For these reasons, significant environmental impacts of the temporary closures of airspace and waterways, and the issuance of NOTAMS and NOTMARs under the Proposed Action, are not anticipated.

A specific safety plan would be developed for the Launch Vehicle Program to ensure that launch operations comply with applicable regulations, including but not limited to the following:

- AFSPC Manual (AFSPCMAN) 91-710, Range Safety Requirements, as tailored for the Firefly Program
- Defense Explosives Safety Regulation (DESR) 6055.09 in accordance with AFSPCMAN 91-710
- Air Force Instruction (AFI) 31-101, Air Force Installation Security Program
- DoD 5220.22-M, National Industrial Security Program Operating Manual (for DoD missions only)
- AFI 32-1023, Design and Construction Standards and Execution of Facility Construction Projects
- Air Force Occupational Safety and Health Standards (for DoD missions only)
- National Fire Protection Association, National Fire Codes
- American National Standards Institute (ANSI)
- Occupational Safety and Health Administration (OSHA)

2.1.4 Launch Trajectory

Launch vehicle trajectories will be specific to each particular mission based on customer needs. All launches are expected to be conducted to the east over the Atlantic Ocean between the allowable azimuths of 44 degrees to the northeast and 110 degrees to the southeast. As part of the licensing evaluation process, the FAA conducts a policy review, payload review, financial determination, and safety review. Space Florida would complete a Flight Safety Analysis as part of their launch site operator license application, which would include an Expected Casualty calculation and Operational Restrictions, and the FAA would evaluate this analysis as part of the safety review to ensure that the results meet 14 CFR 420 regulations. The launch operator will also complete the Flight Safety Analysis and define specific trajectories as part of their launch operator license. All approved trajectories are based on specific launch vehicle performance and characteristics and would satisfy 14 CFR 420, as well as 14 CFR 415/417 regulations.

2.1.5 Frequency of Launches

Space Florida expects up to 24 annual Concept A/B launches. Initially, launches will primarily consist of Concept A vehicles, with Concept B launches gradually increasing as the program develops. Of the 24 annual launches, it is anticipated that a maximum of 18 of those launches will consist of Concept B launches. For the purposes of assessing noise-related impacts in this EA, the analysis conservatively models 10 Concept A launches and the maximum number of 18 Concept B launches. This assumption will yield the maximum noise exposure anticipated from launches. It is expected that 70 percent of the launches would occur during daylight hours and 30 percent of the launches would occur during nighttime hours. For this EA, nighttime is defined as any event occurring after 10 PM and before 7 AM.

2.1.6 Vehicle Assembly and Transportation

The Proposed Action's Launch Vehicle Program is designed for minimal vehicle assembly or processing on the launch pad, and the majority of the vehicle assembly would occur at Exploration Park. Launch vehicle stages and payloads would arrive at SLC-20 from Exploration Park via standard tractor-trailer (no longer than 80 ft [24 m]). Oversized load movements are coordinated through CCAFS Cape Support. The roads at CCAFS were designed to Florida Department of Transportation (FDOT) standards. Specifically, this standard is to support an HS-20 truck with an axle load of 32,000 lb (14,515 kg) for the rear axles. Two trips are assumed to be required for each Concept A vehicle launch and up to three trips for each Concept B vehicle launch. Launch providers will conform to HS-20 FDOT specifications. These specifications permit a maximum axle loading of 8,000 lb (3,628 kg) on the cab axle and 32,000 lb (14,515 kg) on the rear axles, for an overall maximum weight of 80,000 lb (36,287 kg). No roadway improvements to support this route would be required for the delivery of launch components to SLC-20. Table 2-7 and Figure 2-1 show this planned transportation route. The Alternative Route would only be used if the Primary Route were not available for use and the use of this route is rarely anticipated.

Table 2-7 Transportation Route from Exploration Park to SLC-20*

Segment	Start	End
1	Manufacturing Site	Space Commerce Way
2	Space Commerce Way	State Highway 405 (NASA Parkway)
3	State Highway 405 (NASA Parkway)	KSC Gate 3
4	KSC Gate 3	NASA Parkway
5	NASA Parkway	Samuel C. Phillips Parkway
6	Samuel C. Phillips Parkway	Heavy Launch Road
7	Heavy Launch Road	ICBM Road
8	ICBM Road	SLC-20

* Cape Support will be notified before transportation of articles along the route to coordinate movements of any oversized loads before delivery.

2.1.7 Support Facilities

Space Florida intends to refurbish, enhance, and use the existing SLC-20 support shop, HIF, and Blockhouse. In addition, a potential future deluge containment area is sited north of Launch Pad A (Figure 2-2). Specific to the potentially historic Blockhouse, exterior repairs would include fixing select portions of the top-layer roof and other items to maintain good working order. All exterior repairs will be coordinated with USAF and the State Historic Preservation Office (SHPO). New construction near SLC-20 would occur in three phases with the final phase illustrated in Figure 2-2 and as summarized in Table 2-8 from 2020 through 2021.

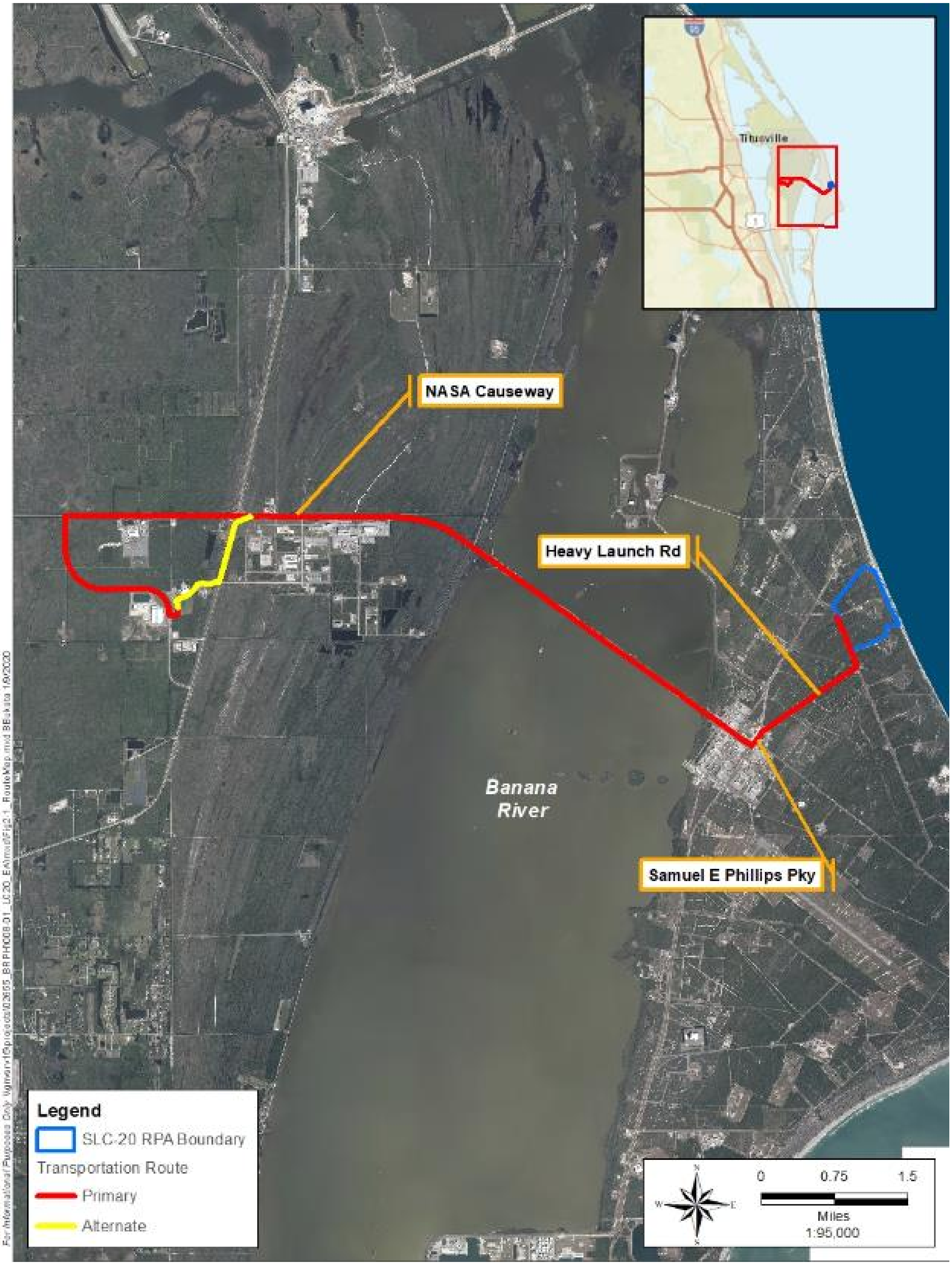


Figure 2-1 Transportation Route from Exploration Park to SLC-20

1 **Figure 2-2 Proposed Site Construction**

Table 2-8 Support Facility Construction Requirements

Phase	New Facility	Existing Site
Phase 1	Concept A Pad	Fac 15540, Launch Pad A
	Concept A Launch Equipment	Fac 15541, Equipment Building Pad A
	Deluge Containment	New Construction Near Former Fac 15540 and Fac 15541
	Concept A Environmental Conditioning System (ECS)	New Construction
	RP-1 and Gaseous Nitrogen Storage	Fac 15500AD, Fuel Holding Area
	Ordnance Storage	New Construction Near Former Fac 15640, Launch Pad B
	LOX, Liquid Nitrogen, and Gaseous Helium	Fac 15608, Power Center; Fac 15609, Control Center; and Fac 15531, Retaining Wall (Former Oxidizer Holding Area)
	Generators	New Construction Near Fac 18800, Blockhouse
	Launch Communication Equipment and Pad Office	New Construction Near Fac 18800, Blockhouse
	Support Shop	Fac 18806, Payload Assembly Building
	Pad Security	Fac 18803, Guard House
	Non-hazardous Payload Process Facility	Fac 18705, Warehouse
	Horizontal Integration Facility	
Phase 2	Complex Support Building/Office	New Construction
	Deluge Containment	Fac 15500B, Launch Stand and Ramp
	Concept A/B Pad	
	Concept B ECS	
	Concept B Launch Equipment	
	New Horizontal Integration Facility/Hazardous Payload Processing Facility	New Construction
	Water Pump House	New Construction
Phase 3	Customer Support Building/Office	New Construction

The initial construction phase would only include infrastructure needed to support the Concept A launch vehicle with the existing HIF and a deluge containment system. Phase 2 would add a combined Concept A/B pad in the center of SLC-20 and a new HIF/hazardous payload processing facility. The maximum deluge containment system size at full buildout is expected to include approximately 45,000-gal (170,344 L) of deluge water containment storage. In addition, a complex support building/office would be added outside the main gate. In Phase 3, Concept A and B launches would occur at the center launch pad with the addition of a new customer support building outside the main gate and adjacent to the operations support building.

Explosive safety quantity-distance criteria would be used to establish safe distances from all onsite facilities and adjoining roadways. Launch providers would be compliant with AFSPCMAN 91-710, which specifies that all facilities, including launch complexes, used to store, handle, or process ordnance or propellants shall be properly sited and approved in accordance with DoD quantity-distance criteria and explosive safety standards specified in DoD 6055.9-STD and implemented in Air Force Manual 91-201.

With exception of the new HIF/hazardous payload processing facility, all construction would occur in previously disturbed areas. In support of the proposed construction, it is expected that the guard house and electrical shed would be demolished and replaced. The existing lightning protection towers at Concept Pad A would remain in place, and new lightning protection towers would be added during the construction of the Concept A/B pads during Phase 2 construction.

Onsite infrastructure improvements would also be completed to ensure adequate water, wastewater, and electrical requirements are met to accommodate up to 45 people. Domestic water service to accommodate this demand is estimated to be approximately 1,500 to 2,000 gallons per day (gal/d) (5,678 to 7,570 liters per day [L/d]), with domestic sanitary service estimated to be 1,200 to 1,700 gal/d (4,542 to 6,435 L/d) during peak launch operations with the full complement of 45 people present at the site. However, these demands and adequacy of existing systems would be confirmed upon design development. Currently, 12-inch combined water and fire protection lines serve the facility, and sewer service is provided via several onsite septic systems and drain fields. Initially, minor maintenance and renovation of these septic systems may be required for initial operations. However, if offsite sanitary collection services become available along ICBM Road, an onsite lift station, force main, and sewer service lines may be installed to connect to the offsite system. Electrical equipment such as transformers will be sized and specified at the time of design. Location and size of these transformers would be coordinated with 45 SW at the time of design for incorporation into the CCAFS Spill Prevention, Control, and Countermeasure Plan (SPCCP). In support of emergency generators near the Blockhouse, one AST to store approximately 3,200 gal (12,113 L) of diesel fuel will be required. The AST will also be included in the site's SPCCP.

2.2 ALTERNATIVES CONSIDERED

CEQ Regulations (40 CFR §1502.14) require agencies to consider a reasonable range of alternatives. Reasonable alternatives include those alternatives that meet the purpose and need of the Proposed Action. Alternatives were evaluated for reasonableness using the following criteria:

- Safety – Location that provides the maximum safety to the public and workers while ensuring maximum operational performance.
- Multi-User Capability – Ability to handle and launch small- to medium-lift class launch vehicles with multi-user expansion capability to maximize the utility of the launch complex in the future. Note that only one user has expressed interest in operating from the Proposed Action area at this time.
- Geographic Location – An existing launch complex in Florida that complies with Space Florida's statutory mandate of providing commercial space services within the territory of Florida.
- Operational Flexibility – Avoids and/or minimizes impacts to the following: launch scheduling conflicts, known cultural resources where reconstruction would be prohibited, excessively contaminated soils and/or groundwater whose cleanup is cost-prohibitive, known biological species critical habitat, proximal distance to Exploration Park, and populated areas.
- Availability – A launch complex that is available, requires relatively limited reconstruction to be put into service, and is not currently planned for use by others.

- Long-term Operational Costs – Controlling long-term operational costs associated with local wages, utility rates, logistical costs, real estate occupancy costs, construction costs, taxes, insurance, etc.
- Schedule – Ability to complete construction-related tasks in support of 2020 Alpha launch.
- Workforce Availability – Ability to acquire skilled workers from regional workforce supply.
- Ability to handle and launch small- to medium-lift class launch vehicles.
- Compatibility with CCS Master Plan for launches intended for small- to medium-lift capacity.

2.2.1 No Action Alternative

CEQ regulations (40 CFR §1502.14) require agencies to consider a "no action" alternative in the NEPA analyses to compare the effects of not taking action with the effects of the action alternative(s). The No Action Alternative serves as a baseline for comparing the impacts of the Proposed Action. Under the No Action Alternative, approximately 220 acres (89 ha) would not be transferred from USAF to Space Florida via an agreement, 33 acres (13 ha) of the 214 acres (87 ha) would not be available for use from Space Florida, and commercial aerospace tenants would not conduct small- and medium-lift launch vehicle operations at SLC-20. Moreover, Space Florida and any tenants would not apply for a commercial launch license from the FAA for commercial space launch operations at SLC-20. SLC-20 would remain unused. The No Action Alternative would not meet the purpose and need as stated in Section 1.3.

2.2.2 Alternatives Considered but Eliminated from Further Consideration

Other launch sites within Florida, in accordance with the statutory constraints of Space Florida's charter, were considered; however, none of these sites were considered reasonable as they did not meet the screening criteria. Specifically, Space Florida has a statutory constraint to provide service within the territory of Florida and the unique requirements to access orbital launch range assets (Space Florida 2018). Therefore, space launch sites in states other than Florida were not considered. In addition, operational support facilities and personnel are required to be located close to the space launch site. Exploration Park, a dedicated aerospace manufacturing, research, and office park, is outside the gates at KSC, has 48 engineers per 1,000 workers, and ranks in the top 30-most engineer populated metros in the country providing commercial aerospace users with a uniquely skilled workforce to support their missions close to their actual launch sites (Space Florida 2019).

Other launch sites within the CCAFS territory were considered, such as SLC-15 and SLC-16; however, these sites were dismissed as they do not meet the Availability screening criteria (planned or potential development by other users) and cannot as readily meet the Schedule criteria as SLC-20, as this complex has been utilized to support NASA programs in recent years.

2.2.3 Preferred Action Alternative

The Proposed Action has been identified as the Preferred Action Alternative for the following reasons:

- Meets safety criteria. Specifically, it does not overfly populated areas or operational facilities at CCAFS.

- Has the multi-user expansion capability to support small- to medium-lift class commercial aerospace launch vehicles.
- Meets the statutory mandate that requires Space Florida to support commercial aerospace development on lands within Florida.
- Meets the operational flexibility criteria list of requirements above.
- Uses an existing launch complex that is not committed to others and would require limited reconstruction to be put into service.
- Meets the long-term operational cost criteria due to its existing launch complex status and location of available space for long-term expansion as a multi-user launch complex proximal to a variety of commodity pipelines that could be available in the future if tie-ins were beneficial to its operations.
- Meets the schedule criteria to be ready for an Alpha or Alpha-size launch in 2020.
- Meets the workforce criteria.
- Located within 10 miles (1.6 km) of Exploration Park and close to a manufacturing location.
- Uses an existing launch complex facility.
- Compatible with the CCS Master Plan, which requires that Space Florida-supported launch locations be within Florida.
- Aligns with DoD Directive 3230.3.
- Supports the screening criteria described in Section 2.2 to include avoiding known cultural resources where reconstruction would be prohibited and biological species critical habitat.

3.0 AFFECTED ENVIRONMENT

In compliance with NEPA and CEQ regulations, this Section describes the existing environment at CCAFS associated with the Proposed Action and the No-Action Alternative. Each sub-section summarizes the affected environment for the resource areas analyzed in detail in this EA. Fifteen broad environmental resource areas were considered to provide context for understanding the potential effects of the Proposed Action and as a basis for assessing the significance of these potential impacts. The areas which were reviewed include land use/visual resources (which includes coastal resources), noise, biological resources, cultural resources, air quality, climate, hazardous materials/hazardous waste (which includes solid waste and pollution prevention), water resources, geology and soils, transportation, utilities, health and safety, socioeconomics, environmental justice, and Section 4(f).

Additional resources required to be assessed by FAA Order 1050.1F, including natural resources and energy supply, farmlands and children's environmental health and safety risks, were considered but are dismissed from detailed evaluation since these resources have no potential to be affected by the Proposed Action. The lands at CCAFS do not include prime farmland. Therefore, this resource area is not addressed in detail. Risks to children are not addressed for this action as no child-care facilities or other children-related activities occur on CCAFS.

For each resource area, a region of influence (ROI) was established. The ROI is the area within which the Proposed Action may cause either an adverse or beneficial impact. The land area within the Proposed Action in Figure 1-2 shows that the area of SLC-20 has been previously disturbed.

3.1 LAND USE/VISUAL RESOURCES

Compatible land uses are those that fit within the land use patterns (vehicle launches, residential, commercial, industrial, recreational, etc.), land ownership (federal, state, private), and land use management plans. Zoning, management plans, and policies regulate how land is used. Visual resources are any naturally occurring or manmade feature that contributes to the aesthetic value of an area. Areas such as coastlines and national parks are usually considered to have high visual sensitivity. 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 proximate to the shorelines of the several coastal states and includes islands, transitional and intertidal areas, salt marshes, wetlands, and beaches (16 USC Part 1453).

The ROI for land use and visual resources includes the viewshed around SLC-20, such as adjacent lands at and surrounding CCAFS that would be able to view the launch pad, buildings, and/or vehicles during launches, such as off-station lands within launch safety clear zones. The ROI for coastal resources encompasses the station boundaries and potentially affected adjacent lands, including off-station lands within launch safety clear zones or land uses that may be affected by activities on the station.

CCAFS comprises 15,800 acres (6,394 ha), which is approximately 2 percent of the total land area of Brevard County. The dominant land uses at CCAFS are launch and landing operations, range support, airfield, port operations, station support areas, and open space.

Launch operations land use areas that are present along the Atlantic Ocean shoreline include both inactive and active launch sites and support facilities. These sites also include lightning protection towers, tall integration buildings, and other launch-related structures. The CCAFS Skid Strip has always supported landing operations of “horizontal” vehicles like airplanes, jets, and unguided missiles. CCAFS operations also include Reusable Launch Vehicle (RLV) landings supported by a 2014 EA (USAF 2014). Open space occurs throughout CCAFS, and there are no public beaches.

The area surrounding SLC-20 is generally flat and dominated by live oak/saw palmetto hammock. The Proposed Action site is on the east side of CCAFS, off ICBM Road, and the Atlantic Ocean is to the east. SLC-34 is to the north and SLC-19 is to the south. The site is already extensively developed and has been designated by CCAFS for use as a launch complex since the late 1950s (Figure 1-3 and Figure 2-2).

KSC, which is north and west of CCAFS, includes predominantly industrial uses associated with NASA launch programs and open space associated with the Merritt Island National Wildlife Refuge (MINWR), located approximately 1.5 miles (2.4 km) from the SLC-20 site. Uses of the river and ocean water areas surrounding CCAFS include commercial fishing, marine recreation, and marine transportation. The Canaveral National Seashore (CNS) is north of CCAFS, approximately 10 miles north of the SLC-20 area and is operated by the National Park Service (NPS). No noise sensitive areas (public parks, libraries, churches, etc.) exist near the site. The closest residential area to the site is Cape Canaveral and is approximately 8 miles (13 km) to the south of the launch site (Figure 1-1). The Cape Canaveral area also includes Jetty Park and cruise terminals. Currently, no light sources are at the launch site.

The entire State of Florida is defined as being part of a coastal zone (National Oceanic and Atmospheric Administration [NOAA] 2004). A federal agency must ensure that proposed activities within the coastal zone are consistent with that state’s Coastal Zone Management Act (CZMA). Federal activity in or affecting a coastal zone requires preparation of a Coastal Zone Consistency Determination, in accordance with the federal CZMA of 1972. The Proposed Action is subject to the requirements of the federal CZMA.

Responsibility for administering the Coastal Zone Management Plan has been delegated to states that have developed state-specific guidelines and requirements. The NOAA 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.

Brevard County and the City of Cape Canaveral are the local planning authorities for incorporated and unincorporated areas near CCAFS. However, neither Brevard County nor the City of Cape Canaveral has land use or zoning authority over CCAFS land because it is federally owned. CCAFS has developed a general plan that defines the installation’s land uses and zoning. FDEP is the state’s lead coastal zone management agency, but USAF is responsible for making the final coastal zone consistency determinations for its activities within the state. The EA will be submitted to the Florida Clearinghouse who will then coordinate review of the proposed action by FDEP and Florida Coastal Management Plan (FCMP) member agencies

3.2 NOISE

3.2.1 General Description

Any unwanted sound that interferes with normal activities or the natural environment is defined as noise. The measurement and human perception of sound are based on three principal physical characteristics: intensity, frequency, and duration. *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*, which is measured in terms of cycles per second, also called hertz (Hz), determines how the pitch of the sound is perceived. Low-frequency sounds are characterized as rumbles or roars, while typical high-frequency sounds are sirens or screeches. *Duration* is the length of time a sound can be detected.

The decibel (dB), which is a logarithmic unit that accounts for the large variation in sound pressure amplitudes, is the standard unit for the measurement of sound. Sound levels that have been adjusted to correspond to the frequency response of the human ear are referred to as A-weighted (dBA) sound pressure levels. Environmental noise is often expressed in terms of dBA.

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. These descriptors can also be used to qualitatively assess the effects of noise on wildlife.

Day-Night Average Sound Level (DNL) represents the average sound level exposure for annual average daily events. FAA Order 1050.1F requires that the assessment of noise impacts on noise-sensitive areas uses the DNL metric to determine if significant impacts would occur. Typically, noise sensitive areas include residential, educational, health, and religious structures and sites, and parks or recreational areas (including areas with wilderness characteristics), wildlife refuges, and cultural and historical sites.

Table 3-1 provides common sound level descriptors.

Table 3-1 Noise Descriptions and Definitions

Description	Definition
A-Weighted Sound Level	The momentary magnitude of sound weighted to approximate the human ear's frequency and sensitivity. A-weighted sound levels typically measure between 20 Hz 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 Sound Level (DNL)	An A-weighted equivalent sound level averaged over a 24-hour period with a 10-dB "penalty" added to nighttime sounds. 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 Hz and above 3,000 Hz. 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 to nighttime sounds. CDNL is similar to DNL, except that C-weighting is used rather than A-weighting.
C-Weighted Sound Exposure Level (CSEL)	C-weighted SEL. The same as SEL except the measurement is in C-weighting rather than A-weighting.

Description	Definition
LAmax	LAmax is the A-weighted, maximum, sound level. (Maximum is not *peak.*)
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.
Sound Exposure Level (SEL)	A-weighted SEL. The total sound energy in a sound event if that event could be compressed into 1 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.

3.2.2 Ambient Noise Levels

The ROI for noise includes the area around SLC-20, CCAFS, KSC, and the closest populated areas, which are Cape Canaveral and Cocoa Beach to the south and Merritt Island to the west and southwest. Noise levels around industrial facilities at CCAFS and KSC are comparable to those of an urban industrial area, reaching levels of 60 to 80 dBA. The aircraft landing facilities and CCAFS Skid Strip are additional on-site sources of noise.

Other less frequent but more intense sources of noise are launches from CCAFS and KSC. The largest portion of the total acoustic energy produced by a launch vehicle is usually contained in the low-frequency end of the spectrum. Launch vehicles also generate sonic booms, which are shock waves that result from the displacement of air in supersonic flight.

Merritt Island, Cocoa Beach, and Cape Canaveral are more than 7 miles (11 km) from CCAFS and KSC. The distance between CCAFS, KSC, and adjacent communities reduces the noise effects experienced in residential areas. Typical sound levels in these areas are usually low with higher levels occurring in industrial areas near Port Canaveral or 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.

3.2.3 Construction Related Noise Description and Considerations

Temporary noise from the operation of construction equipment (e.g., earth-moving machinery, dump trucks, and power tools) is usually limited to a distance of 1,000 feet (305 m) or less. Vehicles associated with construction typically generate between 65 and 100 dBA at a distance of 50 feet (15 m). 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.

3.2.4 Launch Operations Related Noise Description and Considerations

Launch operations-related noise refers to noise generated from activities such as actual launches and also temporary noise during maintenance or refurbishment activities and ongoing noise generated from worker traffic to and from the selected site. The highest recorded noise levels at KSC were produced by Space Shuttle launches, which could exceed 160 dBA. Actual launch activities are the major source of all operational noise. Three distinct noise events are associated with launch and ascent of a launch vehicle: (1) on-pad engine noise, (2) in-flight engine noise, and (3) sonic booms. Operations-related noise from the actual launches are summarized below.

On-Pad Noise

On-pad engine noise occurs when engines are firing but the vehicle is still on the pad. The engine exhaust is diverted horizontally by a flame deflector or flame duct. Noise levels in the immediate vicinity of the launch vehicle and within the launch complex are high. Since the sound source is at or near ground level, propagation from the launch vehicle to off-site locations is along the ground with substantial attenuation over distance. Accordingly, on-pad noise levels are typically much lower than inflight noise levels.

In-Flight Engine 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 noise 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; therefore, less attenuation of the sound occurs as it propagates to large distances.

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 Hz).

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. Sonic booms are considered low‑frequency impulsive noise events with durations lasting a fraction of a second. The intensity of a sonic boom 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, and measured in psf.

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.

3.3 BIOLOGICAL RESOURCES

This section describes the vegetation and animal species that occur or could potentially occur within the ROI. For biological resources, the ROI includes the Proposed Action boundary and areas within the proposed RPA boundary that could be affected by construction activities and launch operations. Biological resources include native plants and animals and the habitats in which they exist. Sensitive and protected biological resources include plant and animal species that are threatened or endangered (T&E) and species of special concern (SSC) as listed by USFWS and the Florida Fish & Wildlife Conservation Commission (FWC).

USAF 45 SW is committed to the long-term management of all-natural areas on its installations as directed by AFI 32-7064, Integrated Natural Resources Management. Long-term management objectives are identified in the 45 SW's 2018 Integrated Natural Resources Management Plan (INRMP) with specific land management objectives identified in the Scrub-Jay and Sea Turtle Management Plans in the appendices of the INRMP.

The following sections were derived from several sources, including the 45 SW 2018 INRMP and a recently completed Biological Assessment (BA) for the site. The BA was completed and submitted to USFWS on January 10, 2020. In response to this BA, Appendix C provides April 23, 2020 correspondence from the USFWS stating that they concur with the BA and the July 2020 BO that was subsequently issued.

3.3.1 Vegetation

Vegetation Communities

Thirteen natural vegetation communities occur on CCAFS (USAF, 2018a), which are summarized in Table 3-2. Many of these natural communities are high quality despite the communities being fragmented by mission-related construction and clearing activities. These communities range from scrub to mangrove swamps (Figure 3-1). The dominant native vegetation communities on CCAFS consist of maritime hammock, coastal strand, and live oak/palmetto. Eight species of state-listed plant species have been documented on CCAFS. None of the eight species have been identified within the boundaries of the Proposed Action. No federally listed plant species have been documented on CCAFS.

Vegetation within the Proposed Action area has been periodically maintained by mowing/ trimming and is dominated by herbaceous species with a few scattered shrubs and short trees. As a result, the majority of the Proposed Action area is not comprised of native vegetation communities. Figure 3-1 shows that the Proposed Action area is composed of two upland and one wetland communities, and Figure 3-2 provides a topographic map of the area.

Uplands – The following two upland habitats are found within the Proposed Action boundary: (1) Maintained Grasses and (2) Live Oak/Saw Palmetto Hammock. Maintained Grasses comprise 33 acres of existing SLC-20 and refers to vegetated areas and areas of impervious surface such as roads, buildings that have been maintained inconsistently (Figure 3-1). Vegetated areas within the Proposed Action area are dominated by a diversity of native and exotic species such as ragweed (*Ambrosia artemisiifolia*), beggars tick (*Bidens alba*), frogfruit (*Phyla nodiflora*), muhly grass (*Muhlenbergia capillaris*), Bermuda grass (*Cynodon dactylon*), bahia grass (*Paspalum notatum*), alamo vine (*Merremia dissecta*), mother of thousands (*Kalanchoe daigremontiana*),

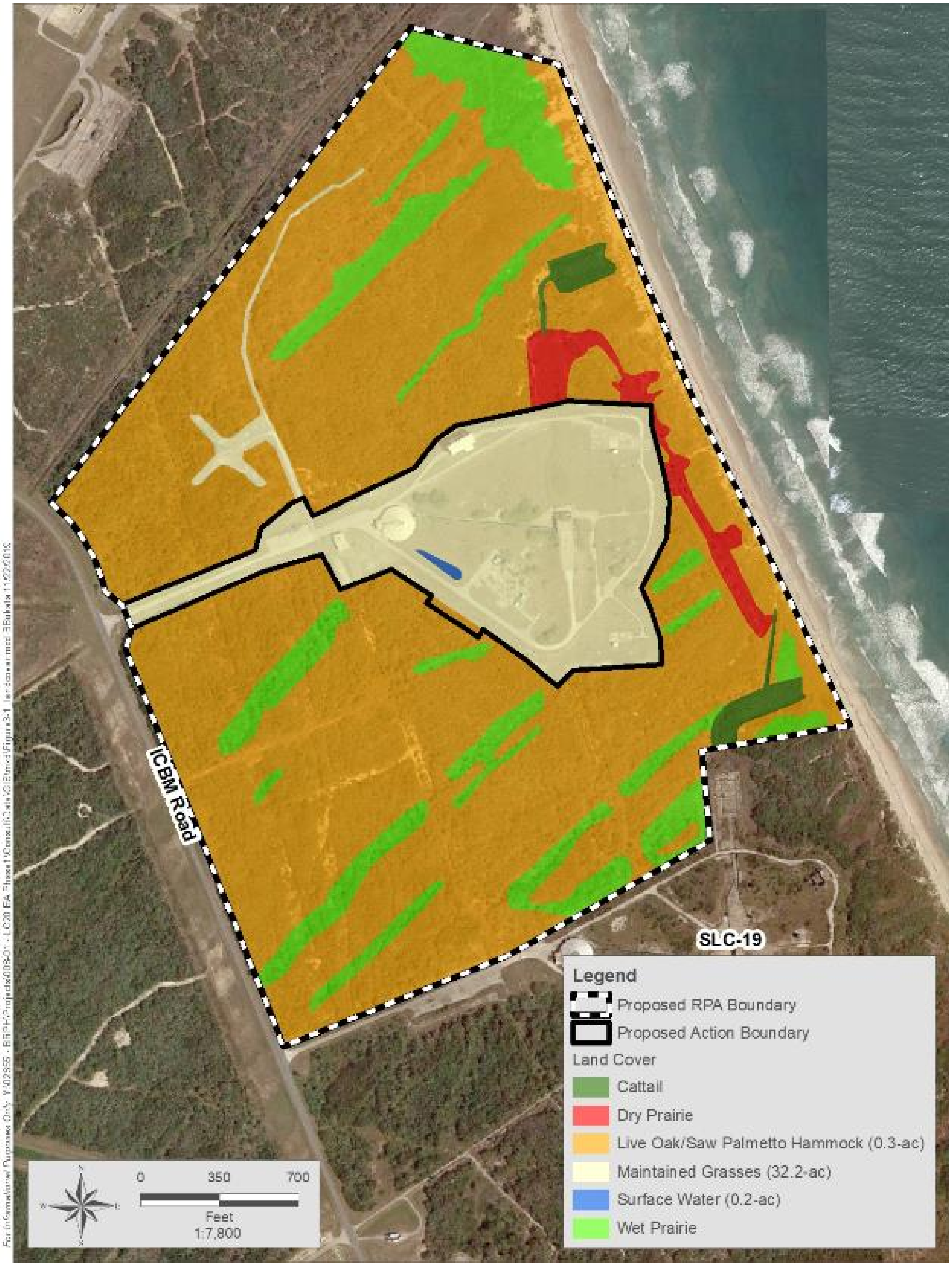


Figure 3-1 Existing Land Cover Map

Table 3-2 Summary of Natural Vegetation Communities on CCAFS

Natural Vegetation Community	Acres (Hectares)
Beach Dune (acreage not available)	Not Available
Coastal Grassland	Included in Coast Strand Acreage
Coastal Strand	1,728 (698)
Basin Marsh	75 (30)
Coastal Interdunal Swale	142 (57)
Maritime Hammock	2,291 (928)
Live Oak/Saw Palmetto Hammock	1,237 (501)
Live Oak/Saw Palmetto Shrubland	1,477 (598)
Xeric Hammock	556 (225)
Scrub	1,083 (438)
Tropical Hammock	113 (46)
Hydric Hammock	9 (4)
Mangrove or Exotics	901 (365)

Source: USAF 2018a.

sunflower (*Helianthus debilis*), lantana (*Lantana sp.*), century plant (*Agave americana*), prickly pear cactus (*Opuntia humifusa*), morning glory (*Ipomea* sp.), partridge pea (*Chamaecrista fasciculata*), and winged loosestrife (*Lythrum alatum*). Several large clumps of Brazilian pepper (*Schinus terebinthifolius*) are also found in the central and south region with a few live oak (*Quercus virginiana*) and hog plum (*Ximenia americana*). In addition, several large areas of St. Augustine grass (*Stenotaphrum secundatum*) exist throughout the site as well as a large monoculture of guinea grass (*Megathyrsus maximus*).

The second upland community, Live Oak/Saw Palmetto Hammock, is found in the southwest region of the Proposed Action area and comprises approximately 0.3 acre (Figure 3-1). This area is dominated by live oak, cabbage palm (*Sabal palmetto*), saw palmetto (*Serenoa repens*), greenbriar (*Smilax* sp.), and grapevine (*Vitis rotundifolia*).

Surface Water – A small surface water community, comprising 0.19 acre, is found in one location within the Proposed Action boundary (Figure 3-1 and

Figure 3-2). This feature is likely man-made stormwater treatment system excavated to store and/or treat road or site runoff. It is dominated by St. Augustine grass, sedges (*Cyperus* sp.), frogfruit, pennywort (*Hydrocotyle umbellata*), and winged loosestrife. Surface water was not present, soils were extremely dry, and hydric soil indicators consisted of sandy redox. Due to the lack of an organic horizon at the surface, this surface water likely does not experience prolonged inundation during the wet seasons; rather, the water table is found at or below grade.

Figure 3-2 DEM Map of Proposal Action Site

3.3.2 Wildlife

CCAFS is on a barrier island that supports many plants, animals, and natural communities. Barrier islands along the Atlantic coast are especially important to nesting sea turtles and populations of small mammals and as foraging and roosting habitat for a variety of resident and migratory birds. Specifically, more than 25 mammalian species, more than 50 amphibian and reptile species, and more than 200 bird species are known to occur on or in the vicinity of CCAFS.

The coastal scrub and associated woodlands provide habitat for a wide range of wildlife including raccoon, long-tailed weasel, round-tailed muskrat, southeastern beach mouse, migratory birds, and mammals such as the white-tailed deer, armadillo, bobcat, and feral hog. Numerous marine mammals populate the coastal and lagoon waters including the bottlenose dolphin, the spotted dolphin, and the manatee, which is protected.

Amphibians documented on CCAFS include the spade foot and eastern narrow-mouth toads, southern leopard frogs, Florida gopher frog, and green and squirrel tree frogs. Reptiles observed include the American alligator, Florida box turtle, gopher tortoise, Florida softshell, green anole, six-lined racerunner, broadhead skink, southern ringneck snake, everglades racer, eastern coachwhip, diamondback rattlesnake, indigo snake, and pine snake.

The seagrass beds in the north Indian River Lagoon (IRL) system provide important nursery areas, shelter, and foraging habitat for a wide variety of fish and invertebrates, manatees, and green sea turtles. The inland rivers and lagoons provide habitat for marine worms, mollusks, and crustaceans. The Mosquito Lagoon is an important shrimp nursery area. The beaches and off-shore area are inhabited by five species of marine turtles.

A number of saltwater fish species can be found within Indian and Banana River Systems including the bay anchovy, pipefish, goby, silver perch, lined sole, spotted sea trout, and oyster fish. The small freshwater habitats found on CCAFS contain bluegill, garfish, largemouth bass, killifishes, sailfin molly, and top minnow (USAF 1998).

Migratory Birds

Cape Canaveral is situated along a major flyway route for migratory birds and therefore home to numerous birds listed on the USFWS migratory bird list, all of which are protected by the Migratory Bird Treaty Act (MBTA). All but a few bird species (e.g., pigeons, European starlings) found on CCAFS are on this list. Executive Order (EO) 13186, signed in 2001, requires federal agencies to protect migratory birds and their habitats. This requires that if nests may be impacted, the nest must be empty of eggs or young before relocation or removal.

CCAFS also supports a large population of ospreys and can support the bald eagle. Ospreys are most often found near water, nesting near the top of large trees, bore-sight towers, utility poles, antennas, and gantries. The osprey is federally protected by the MBTA, which makes it illegal to destroy a nest without the proper permits. Currently, ospreys are not nesting on or in any trees or structures at the Proposed Action site or in the RPA boundary area. US Congress had ensured the bald eagle's protection under the MBTA and the Eagle Act. The bald eagle was delisted from the endangered species list in 1995 and the threatened species list in 2007. It is still protected by the State of Florida through the FWC and Florida Statute (68A-16.002, FAC). A review of http://myfwc.maps.arcgis.com/apps/webappviewer/index.html?id=253604118279431984e8bc3ebf1cc8e9 in August 2019 determined that a bald eagle nest is not present within 6 miles (9.7 km) of SLC-20.

Threatened and Endangered Species

CCAFS contains habitat utilized by a large number of federally listed and state-listed species. The Florida Natural Areas Inventory (FNAI) conducted a comprehensive biological survey of CCAFS for the 45 SW. This 2-year survey was completed in December 1997 to document rare, threatened, and endangered flora and fauna, migratory birds, and outstanding natural communities. Survey efforts at CCAFS since this time (Gulledge et al. 2009; Reyier et al. 2010; 2011; Oddy et al. 2012; Fleming and Greenwade 2007; Hankla 2008) have identified additional federally and state-listed sensitive species occurring at the installation. Federally or state-listed species occurring within CCAFS include five fish, nine reptiles, 15 birds, three mammals, and 11 plants. No federally designated critical land habitat under Section 4 of the Endangered Species Act (ESA) is mapped on the installation. However, critical in-water habitat for the West Indian manatee is mapped within the Banana River and within inlets/bays of CCAFS that connect to the Banana River. Federally designated critical habitat for the loggerhead sea turtle and North Atlantic right whale is also mapped along the Atlantic Coast. USAF negotiated with USFWS to avoid critical habitat designation on land at CCAFS for the loggerhead sea turtle (79 FR 39756, 398051). This USFWS exemption was granted on 10 October 2012 (USFWS 2012).

Table 3-3 presents listed species that are known to be present or near (within 100 ft [30.5 m]) the Proposed Action. USAF (2018a) provides a list of federal and state regulatory requirements, which address vegetation and wildlife that may be present on CCAFS and a more detailed description of protected species present at CCAFS.

Table 3-3 Protected Species Fauna Found in the Vicinity of the Proposed Action

Common Name	*Scientific Name*	Status	
		Federal	**State**
Atlantic Sturgeon*	*Acipenser oxyrinchus*	E	
Oceanic Whitetip Shark*	*Carcharinus lonigmanus*	T	
Nassau Grouper	*Epinephalus striatus*	T	
Giant Manta Ray*	*Manta birostris*	T	
Smalltooth Sawfish*	*Pristis pectinata*	E	
Amphibians			
None listed			
Reptiles			
American Alligator	*Alligator mississippiensis*	T(S/A)	
Loggerhead Sea Turtle	*Caretta*	T	
Green Sea Turtle	*Chelonia mydas*	T	
Leatherback Sea Turtle	*Dermochelys coriacea*	E	
Eastern Indigo Snake	*Drymarchon couperi*	T	
Hawksbill Sea Turtle	*Eretmochelys imbricata*	E	
Gopher Tortoise	*Gopherus polyphemus*	C	T
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	E	
Florida Pine Snake	*Pituophis melanoleucus mugitus*		T
Birds			
Florida Scrub-Jay	*Aphelocoma coerulescens*	T	
Red Knot	*Calidris canutus rufa*	T	
Crested Caracara	*Caracara cheriway*	T	
Piping Plover	*Charadrius melodus*	T	
Snowy Plover	*Charadrius nivosus*		T
Little Blue Heron	*Egretta caerulea*		T
Reddish Egret	*Egretta rufescens*		T
Tricolored Heron	*Egretta tricolor*		T
Southeastern American Kestrel	*Falco sparverius paulus*		T
American Oystercatcher	*Haematopus palliatus*		T
Wood Stork	*Mycteria americana*	T	
Roseate Spoonbill	*Platalea ajaja*		T
Black Skimmer	*Rynchops niger*		T
Roseate Tern	*Sterna dougallii*	T	
Least Tern	*Sternula antillarum*		T

Common Name	*Scientific Name*	Status	
		Federal	State
Mammals			
North Atlantic Right Whale*	*Eubalaena glacialis*	E	
Southeastern Beach Mouse	*Peromyscus polionotus niveiventris*	T	
West Indian Manatee	*Trichechus manatus*	T	
Plants			
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
Beach-Star	*Remirea maritima*		E
Inkberry	*Scaevola plumieri*		T

Notes:
* Species does not occur on 45 SW properties, but occurs in water adjacent to 45 SW properties.
C = Candidate species.
E = Endangered species.
S/A = Species listed due to similarity of appearance to American crocodile.
T = Threatened species.

Of the species listed in Table 3-3 that could potentially be found in the vicinity of the Proposed Action area, the following five listed wildlife species of concern have been identified based on their documented presence or potential to utilize habitats within the Proposed Action boundary or adjacent to it:

- Florida scrub-jay (*Aphelocoma coerulescens*)
- Southeastern beach mouse (*Peromyscus polionotus niveiventris*)
- Eastern indigo snake (*Drymarchon corais couperi*)
- Marine turtles
- Gopher tortoise (*Gopherus polyphemus*)

The following paragraphs give a broad overview for these five species of concern. Additional information on these species, as well as others that can be found in the vicinity of the Proposed Action area but not within the Proposed Action Boundary, is provided in the BA (Appendix D).

Florida Scrub-Jay

The Florida scrub-jay is a federally threatened bird endemic to open, oak-dominated scrub habitats of Florida. Widespread destruction and degradation of scrub habitat over the last century have resulted in dramatic declines in the distribution and abundance of this species. Because the scrub-jay is intimately tied to open, oak-dominated scrub, conservation of the species depends upon restoration of sufficient optimal habitat to support large populations. Populations of this species that remain are small, demographically isolated, and likely to decline. One of three core populations that contains over half of the State's remaining scrub-jays is found at KSC/CCAFS (45 SW 2018).

Since the majority of CCAFS is or could be scrub-jay habitat, land-clearing activities have the potential to adversely impact scrub-jays and their habitat. Management actions for scrub-jays on CCAFS are primarily oriented toward habitat improvement. USFWS has designated CCAFS as part of a core scrub-jay area, indicating that all scrub habitat on CCAFS is highly valuable to the recovery of the species. Consultations between USFWS and USAF led to the development of a Scrub-Jay Management Plan for CCAFS and includes a requirement to mitigate loss of scrub or potential scrub at a ratio of 2:1. A Scrub Habitat Restoration Plan was developed subsequent to the management plan and provides a strategy for restoring the scrub habitat needed by this species. The CCAFS land area is divided into Land Management Units (LMU), which are used to account for and manage many items including scrub-jay populations and burn strategies. The objective of scrub habitat restoration on CCAFS is to restore the over-mature scrub to a condition suitable to support the Florida scrub-jay. The main methods used for habitat restoration are mechanical treatment and prescribed burning of mechanically treated sites within the LMU. No land management has occurred east of ICBM Road near the Proposed Action area.

USAF conducts a yearly census of the Cape Canaveral population of scrub-jays in all suitable accessible jay habitat. In 2018, 136 Florida scrub-jay groups were identified, which has varied from 104 groups in 2000 to 157 groups in 1996 and 1997 (Figure 3-3 and Figure 3-4). Data from the 2018 census did document a single group just east of ICBM Road but over 1,300 feet west of the Proposed Action boundary (Figure 3-5).

Southeastern Beach Mouse

The southeastern beach mouse is a federally threatened subspecies that historically existed on coastal dunes and coastal strand communities from Ponce Inlet (Volusia County) south to Hollywood, Florida (Broward County) (Humphrey et al. 1987). Currently, the southeastern beach mouse is restricted to predominantly federal lands encompassing and adjacent to CCAFS, KSC, CNS, MINWR, and a few locations on Pelican Island National Wildlife Refuge and Sebastian Inlet State Park (Oddy et al., 2012). Reasons for decline in southeastern beach mouse populations include habitat loss due to development and erosion, habitat fragmentation, isolation, competition from the house mouse, and predation from domesticated cats (Stout, 1992). This species is a high priority for management on federal lands encompassing the Cape Canaveral Barrier Island Complex (CCBIC), which includes KSC/MINWR, CCAFS, and CNS.

On CCAFS, the mice occur from the coastal dunes inland to the west side of Samuel C. Phillips Parkway and are generally found where the sand is suitable for burrows, coastal scrub is present, and the water table is not close to the surface. While inland populations may be more stable, their abundance varies from site to site inland of the dune system. However, nearly every coastal scrub site surveyed on CCAFS could support the beach mouse.

A long-term sampling grid (BG3) is north of the Proposed Action area but within the RPA Boundary as well as a 2011 to 2012 random coastal point referred to as 18 (Figure 3-6).

Southeastern beach mice were captured at these locations during the 2011 to 2012 sampling period (Oddy et al. 2012). Sampling conducted in 2018 did not detect the presence of this species (Oddy and Stolen 2018) (Figure 3-7), and results of the sampling determined a habitat occupancy rate of 0.72 percent of CCBIC coastal habitat was occupied. More importantly, several southeastern beach mice were captured inside the SLC-20 Blockhouse (Facility 18800) in 2001 (ESC, 2002). As a result, the presence of this species has been confirmed within the Proposed Action boundary as well as within the RPA boundary area.

Eastern Indigo Snake

The eastern indigo snake is a federally threatened species and the longest of North American snakes, reaching a length of over 8 feet. It is found in a diversity of habitats and is closely associated with gopher tortoise burrows, which it uses for shelter during cold weather and extremely dry periods. Major threats to the indigo snake on CCAFS are habitat loss and vehicle traffic. The eastern indigo snake is a top carnivore and feeds on other snakes, frogs, salamanders, toads, small mammals, and birds and can have a home range of over 200 acres (USAF, 2018a). The eastern indigo snake has been observed on CCAFS and likely occurs throughout the installation; however, exact numbers are not known. The breeding season occurs between November and April with egg-laying occurring May through June with hatchlings emerging in late July through October. An installation-wide census for the eastern indigo snake has not been completed.

This species has the potential to occur within the Proposed Action boundary based on the abundance of gopher tortoise burrows. This species is also likely to occur within the RPA boundary area due to the habitat type and presence of gopher tortoise burrows.

Marine Turtles

Four species of federally protected sea turtles have been documented as nesting on CCAFS: the loggerhead (*Caretta caretta*), green (*Chelona mydas*), leatherback (*Dermocheyls coriacea*), and the Kemp's ridley (*Lepidochelys kempii*) sea turtle. Nests are deposited on CCAFS each year between April and September. Each year, between 1,400 to 3,600 sea turtle nests are deposited on the 13 miles of beach at CCAFS based on nest surveys at CCAFS from 1986 through 2018 (Figure 3-8) (USAF 2018b).

Figure 3-3 2018 Florida Scrub-Jay Census Map

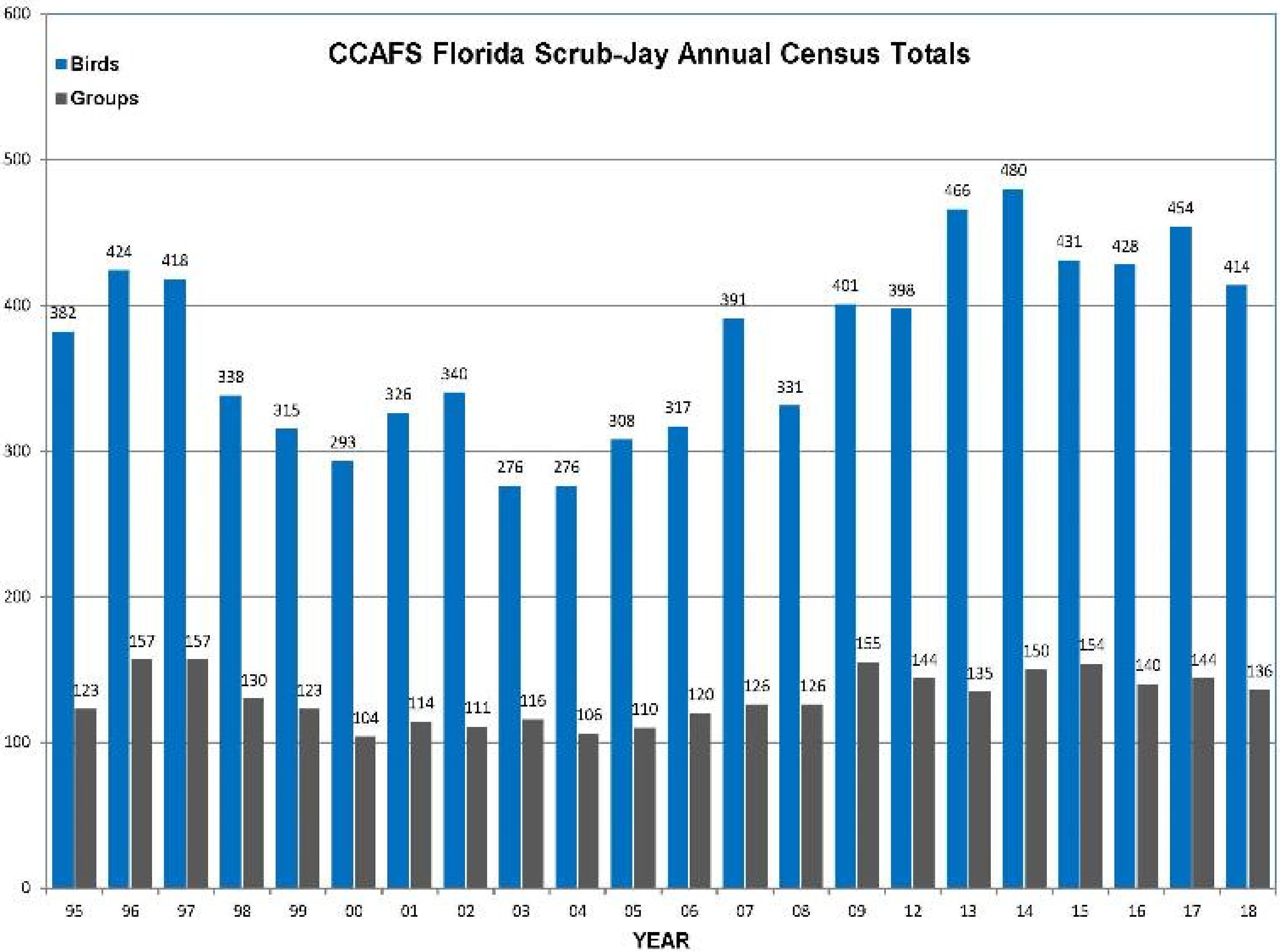


Figure 3-4 CCAFS Florida Scrub-Jay Annual Census Totals (45 Space Wing 2019)

Figure 3-5 Proposed Florida Scrub-Jay Habitat Impacts and Census Data

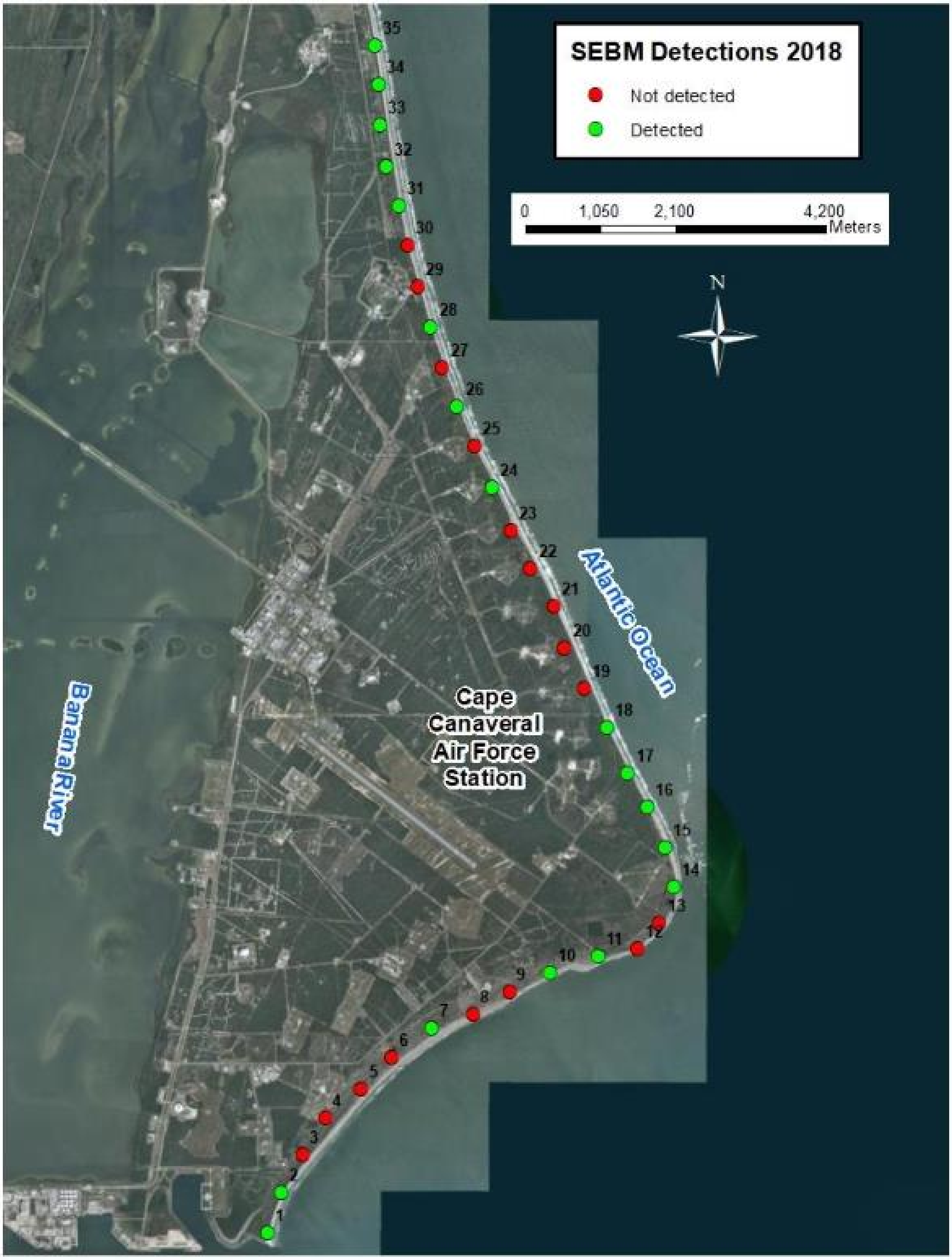


Figure 3-6 2018 Southeastern Beach Mice Detection Location Map

(Green circles indicate that beach mice were detected at a site, and red circles indicate no detection at a site. Numbers indicate site locations.) (Oddy and Stolen 2018)

Figure 3-7 Land Management Units (Blue), Long-Term Grids (Green), and Random Coastal Points (Red) on CCAFS Where Small Mammal Trapping Occurred in Fall 2011 and Spring 2012

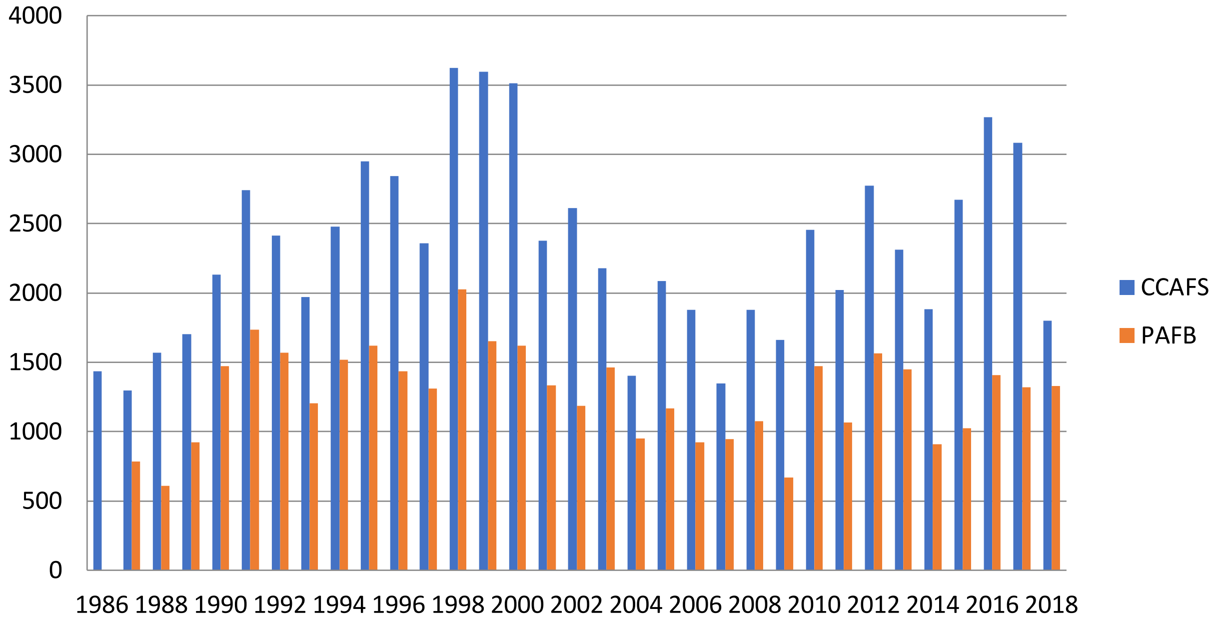


Figure 3-8 All Sea Turtle Nests Deposited at CCAFS and PAFB

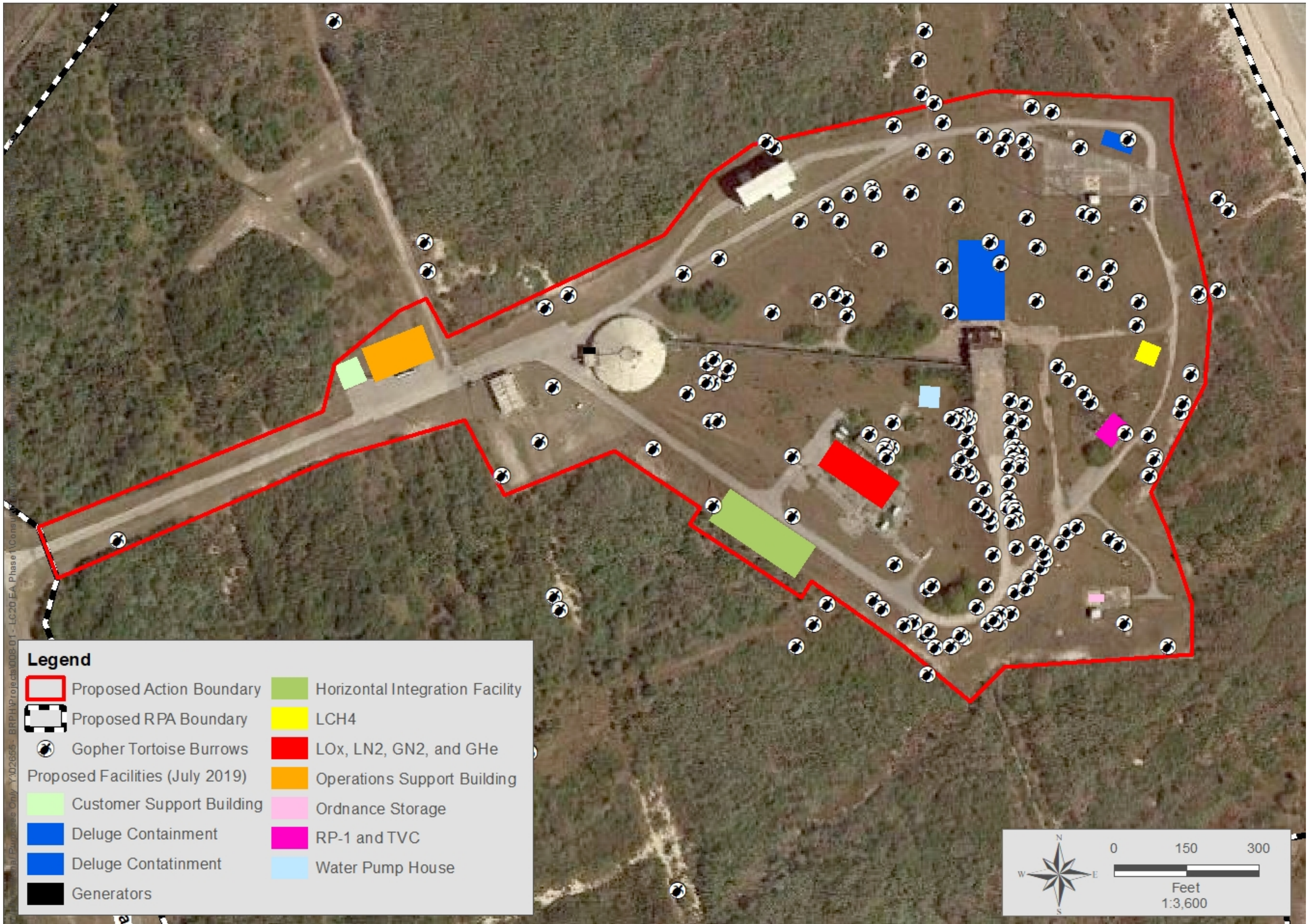
Although sea turtles spend much of their lives in the ocean, females come ashore each year to nest. Preliminary research indicates that lights adjacent to sea turtle nesting beaches may hinder the beach nest site selection of nesting females. Regarding sea turtle hatchlings, extensive research has demonstrated that the principal component of the emergent sea turtle hatchlings' orientation behavior is visual (Carr and Ogren, 1960; Dickerson and Nelson, 1989; Witherington and Bjorndal, 1991). Artificial beachfront lighting has been documented to cause disorientation (loss of bearings) and misorientation (incorrect bearing) of hatchling turtles.

In 1988, in compliance with Section 7 of the ESA, USAF developed Light Management Plans (LMPs) for various areas and facilities on CCAFS to protect sea turtles. A BO issued by USFWS in April 1991, with several subsequent revisions, requires LMPs for any new facilities that are close to the beach, are not constructed in accordance with 45 Space Wing Instruction (SWI) 32-7001, have lighting directly visible from the beach, and/or may cause significant sky glow. The BO was modified again in 2008 and authorized a 3-percent take of nesting females and up to 3 percent of all hatchlings disoriented/misoriented from a representative sample of all surveyed marked nests. The BO also requires at least five night-light surveys at CCAFS and PAFB during the peak of nesting season (May 1 through October 31). Currently, no exterior lighting operates at SLC-20, and no disorientation has been documented on the beach in this area for several years.

Gopher Tortoise

The gopher tortoise is a State-listed threatened species by FWC and is protected by State law, Chapter 68A-27, Florida Administrative Code (FAC). The gopher tortoise is also currently classified as a *Category 2 Candidate Species* by USFWS under the ESA. The basis of the *Threatened* classification by FWC for the gopher tortoise is due to habitat loss and destruction of burrows. The gopher tortoise can live up to 80 years in the wild and occurs in upland habitats such as sandhills, pine flatwoods, scrub, scrubby flatwoods, dry prairies, xeric hammock, pine-mixed hardwoods, and coastal dunes. Gopher tortoises will dig and use several burrows during the warm months and burrows can range from 3 to over 50 feet (0.9 to 15 m) long. These burrows provide refuge for more than 350 other commensal species such as small mammals, frogs, mice, snakes, and insects.

In July 2019, a pedestrian gopher tortoise survey was completed for approximately 90 percent of the Proposed Action area and approximately 60 percent of high probability habitat in the RPA boundary. Within the Proposed Action area, a diversity of burrow sizes was observed, from juveniles to large adults, with over 160 potentially occupied (PO) burrows observed within the boundary and 35 observed outside the boundary (Figure 3-9).



1 **Figure 3-9 Proposed Action Boundary PO Gopher Tortoise Burrow Location Map**

Figure 3-10 Proposed RPA Boundary Area PO Gopher Tortoise Burrow Location Map

3.4 CULTURAL RESOURCES

Historical and cultural resources include prehistoric and historic sites, man-made structures, buildings, and remnants of legacy launch vehicles districts, artifacts, or any other physical evidence of human activity considered important to a culture or community for scientific, traditional, religious, or any other reasons. The ROI for the historical and cultural resources for the Proposed Action includes the legacy SLC-20 area and extends to the balance of the entire 220 acres (89 ha) area proposed for the real property transfer between 45 SW and Space Florida.

An extensive array of federal and state laws exist that require analyses of possible effects to cultural resources during the planning, design, and construction on federal lands and elsewhere. These laws and regulations prescribe the responsibilities and coordination between the federal agency where the Proposed Action would occur and stakeholder agencies having review and comment authority over the Proposed Action. These agencies include the State Historic Preservation Officer (SHPO), Tribal Historic Preservation Officers (THPOs), and Advisory Council on Historic Preservation (ACHP). Specific laws pertaining to the treatment of cultural resources are Sections 106 and 110 of the National Historic Preservation Act (NHPA), Archaeological Resources Protection Act (ARPA), American Indian Religious Freedom Act (AIRFA), and Native American Graves Protection Act (NAGRA). AFI 32-7065, *Cultural Resources Management*, provides guidelines for the protection and management on USAF-managed lands.

Only those cultural resources that are determined to be significant or potentially significant under the regulations cited are subject to protection from adverse impacts from a Proposed Action. To be considered significant, a cultural resource must meet one or more of the criteria established by the NPS that would make the resource eligible for inclusion in the NRHP. The phrase “eligible for inclusion” includes all properties that meet the NRHP listing criteria, which are specified in the Department of the Interior regulations cited in Title 36 CFR 60.4 and NRHP Bulletin 15. Any property considered prehistoric, historic, or considered to be traditionally significant are collectively referred to as “historic properties.”

3.4.1 Archaeological and Historic Resources

Archaeological

Research suggests that Florida experienced its first human occupation as early as 15,000 years ago. Cape Canaveral has a long record of human occupation, which is reflected by the presence of numerous prehistoric and historic sites that are part of the area’s rich archaeological heritage. Human occupation at Cape Canaveral spans from the first Native Americans approximately 5,000 years ago (Doran et al. 2014). This early settlement had its focus within the Banana River Lagoon (BRL) salt-marsh area with evidence of a wider distribution of inhabitance into the entire peninsula with utilization of marine, estuarine, and terrestrial resources. Prehistoric inhabitance in the vicinity of CCAFS include the following periods: Archaic Period, Mt. Taylor Period, Orange Period, Transitional Period, Malabar I, IIA, and IIB Periods, and Protohistoric or Seminole Period.

In Florida, the Middle Archaic (circa 5,000 BC) witnessed increased population growth and reliance on marine resources. Sites were expanded into the St. Johns River area, along the Atlantic coastal strand, and along the southwest Florida coast into south Florida (Milanich 1995). Maritime adaptations become increasingly apparent from 7,000 BC. Shellfish resources first appear in the archaeological record during the Middle Archaic. Extensive shell middens along the coast and canal systems connecting mangrove swamps were constructed by humans using the coastal zone. Middle Archaic sites, specifically shell middens, are plentiful and are found in a variety of locations in Florida (Milanich 1994). The Orange Period (2,000 to 500 BC) was noted for the first appearance of ceramics and, while still hunter-gatherers, saw increased sedentism with middens becoming commonplace. Malabar I saw villages with special use camps and even larger populations. Malabar II (AD 900 to 1565) saw the beginning of non-local objects, European artifacts, and evidence of wreck salvaging introducing the “Contact Period” (1500 to 1565).

Regarding the “Contact Period”, the Florida peninsula first appeared in cartography in 1502 on the Cantino map and in 1507 on the Waldseemuller map (Lydecker et al. 2011).

While it is unknown when Europeans first made contact with Florida’s native tribes, Juan Ponce de León made the first “authorized discovery” of Florida in 1513 (Griffin 1983; Turner 2013). Before that documented voyage, it is virtually certain that Spaniards were using Florida as a staging ground to capture slaves and possibly provision their ships, as had been practiced extensively in the Bahamas for some time. The exact location of Juan Ponce de León’s initial landfall remains unknown, but judging from the latitude recorded in his log the prior day it would have been somewhere close to present-day Ponte Vedra, north of St. Augustine. He claimed the “island” for Spain and named it La Florida because it was the season of Pascua Florida (“Flowery Easter”) and because much of the vegetation was in bloom.

Like other conquistadors in the Americas, Ponce de León was likely looking primarily for gold, Indians to enslave, and land to govern under the Spanish crown. Accounts of the Ponce de Leon voyage describe interactions with the Ais Indians, the tribe occupying the Central East Coast of Florida, including Cape Canaveral, at the time (Rouse 1951). The Ais were one of the most powerful tribes in Florida at the time of the first Spanish contact. Their settlements were numerous but dwellings temporary, reflective of their hunter-gatherer lifestyle.

Traditional resources associated with the Ais include archaeological sites, mounds, burial sites, ceremonial areas, caves, and plant habitat and gathering areas including any sites that would have religious or heritage significance. These traditional resources could be considered significant traditional cultural properties (TCPs), are subject to the same regulations as other historic properties, and are therefore afforded the same protection. No Ais Indians remain, but their traditional culture is represented by the Seminole and Miccosukee Tribes of Indians in Florida. During a site visit to CCAFS in 2011, the Seminole Tribe of Florida and Seminole Nation of Oklahoma verbally stated that they have no TCPs on CCAFS. (45 SW Cultural Resource Manager [CRM], personal communication to W. Puckett, September 2019) The 45 SW updated its Installation Cultural Resource Management Plan (ICRMP) in 2015, which also stated that no TCPs are present at CCAFS.

Historic

Cape Canaveral played a role as a prominent landmark in nearly every era of recorded history in the New World but was not permanently occupied to any great extent until relatively recently. As a sign of its ephemeral early occupation, a Town of Canaveral is shown in different locations on maps in the last 150 years, following the focus of residential development. Historical occupations include First Spanish (1513 to 1763), British (1763 to 1783), Second Spanish (1783 to 1821), American Territorial (1821 to 1842), Early Statehood (1842 to 1861), Civil War (1861 to 1865), Reconstruction and Late Nineteenth Century (1865 to 1899), and Twentieth Century (1900+).

Cape Canaveral is now in Brevard County, which has changed boundaries several times. Brevard County was formed on March 14, 1844, from a segment of Mosquito County (Orange County). Brevard County, called St. Lucie County until 1854, was named for the Florida State Comptroller at the time, Theodore W. Brevard. Titusville, the County seat, had early roots as the community of Sand Point, which was formed to serve early settlers lured to the area by homestead land grants through the Armed Occupation Act of 1842.

According to the 45 SW ICRMP, the federal government began buying land from the state in Cape Canaveral in the late 1940s to establish a long-range proving ground. A committee was formed by the DoD in 1946 with the task of finding a suitable missile test center; subsequently, the Long-Range Proving Ground on Cape Canaveral was established in 1949 under the jurisdiction of USAF (USAF 2015a). Important factors for the committee choosing Cape Canaveral included the weather, geographical isolation, low land prices, existence of government-owned property in the area, and proximity to islands in the West Indies and South Atlantic, which could be used for tracking missiles. By 1948, CCAFS was firmly established as a launch site for USAF (USAF 2015a). An extensive history of CCAFS space operations can be found in works by USAF and Pan American World Airways, Inc. (1974) and Mark C. Cleary (1994). This land has had numerous names under government ownership including Cape Canaveral (1950 to 1963), Cape Kennedy (1963 to 1974), Cape Canaveral (1974 to 1994), and CCAFS (1994 to present).

3.5 AIR QUALITY

Air quality at CCAFS is regulated under Federal Clean Air Act regulations (Title 40 CFR Parts 50 through 99) and FAC Chapters 62-200 through 62-299. The US Environmental Protection Agency (USEPA), under the authority of the Clean Air Act, as amended, has established nationwide air quality standards known as the National Ambient Air Quality Standards (NAAQS). The NAAQS represent the maximum allowable atmospheric concentrations of health-based criteria and are referred to as "criteria pollutants." These criteria pollutants include carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide SO_2), particulate matter (PM) 10 micrometers or less in diameter (PM10), and PM 2.5 micrometers or less in diameter (PM2.5). The NAAQS are further broken down into two categories, the National Primary Standards and National Secondary Standards. The Primary NAAQS provide public health protection including the health of "sensitive" populations including the elderly, children, and persons with asthma. The Secondary NAAQS provide general public welfare protection against decreased visibility, damage to animals, crops, vegetation, and buildings. Table 3-4 lists the NAAQS.

Table 3-4 Federal National Ambient Air Quality Standards

Pollutant	Average Time	Federal Primary NAAQS	Federal Secondary NAAQS
CO	8-hour	9 ppm	N/A
	1-hour	35 ppm	N/A
Pb	Rolling 3-month Average	0.15 $\mu g/m^3$	0.15 $\mu g/m^3$
NO_2	1-hour	100 ppb	N/A
	Annual	53 ppb	53 ppb
O_3	8-hour	0.07 ppm	0.07 ppm
$PM_{2.5}$	Annual	12 $\mu g/m^3$	15 $\mu g/m^3$
	24-hour	35 $\mu g/m^3$	35 $\mu g/m^3$
PM_{10}	24-hour	150 $\mu g/m^3$	150 $\mu g/m^3$
SO_2	1-hour	75 ppb	N/A
	3-hour	N/A	0.5 ppm

Source: USEPA 2019.

Notes: $\mu g/m^3$ = micrograms per cubic meter of air; ppb = parts per billion; ppm = parts per million

The State of Florida has a statewide network of air-quality monitoring. The focus of this network is the management of air quality throughout the state with a focus on those areas where ambient air quality standards are at risk of being violated and areas where the ambient standards are being met but are at risk due to potential growth in the populations of those areas or industrial growth. Regional air quality in Florida is assessed at county level; Brevard County is designated as "in attainment" with the NAAQS. The term "in attainment" refers to areas with concentrations of criteria pollutants that are below the levels established by the NAAQS. If the concentration of one or more criteria pollutant in an area exceeds the levels established by the NAAQS, the area may be classified as a "non-attainment" area. Since Brevard County is in attainment for all regulated criteria pollutants, no conformity determination is required for the Proposed Action.

Table 3-5 summarizes air emissions for 2012 through 2016 for CCAFS of actual tons per year of the NAAQS-regulated criteria pollutants and total hazardous air pollutants (HAPs).

Table 3-5 History of Actual Annual Emissions (Tons per Year) at CCAFS

Pollutant	Year				
	2016	2015	2014	2013	2012
CO	11.66	10.75	9.83	10.95	19.47
Pb	0.000033	-	-	-	-
NO_2	42.21	36.28	33.56	35.79	73.58
$PM_{2.5}$	3.00	2.59	2.66	2.63	5.20
PM_{10}	2.76	2.31	2.21	2.29	5.03
HAPs	0.02	0.03	0.03	0.03	0.15
VOCs	3.35	2.86	2.69	2.84	6.22

Source: FDEP 2019.

Notes: VOCs = volatile organic compounds.

With respect to ozone depleting chemicals (ODCs), use of ODCs at CCAFS is strictly prohibited and will not be used as part of any construction or operation occurring at the proposed reconstruction of SLC-20.

3.6 CLIMATE

3.6.1 Regional Conditions

Climate is a term which refers to the long-term regional and/or global average of temperature, humidity, and rainfall patterns over long periods. In the mid-latitudes where Brevard County is located, the meteorological conditions result in one of the most diverse ecosystems in North America due to the rare combination of climates. Brevard County is exposed to a temperate climate from the north and a warm subtropical climate to the south creating favorable conditions for a wide variety of floral and faunal ecosystems. The climate in the region is characterized by hot, humid, summers with temperatures in the mid-to-upper 90 degrees Fahrenheit (°F) (32 degrees Celsius [°C]). Winters are mild with daytime temperatures ranging from 60 to 70°F (15 to 21°C); occasionally, temperatures fall to freezing levels in January and February.

Hurricane season occurs from June through November with a majority of hurricanes developing between August and October. The peninsula of Florida is surrounded by the Atlantic Ocean and Gulf of Mexico; therefore, oceanic currents contribute to the State's weather, creating atmospheric conditions suitable for spawning thunderstorms, lightning, and periodically hurricanes. Humidity in the region is highly variable with relative humidity in the summer being between 70 and 90 percent. During non-summer months, the relative humidity is high in the morning, averaging 90 percent, but dropping to between 55 and 65 percent in the afternoons.

Regarding precipitation, average annual rainfall in the Brevard County area is approximately 52 inches per year (125 cm) with 70 percent occurring between May and October primarily due to afternoon thunderstorms (NASA 2013). The maximum rainfall months are August and September with an average of 7.6 inches (17.5 cm) of rain; conversely, the least amount of rain falls in January with an average of 2.3 inches (5.8 cm) (Weather Atlas 2019).

The principal meteorological conditions that control dispersion are winds and turbulence (or mixing ability) of the lower atmosphere. In the mid-latitudes where CCAFS is located, the lower atmosphere (troposphere) extends 6.2 to 7.5 miles, (10 to 12 km) above the earth's surface to the bottom of the stratosphere. Wind speed and direction are variable and correlated with seasonal meteorological conditions. Winds during the summer are predominantly from the south and southeast and become more easterly in the fall. During the winter, winds are typically from the north and northwest. Uneven solar heating of land and water during the summer causes a sea breeze (from ocean to land) during the day and a land breeze (from land to ocean) at night. 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 therefore pollutant dispersion increases. In general, stable conditions occur most frequently during the nighttime and early morning.

3.6.2 Global Climate

Greenhouse gases (GHGs) are gases that trap heat in the atmosphere. The primary GHGs of concern are CO_2, methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride (SF6). These emissions occur from natural processes and human activities. According to the FAA Order 1050.1F Desk Reference, climate change is a global phenomenon that can have local impacts (FAA 2015). Scientific measurements show that the earth's climate is warming, with concurrent impacts including warmer air temperatures, increased sea-level rise, increased storm activity, and an increased intensity in precipitation events.

The six reporting facilities in Brevard County had a total of 3,222,445 metric tons of carbon-dioxide equivalent (CO_2e) emissions in 2017 (USEPA 2020). (GHG emissions are often measured in carbon-dioxide equivalent, which is calculated by multiplying emissions by the gas's global warming potential.) The majority (i.e., 97 percent) of those emissions in Brevard County, specifically 3,124,301 metric tons of CO_2e, were associated with the power plant and waste sectors (USEPA 2020).

3.7 HAZARDOUS MATERIALS AND HAZARDOUS WASTE

The ROI for potential impacts from hazardous material, solid waste, and pollution prevention includes the areas within and around SLC-20.

3.7.1 Hazardous Material and Hazardous Waste

Hazardous materials are any substance or material that has been determined to pose substantial or potential threats to public health or the environment when transported in commerce (49 CFR Part 172). This includes a subset of solid wastes that meet the criteria identified in 40 CFR Parts 260 and 261, hazardous substances and hazardous wastes. Hazardous substances are any element, compound, mixture, solution, or substance defined as a hazardous substance under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and listed in 40 CFR Part 302. If released into the environment, hazardous substances may pose substantial harm to human health or the environment. Hazardous wastes have characteristics as defined by the RCRA in 40 CFR Part 261 which *… may (a) cause, or significantly contribute to, an increase in mortality or an increase in…illness or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of or otherwise managed*. Hazardous waste is further defined as any solid waste that possesses hazardous characteristics of toxicity, ignitability, corrosivity, or reactivity, or is specifically listed as a hazardous waste in Subpart D of 40 CFR Part 261.

USEPA regulates hazardous chemicals, substances, and wastes under RCRA, CERCLA, and the Toxic Substances Control Act (TSCA). These regulations provide requirements for the generation, storage, transportation, treatment, handling, and disposal of hazardous materials and hazardous waste. USEPA and various states also have regulations regarding the operation and maintenance of underground storage tanks and ASTs. In addition, OSHA has definitions and workplace safety-related requirements and thresholds for approximately 400 hazardous and toxic substances, and DOT has definitions and requirements for the safe transportation of hazardous materials. Numerous types of hazardous materials are currently used at CCAFS to support various space missions and general maintenance operations.

Individual contractors and organizations maintain their own hazardous waste satellite accumulation points and 90-day hazardous waste accumulation areas in accordance with RCRA. Any amount of hazardous waste can be stored at a 90-day hazardous waste accumulation area, but wastes must be disposed of off-site within 90 days. Under current RPAs, Space Florida would be responsible for the collection and transportation of hazardous wastes (including propellant waste) from the satellite accumulation areas to a 90-day hazardous waste accumulation area, then to an off-site permitted treatment, storage, and disposal facility. As specified under lease agreements and contracts, the contractors are under contract to reduce, where possible, the use of Class II Ozone-Depleting Substance and Environmental Planning and Community Right-to-Know Act (EPCRA) 313 chemicals.

Environmental Baseline Surveys (EBS) performed in 1998 and 2018 indicated that no hazardous substances were used or stored on site from 1998 through 2001 and according to the 2018 EBS, no hazardous waste was used or stored on site through 2018. No record of any spills exists in both EBSs. The 1998 EBS reported that in the early 1990s, SLC-20 was designated as a SWMU (# 043), which is discussed in further detail in Section 3.7.3. Since operations began in 1959 until at least 1965, hazardous materials were used on site. Storage and release of non-hazardous waste was also reported to have occurred from approximately 1978 to 1988. The UST (Facility 15500A-1) installed in 1966 (680 gallons) was removed as part of the RFI/IM efforts at the site. The IM included the excavation of 20 tons of associated petroleum- and metal-contaminated soils in addition to the removal of the UST. A complete list of all the materials used or stored on site is not available. However, the following items were documented to be associated with SLC-20:

- Diesel Fuel No 2.
- Hydrazine.
- LOX.
- Nitrogen Tetroxide.
- Kerosene.
- Trichloroethylene.

- Hydraulic fluid.
- Petroleum and petroleum products.

Paint used on the facilities and structures at this site is assumed likely to contain lead and PCBs. The presence of hazardous materials in the soil and groundwater is discussed more thoroughly in Section 3.7.3.

Future tenants would have operations that use products that could contain hazardous materials, including paints, solvents, oils, lubricants, acids, batteries, propellants, ordnance, and chemicals, which are routinely used at CCAFS. Proposed operations do not deviate from current CCAFS operations or introduce new or different hazardous materials or operations. Hazardous materials are transported in accordance with FDOT regulations for shipping hazardous substances. Ordnance is transported to and stored at Fuel Storage Area 2 until ready for use. Hazardous materials, such as liquid rocket propellant, are transported and stored in specially designed containers to reduce the potential of an exposure.

Management of hazardous materials and petroleum-related fuels is the responsibility of each organization on CCAFS. RCRA requirements would be accomplished by the directives listed in the respective permits issued to KSC or CCAFS (Installation Emergency Management Plan 10-2, 45 SW Management Plan 19-14, and KSC Handbook [KHB] 8800.6). No sites at CCAFS are listed or under consideration for listing on the National Priorities List (USEPA 2013).

USAF provides emergency spill response that is beyond the user's response. Space Florida's tenant will prepare an Emergency Response Plan for its launch program in accordance with the CCAFS Hazardous Materials Emergency Response Plan. The CCAFS Hazardous Materials Emergency Response Plan ensures that adequate and appropriate guidance, policies, and protocols regarding hazardous material incidents and associated emergency response are available to and followed by all personnel and commercial entities.

In addition, Space Florida's tenant(s) would develop a site-specific SPCCP for petroleum-related storage tanks and systems, including USTs or ASTs containing petroleum and diesel at SLC-20. According to the 1998 EBS, no ASTs or USTs are on site. However, the 2018 EBS found that one large white AST used to hold pressurized gases was on the paved access road near the guard shack. ASTs were known to be used to support the Titan Launch program and were installed behind protective berms. The 2018 EBS suspects that these tanks may have contained hydrazine, nitrogen-tetroxide, kerosene, or hydraulic fluid. The 2018 EBS also noted that three USTs were installed in 1959. A 280-gallon (1,060-L) steel tank and a 300-gallon (1,136-L) steel tank, both containing Fuel Oil No. 2, were removed in 1991. One 2,000-gallon (7,571-L) steel tank also containing Fuel Oil No. 2 was removed in 1998. The 1998 EBS also documented a 680-gallon (2,574-L) UST used with the Blockhouse boiler that has been inactive since 1966 and was scheduled for removal under the IRP. Whether this tank has been removed is unknown.

A generator would be needed to support the tenant's operations and keep critical equipment working and is estimated to support a duration of 3 days. This would require an AST sized to hold 3,200 gallons (12,113 L) of diesel fuel. As this AST is greater than 500 gallons (1,893 L), FDEP tank registration would be required, and the SPCCP discussed above would also include countermeasure plans for this tank.

3.7.2 Solid Waste

Solid waste, including non-hazardous refuse, trash, or garbage, consists of everyday items such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, and appliances. Alkaline batteries are considered universal waste and are handled separately. General solid refuse at CCAFS is collected by a private contractor and disposed of off-site at the Brevard County Landfill, a Class I landfill at 2250 Adamson Road in the City of Cocoa, Florida. According to the Brevard County website, the existing facility is expanding to develop additional capacity that can meet the needs for future decades. 45 SW also manages a recycling program for appropriate waste material from CCAFS sites. During the 2018 EBS, piles of old piping and refrigerant compressors were found near the former ready room.

3.7.3 Installation Restoration Program

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. The IRP efforts at CCAFS have been conducted in parallel with the program at PAFB and in close coordination with the USEPA, FDEP, and NASA KSC. CCAFS is not a National Priorities List site, and the IRP sites are being evaluated and remediated under RCRA authority while meeting the CERCLA regulations. FDEP has approved the 2019 soil remediation program at SLC-20.

The environmental status of each launch complex ranges from the identification of an area as an active potential release location (PRL), to an active SWMU, and then through assessment and remediation if required, to a closed or “no further action” (NFA) unit. A SWMU can be defined as any site that has had historical operations that had the potential to impact the environment. A RCRA Facility Assessment identifies releases or migration of contaminants from a SWMU. Figure 3-11 shows the locations of SWMU 043 and soil measurement of contaminants. The following provides a brief history of the remedial activities at SLC-20.

During launch activities from 1959 through 1965, several hazardous chemicals were stored and used at SLC-20, including trichloroethylene, fuels, hydrazine, LOX, nitrogen tetroxide, kerosene, hydraulic fluid, paints, lubricants, Freon, and PCBs. Based on generator knowledge, historical paint formulations used on launch structures included PCBs and lead. Routine sand-blasting activities following launches dispersed the PCBs throughout site surface soils. Additionally, paint delamination from the launch structure also contributed to PCB and lead contamination throughout the site.

Since SLC-20 became a SWMU in the early 1990s, numerous environmental assessments and remediation activities have occurred under the RCRA Facility Investigation (RFI) program. Since 2008, the IRP has conducted 5-year reviews of past investigation and data gaps. The 2013 review noted that PCBs in soils were above the industrial SCTL. These soils were generally around the former launch stand area. An ongoing dioxin/furan (compounds that occur when PCBs are heated or burned) study was also documented in the 2013 review. A Preliminary Assessment and Site Investigation were completed at SLC-20 from 1992 to 1995. Based on the results, a Resource Conservation and Recovery Act Facility Investigation (RFI) was initiated to fully evaluate the nature and extent of contamination at the site. Several IM soil removals were performed concurrently with the RFI in 1995 and 1998 to remove contaminated soil and sediment at SLC-20. Based on the RFI results, No Further Action was recommended for groundwater, surface water, and sediment, which was approved by FDEP on September 17, 1999. Based on recommendations from the Five-Year Review in 2008, additional soil sampling was performed to assess for PCBs and metals associated with paint coatings on historical launch structures at the site. Additional soil sampling was conducted along with removal of water and debris at the SLC-20 actuator pit in 2012. From 2015 to 2016, a Data Gap Investigation was performed to laterally and vertically delineate PCB contamination in soil in excess of the industrial SCTL along with sampling at one former substation location to determine if PCBs had leached to groundwater. A temporary groundwater monitoring well was installed and sampled at the location, and all results were less than the FDEP GCTLs for PCBs, thus No Further Action for groundwater was warranted. In addition, a study was performed for dioxin/furan compounds at the site. Dixon/furans compounds were suspected to co-exist with PCB soil contamination at the site based on heating/burning activities during launches. A soil removal was completed in 2019 to address remaining concentrations of PCBs and dioxin/furans in excess of the FDEP industrial SCTLs. Remaining soils are now safe for re-use under industrial land-use scenarios. An interim remediation action was developed and published in 2017, which outlined removal of those soils above the SCTL (Figure 3-11). Under the RFI program and managed by USAF IRP, soil remediation activities were completed in mid-2019.

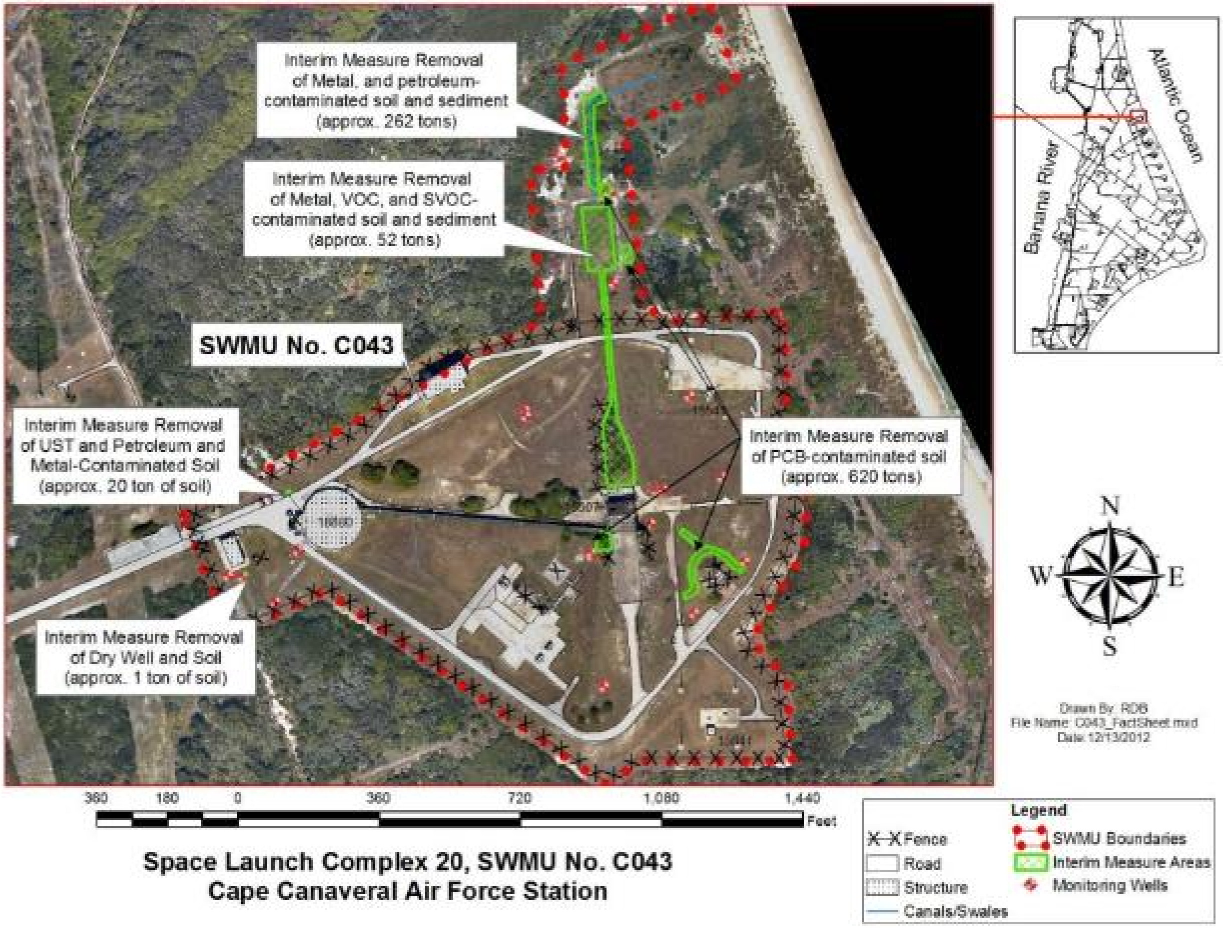


Figure 3-11 Soil Contamination Location Map for SWMU No. C043 (USAF 2013)

3.7.4 Pollution Prevention

Pollution prevention is any practice that reduces, eliminates, or prevents pollution at its source. This can be done by modifying production processes, promoting the use of non-toxic or less toxic substances, implementing conservation techniques, and re-using materials rather than putting them into the waste stream. EO 12088, Federal Compliance with Pollution Control Standards, directs federal agencies to comply with *applicable pollution control standards* in prevention, control, and abatement of environmental pollution and to consult with USEPA, state, and local agencies concerning the best techniques and methods available for prevention, control, and abatement of environmental pollution.

Environmental implications of all projects must be considered during the design phase, and designs must be developed that minimize or eliminate environmental liability. Pollution prevention environmental analysis for a project must be included and performed early in the design phase. The environmental analysis should focus on any potential pollution that may result from the proposed project and must include requirements in the design that promote pollution prevention measures whenever feasible. Designs could also include sustainability initiatives including but not limited to energy conservation, water conservation, and use of recycled or reclaimed content. Where pollution cannot be prevented, the environmental analysis would include requirements that promote recycling, energy recovery, treatment, and environmentally safe waste disposal practices.

Space Florida's tenant(s) will develop a pollution prevention plan containing methods and processes that meet USAF and local requirements.

3.8 WATER RESOURCES

3.8.1 Surface Waters

Water resources include groundwater, surface waters, wetlands, and floodplains and their physical, chemical, and biological characteristics. CCAFS is within the Florida Middle East Coast Basin watershed and situated on a barrier island that separates the BRL from the Atlantic Ocean. This basin contains three major water bodies: the BRL to the immediate west, Mosquito Lagoon to the north, and the IRL to the west of Merritt Island. The BRL has been designated a Class III surface water; a designation under the Clean Water Act that intends for a level of water quality suitable for recreation and the production of fish and wildlife communities. In addition, several water bodies in the Middle East Coast Basin have been designated as Outstanding Florida Waters in Chapter 62-3, FAC, including most of the Mosquito Lagoon and the BRL, Indian River Aquatic Preserve, Banana River State Aquatic Preserve, Pelican Island National Wildlife Refuge, and the CNS. As a result of this designation, these water bodies are afforded a higher level of regulatory protection. In addition, in 1990 the IRL system was designated as an Estuary of National Significance under the USEPA's National Estuary Program.

Figure 3-1 depicts a small man-made surface water that historically served as a stormwater treatment swale. No other surface waters occur within the existing SLC-20 boundary.

3.8.2 Groundwater

The surficial and the Floridan aquifer systems underlie CCAFS. The surficial aquifer system (SAS), which is comprised generally of sand and marl, is unconfined and approximately 70 feet (21.3 m) thick. The SAS is recharged by infiltration of precipitation through the thin vadose zone. Assuming negligible runoff, the amount of recharge is approximately equal to the amount of precipitation minus the amount returned to the atmosphere through evaporation and transpiration (NASA 2013). Overall SAS groundwater flow direction at SLC-20 is predominantly to the south and southwest under a relatively flat hydraulic gradient. Depth to the SAS varies but is approximately 3.3 feet (1 m) (GEAR 2019).

The Floridan aquifer is the primary source of potable water in central Florida and contains water under artesian conditions. It is confined by the clays, sands, and limestones of the overlying Hawthorn Formation which is approximately 80 to 120 feet (24.4 to 36.6 m) thick. Water enters the Floridan aquifer near the center of the Florida peninsula and moves laterally toward the coasts. In the vicinity of CCAFS, groundwater in the Floridan aquifer flows to the northeast.

3.8.3 Wetlands

Wetlands are defined in AFI 32-1067, Water and Fuel Systems (February 2015), as those areas *…that are inundated by surface or ground waters that support plants and animals that need saturated or seasonally saturated soil to grow and reproduce. Wetlands include swamps, marshes, bogs, sloughs, mud flats and natural or manmade ponds*. Wetlands are some of the most biologically productive of all habitats. Wetlands are protected under Section 404, Waters of the US, the Clean Water Act via the US Army Corps of Engineers (USACE), as well as by the State of Florida via the state water management districts (WMDs) and FDEP. EO 11990 requires avoidance, to the extent possible, of 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.

No USACE or St. Johns River Water Management District (SJRWMD) jurisdictional wetlands occur within the Proposed Action boundary.

3.8.4 Floodplains

Floodplains are lowland and relatively flat areas adjoining inland and coastal waters and other flood-prone areas such as offshore islands. These flood hazard areas are identified on Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs) and are referred to as a Special Flood Hazard Area (SFHA). SFHAs are defined as the area that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year. The 1-percent annual chance flood is also referred to as the base flood or 100-year flood. SFHAs are labeled as ‘Zones,’ several of which are east of, but not within, the Proposed Action area:

- Zone AE – The base floodplain where base flood elevations are provided. AE Zones are now used on new format FIRMs instead of A1-A30 Zones.
- Zone AO – River or stream flood hazard areas, and areas with a 1 percent or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. These areas have a 26 percent chance of flooding over the life of a 30-year mortgage. Average flood depths derived from detailed analyses are shown within these zones.
- Zone VE – Coastal areas with a 1 percent or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26 percent chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
- Zone X – Area of minimal flood hazard, usually depicted on FIRMs as above the 500-year flood level.

DOT has implemented EO 11988 through policies and procedures documented in DOT Order 5650.2, Floodplain Management and Protection. DOT Order 5650.2 defines the natural and beneficial values provided by floodplains to include *natural moderation of floods, water quality maintenance, groundwater recharge, fish, wildlife, plants, open space, natural beauty, scientific study, outdoor recreation, agriculture, aquaculture, and forestry.* No floodplains occur within the Proposed Action boundary (Figure 3-12).

3.9 GEOLOGY AND SOILS

CCAFS topography consists of a series of relic dune ridges formed by wind and wave action. The higher naturally occurring elevations occur along the east portion of CCAFS, with a gentle slope to lower elevations toward the marshlands along the BRL. Topography at CCAFS is relatively flat with elevations that range from sea level to 15 feet (4.6 m) above mean sea level (MSL). The geology underlying CCAFS can be generally defined by four stratigraphic units: surficial sands, Caloosahatchee Marl, Hawthorn Formation, and limestone formations of the Floridan aquifer. The surficial sands immediately underlying the surface are marine deposits that are typically approximately 10 to 30 feet (3 to 9.1 m) below the surface. The Caloosahatchee Marl underlies the surficial sands and consists of sandy shell marl that extends to 70 feet (21.3 m) 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 (24.4 to 36.6 m) thick, typically extending to approximately 180 feet (54.9 m) below the surface. Beneath the Hawthorn Formation lie the limestone formations of the Floridan aquifer, which extend several thousand feet below the surface of CCAFS (USAF 2005).

The National Resources Conservation Service (NRCS 2014) identifies 11 different soil types within CCAFS, with the three dominant soil series being (1) Canaveral-Anclote Complex (48 percent), Canaveral-Urban Complex (11 percent), Welaka Sand (10 percent), and Palm Beach Sand (9 percent) (Figure 3-13). The most prevalent type of soil is Canaveral Sand. Canaveral soils are on moderately low ridges and consist of a mixture of light-colored quartz sand grains and multicolored shell fragments.

These dominant soil series are made up of nearly level and gently sloping ridges interspersed with narrow wet sloughs that generally parallel the ridges and extend the entire length of the County along the coast near the Atlantic Ocean. These soils are moderately well drained to excessively drained, and sandy throughout and exceptionally dry, even though the water table is often near the surface during rainy periods. Figure 3-14 provides an NRCS soils map of the Proposed Action site.

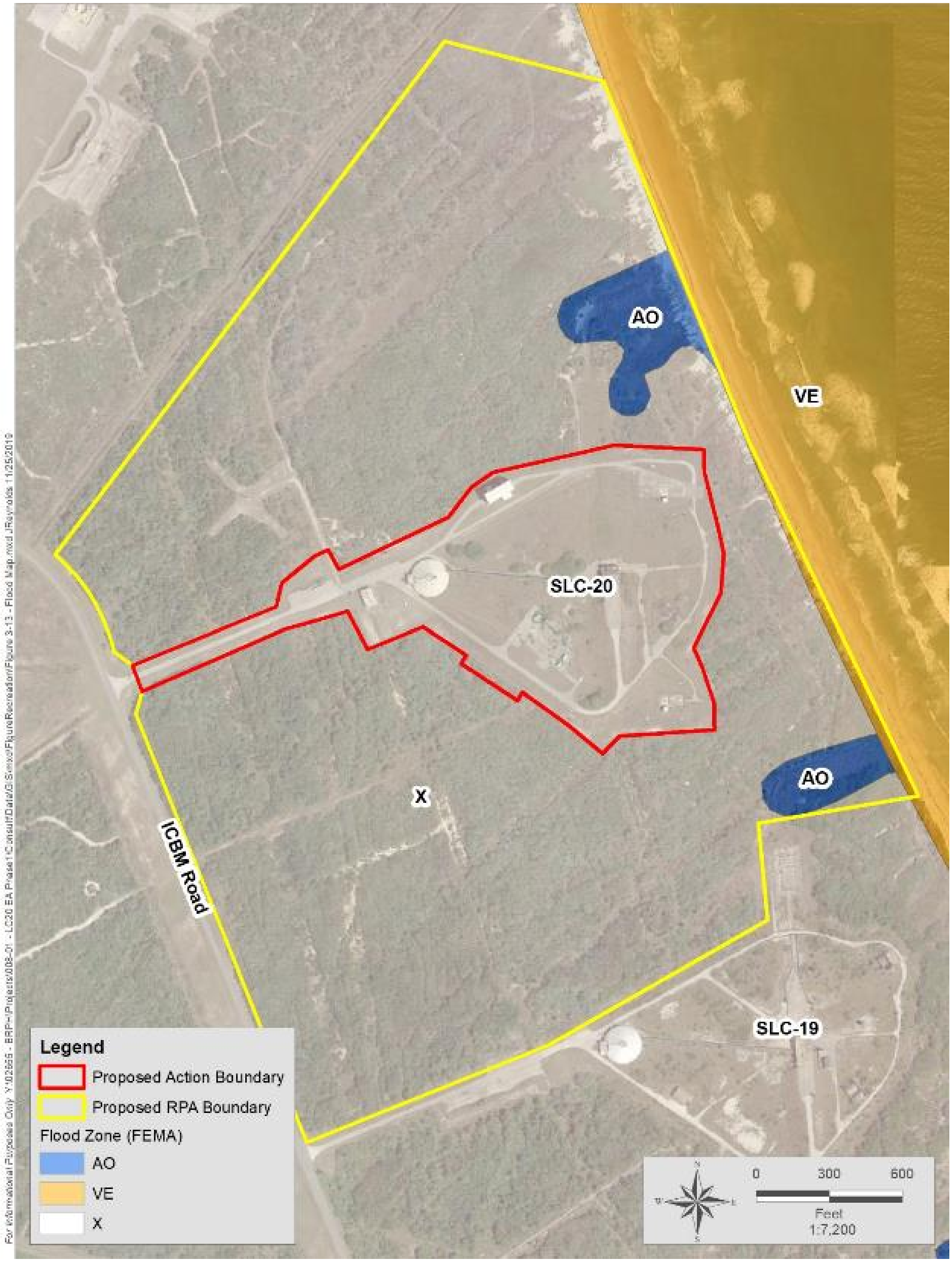


Figure 3-12 Floodplain Map

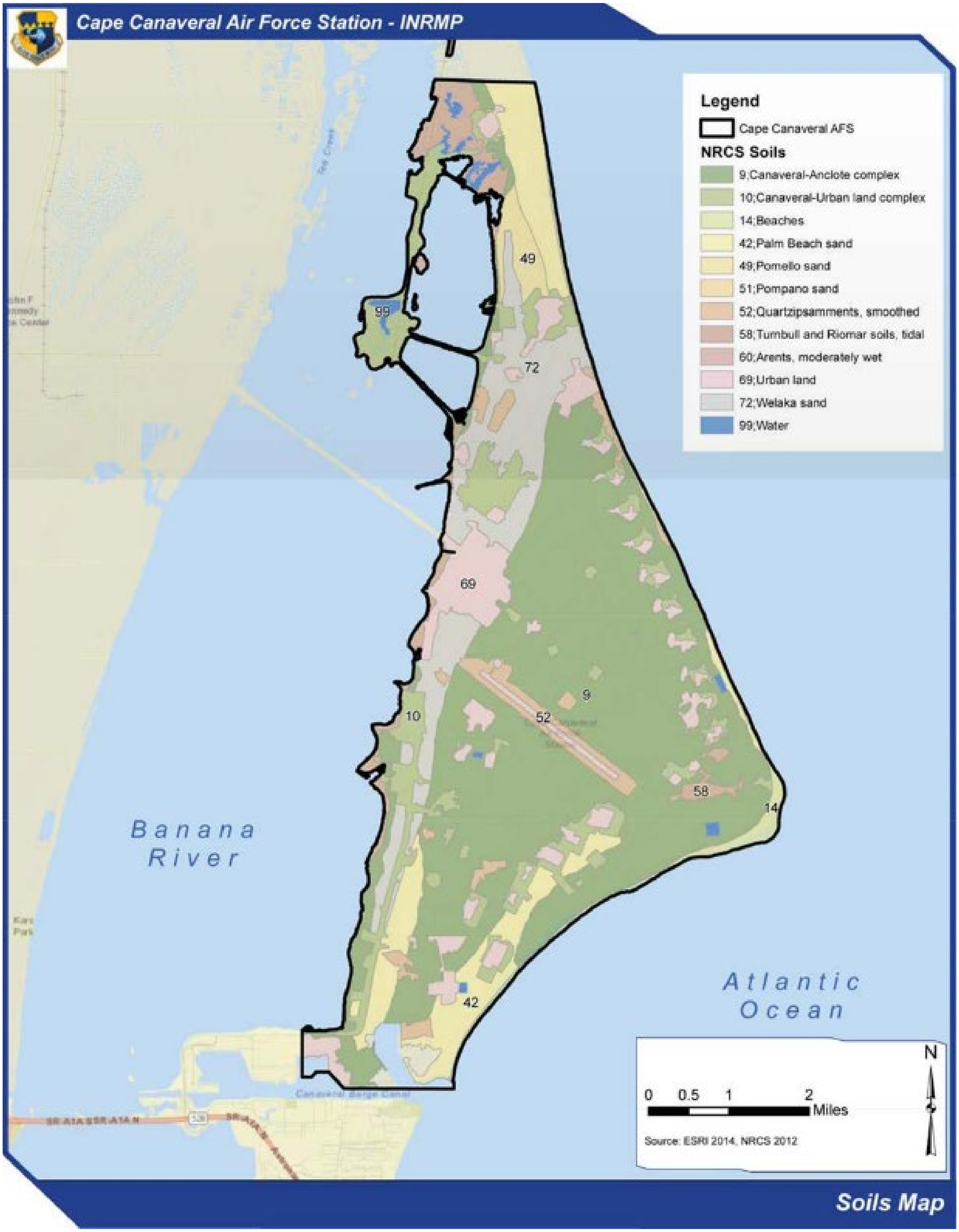


Figure 3-13 Soils Map (USAF 2018)

Figure 3-14 Soils Map

3.10 TRANSPORTATION

3.10.1 Regional Access

CCAFS is approximately 150 miles (241 km) south of Jacksonville, 50 miles (80 km) east of Orlando, and 187 miles (301 km) north of Miami. The general region can be accessed from north and south Florida via I-95 or US Highway (US) 1, and from the west via State Route (SR) 528. Access to CCAFS can occur from the south via SR 528 (A1A) through Port Canaveral to Samuel C. Phillips Parkway, from the north along two access routes through KSC; one via SR 405 (NASA Parkway) or another via SR 402 (Max Brewer Memorial Parkway) (Figure 3-15).

3.10.2 Local Access

The majority of the employees and other related support service providers for CCAFS reside in the unincorporated areas of Brevard County and in the cities of Cape Canaveral, Cocoa, Cocoa Beach, and Rockledge, which are all within 14 miles (22.5 km) of CCAFS. The key roads providing access to CCAFS from the surrounding local communities include SR A1A, SR 520, SR 528, SR 401, SR 405, and SR 3. NASA Causeway (SR 405) connects CCAFS with KSC, the inner barrier islands, and the mainland. South access into CCAFS occurs through Gate 1, which is accessed by SR 401 via SR A1A and SR 528. West access into CCAFS is provided by NASA Parkway East and SR 405. From the north, CCAFS can be accessed through Gate 4 and Gate 6 at KSC along Cape Road. Since the Shuttle Program was terminated in 2011, the general workforce that would be using these roadways has substantially declined.

The main on-site roadway on CCAFS is Samuel C. Phillips Parkway, a two-lane road in some areas, and a four-lane divided highway in other areas that accommodates most of north-south traffic and connects with KSC to the north. SLC-20 is on ICBM Road, which also runs north and south but further east, closer to the beach. It can be accessed from Samuel C. Phillips Parkway by Central Control Road to the south and by Heavy Launch Road to the north. ICBM Road is a lightly traveled road.

Available data indicate that the roads and supporting structures (culverts, bridges, pavement) were constructed to meet FDOT standards. The condition of roadways within CCAFS were most recently assessed in 2013 in a report titled *Roads and Parking Lots Pavement Condition Index Survey Report at Cape Canaveral Air Force Station*, December 2013 (AMEC 2013). Most road pavement conditions were indexed as good or fair. However, a section of Samuel C Phillips Parkway (Section ID 01A) was assigned an index condition of poor. This section extends from approximately SLC-41 north to the turnoff to KSC Pad 39A. The transportation study indicated that while conditions of most culverts that may be transited appeared to be in good condition, some older culverts may require replacement because their conditions cannot be deterministically calculated due to age and condition. Roadways on KSC property from Commerce Way to Cape Road also appear to be in good or fair condition. However, pavement rehabilitation programs are on-going within KSC and the condition will vary over time.

The Proposed Action would transport small- and medium-lift launch vehicles from proposed manufacturing facilities at Exploration Park, KSC to SLC-20 using a standard tractor-trailer and will stay within FDOT maximum weights for an HS-20 vehicle loading (8 kips on front axle, 32 kips for rear axles), for a maximum allowable weight of 80,000 lb (36,287 kg).

Figure 3-15 Regional Road Map

Existing pavement geometries indicate that roadway widths along the access route options are at least 24 feet (7 m)wide and can accommodate the expected transport vehicles (American Association of State Highway and Transportation Officials [AASHTO] WB-96 or WB-114 vehicles, 80 feet (24 m) maximum length, 21 feet (6 m) inside turning radii, and 66 feet (20 m) outside turning radii). Key intersections also appear to be sufficient for FDOT-permitted vehicles; with NASA Parkway at Samuel C. Phillips Parkway having a minimum inside turning radius of 24 feet (7 m), Samuel C. Phillips Parkway at Heavy Launch Road having a slight horizontal alignment deflection with a 100-foot (30-m) radii, Heavy Launch Road at ICBM Road having an inside radius exceeding 60 feet (18 m), and ICBM Road at SLC-20 having an inside radius greater than 90 feet (27 m). Transport of over-sized loads are coordinated with Cape Support before delivery.

3.11 UTILITIES

Operations at SLC-20 were provided by CCAFS from the late 1950s until the site was deactivated in 1996. During demolition activities, many piping and cabling systems were abandoned-in-place; however, SLC-20 has recently been in use and continues to have additional active distribution and collection systems in operation.

3.11.1 Water Supply, Treatment, and Distribution

CCAFS water supply is provided by the City of Cocoa through the City's municipal potable water distribution system. The City pumps groundwater from the Intermediate and Floridan aquifers from well fields in east Orange County. The water is treated by the City at a potable water treatment facility at the same location. Additionally, the City has Aquifer Storage Wells (ASWs) for storage during low usage and the Taylor Creek Reservoir, a surface water storage facility. CCAFS receives potable and fire protection water from all three sources, as it is blended together after treatment (City of Cocoa, 2018).

The US Federal Government has contracted with the City to provide water to KSC, CCAFS, and PAFB. PAFB and CCAFS have a combined total of 6.5 million gallons per day (MGD) allocation and KSC has an additional 2.5 MGD. In 2018, the total daily consumption of water for CCAFS and KCS averaged was 0.7 MGD. Water is used at CCAFS for potable and non-potable purposes. Non-potable use includes hydrant flushing, fire protection, limited irrigation, and launch-related demands. CCAFS recently improved portions of its distribution facilities by separating certain water mains for fire protection only. This improved water quality in the potable distribution system by limiting water age. LC-20 is currently fed from a single 12-inch (30.5-cm) potable line. No separation between fire protection and potable water currently exists.

3.11.2 Wastewater Collection and Treatment

Wastewater at SLC-20 is currently treated in four septic tanks and drainfields. SLC-20 would continue to use this onsite wastewater treatment system in the short-term. If offsite sanitary collection services become available along ICBM Road, an onsite lift station, force main, and sewer service lines may be installed to connect to the offsite system to the CCAFS wastewater treatment plant (WWTP) in the long-term. The WWTP at CCAFS accepts domestic and industrial wastewater. The most recent permit issued for the WWTF was in April 2020 and expires

April 2025. The CCAFS WWTP has a permitted capacity of 0.8 MGD and in 2018 0.454 MGD or 57 percent of the capacity was used.

3.11.3 Electrical Supply

Historically, CCAFS electrical use represents only 0.4 percent of Brevard County's demand. Electrical transmission lines served by Florida Power & Light (FPL) enter CCAFS at three locations: from the southwest boundary, across NASA Causeway, and from Merritt Island. The three feeds are capable of providing 59 Mega Volt/Amperes (MVA) to CCAFS, which is well in excess of that required. Electrical usage in 2015 was 140,352 Mega Watts/Hour (MWH).

The local electrical distribution system is maintained by CCAFS and provides medium-voltage distribution power to SLC-20. Running at 13.2 kilovolts (KV), this medium-voltage distribution system is fed into the site from Load Brake Switch (LBS) BMCG2 through a duct-bank system of conduit and manholes. On site, this medium-voltage power is stepped down through LBS CX20G1 to the various low-voltage distribution transformers, which supplies required power for the existing facilities. The distribution system appears to be capable of supplying electricity to the existing launch facilities. Excess capacity is available should the need arise.

3.11.4 Natural Resources and Energy Supply

As previously stated, launch complexes on CCAFS draw required electrical power and water from the City of Cocoa. No renewable energy resources or local energy sources are available in the area of SLC-20. However, a large FPL solar farm is south of Exploration Park Phase I, and a large 500-acre (202-ha) solar farm is in the planning stages north of the KSC Visitor Center.

3.11.5 Stormwater Collection

Impervious areas constructed after 1992 are subject to the FAC and the SJRWMD stormwater regulations via the State-Wide Environmental Resource Permit (ERP) process that requires new site developments to capture, attenuate, and treat stormwater. As facilities are improved or built, stormwater systems must be built or upgraded to be consistent with the requirements of SJRWMD Rule 40C-4, FAC. Space Florida's tenant would be required to submit engineering design plans that present the proposed site development (e.g., civil design, grading) and the stormwater management system as well as stormwater modeling calculations, all of which will be reviewed and approved by SJRWMD before issuance of an ERP.

Current stormwater flow from impervious surfaces within SLC-20 follows pre-existing flow paths to roadside swales and depressions where it infiltrates and does not appear to discharge off-site.

3.12 HEALTH AND SAFETY

Health and safety issues are managed at CCAFS by organizations that review the planning, construction, pre-flight processing, and launch-day operations. The objective of range safety is to ensure that the general public, launch-area personnel, surrounding launch complexes and personnel, and areas of overflight are compliant with USAF requirements, adhere to the AFSPCMAN 91-710, and all public laws. The AFSPCMAN 91-710 is the document that implements the AFI, *Space Safety and Mishap Prevention Program*, and the Memorandum of Agreement between USAF and the FAA on Safety for Space Transportation and Range Activities. This manual specifies responsibilities and authorities, delineates policies, processes, required approvals, and approval/waiver levels for all activities from or onto USSF ranges including commercial users (AFSPCMAN 2016).

Operational health and safety concerns are primarily the areas in and around CCAFS that could be affected by launch vehicle, equipment, and materials transport to and from the launch complex, payload processing, vehicle safing, and launch operations. As noted above, 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.

Any hazardous materials, including liquid fuels, that must be transported to the launch complex, must be compliant with FDOT regulations regarding interstate shipment of those materials governed by 49 CFR 100-199.

Explosive safety quantity-distance criteria and regulations established by DoD and USAF Explosive Safety Standards are used to establish safe distances from launch complexes and associated support facilities to non-related facilities and roadways. Explosive safety quantity distance criteria will be used to establish safe distances from all onsite facilities and adjoining roadways.

3.13 SOCIOECONOMICS

SLC-20 is in Brevard County. Total population, median household income, households below poverty level, and unemployment rates for Brevard County were used as a basis for identifying existing conditions. Data was obtained from the US Census Bureau 2013 to 2017 American Community Survey 5-Year Estimates.

Table 3-6 compares the total population and median household income in Brevard County in 2010 and 2017. The data show that 10.2 percent of households were living below the poverty level in 2017 and that the unemployment rate was 7.6 percent.

Table 3-6 Brevard County Population Data

	2010	2017	Percent Increase
Population	543,376	568,183	4.6
Median Household Income	$49,523	$51,536	4.1

Source: US Census Bureau, 2013 to 2017 American Community Survey 5-Year Estimate.

In general, the economic influence of the aerospace industry in Florida has declined somewhat with the termination of the Shuttle program. However, commercial space launch companies such as SpaceX, Blue Origin, and several others have had a positive impact of the economics of Brevard County. According to SpaceFlorida.gov, Florida is ranked among the top five US states for aerospace industry employment, with more than 130,000 employees in 2017. More than 17,144 aerospace-related companies are in Florida, which contribute over $19 billion per year in revenues to Florida’s economy.

3.14 ENVIRONMENTAL JUSTICE

Environmental justice is defined by the USEPA 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.*" EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, requires all federal agencies to adopt strategies to address environmental justice concerns within the context of agency operations. Section 989.33 of AFI 32-7061, *Environmental Impact Analysis Process*, requires that a project proponent comply with EO 12898 to ensure that these types of impacts are considered in EAs and other environmental documents.

Minority populations included in the US Census Bureau 2013 to 2017 American Community Survey 5-Year Estimates are identified as White, not Hispanic, Black or African American, Hispanic, Asian, or Other (American Indian and Alaskan Native, Native Hawaiian or other Pacific Islander, some other race, or two or more races). Table 3-7 presents data based on the US Census Bureau 2017, which shows that Brevard County had a population of 568,183 persons and details the racial distribution in the County. The closest population centers to CCAFS are Titusville and Port St. John.

Table 3-7 Brevard County Racial Distribution

Race	Distribution
White, not Hispanic	82.9%
Black or African American	10.2%
Hispanic	9.7%
Asian	2.4%
Other	4.5%

Source: US Census Bureau.

3.15 SECTION 4(f) PROPERTIES

Section 4(f) of the US Department of Transportation Act of 1966 (now codified at 49 USC § 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. 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 or 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 using that land and the program or project includes all possible planning to minimize harm resulting from its use. I

No designated 4(f) properties, including public parks, recreation areas, or wildlife refuges, exist within the boundaries of CCAFS. The MINWR is adjacent to KSC and CCAFS and the CNS is adjacent to KSC and north of CCAFS. The MINWR overlaps the northwest portion of KSC, and all areas not directly used for NASA operations are managed by MINWR and NPS. The nearest public park, Jetty Park, is approximately 5 miles (8 km) south of SLC-20 in the City of Cape Canaveral. Other public parks within an approximate 15-mile (24.1 km) radius of SLC-20 include Kelly Park, KARS Park, Kings Park, and Manatee Cove Park.

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4.0 ENVIRONMENTAL CONSEQUENCES

The analysis in this section focuses on the potential environmental impacts from construction and operation activities at SLC-20. Changes to the natural and human environment that could result from the Proposed Action are evaluated relative to the existing environmental conditions as described in Section 3.0. Four levels of impact may be identified:

- Negligible – The impact is barely perceptible or measurable, remains confined to a single location, and would not result in a sustained recovery time for the resource impacted.
- Minor – The impact is readily perceptible and measurable; however, the impact would be temporary and the resource should recover in a relatively short period.
- Moderate – The impact is perceptible and measurable, and may not remain localized, impacting areas adjacent to the Proposed Action area; adverse impacts to a resource may require several years to recover.
- Significant – An impact is predicted that meets the intensity/context significance criteria for the specified resource.

Under NEPA (42 USC Part 4321 et seq.), significant impacts are those that have potential to significantly affect the quality of the human environment. Human environment is a comprehensive phrase that includes the natural and physical environments and the relationship of people to those environments (40 CFR §1508.14). The CEQ regulations specify that in determining the significance of effects, consideration must be given to *context* and *intensity* (40 CFR § 1508.27).

Context means that the significance of an action must be analyzed in several contexts, such as society as a whole, to an affected region, to affected interests, or to just the locality. In other words, the context measures how far the effect would be *felt*.

The intensity of an action (i.e., the severity of the impact) regionally and locally may be determined by whether it is beneficial or adverse. Intensity refers to the ***severity*** of the effect within the context involved. The intensity of an action may be determined by:

- Unique characteristics in the area (i.e., wetlands, parklands, ecologically critical areas, cultural resources, and other similar factors).
- Overall beneficial project effect versus individual adverse effect(s).
- Public health and safety.
- Degree of controversy.
- Degree of unique or unknown risks.
- Precedent-setting effects for future actions.
- Cumulatively significant effects.
- Cultural or historic resources.

- Special-status species or habitats.
- Compliance with federal, state, or local environmental laws.

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). Since the FAA plans to adopt this EA to support its environmental review of 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

An impact may be considered significant if the project results in nonconformance with approved land use plans or a conflict with existing uses or values of the project area or other properties.

Proposed changes to visual resources can be assessed in terms of *visual dominance* and *visual sensitivity*. Visual dominance describes noticeable physical changes in an area. The magnitude of visual dominance may vary depending on the degree of change in an area. Visual sensitivity is attributed to a particular setting and the desire to maintain the current visual resources in a viewshed. Areas such as coastlines and national parks are usually considered to have high visual sensitivity. When evaluating visual impact, the ability of the general public to view the area where the proposed action or change to the visual resource would occur must also be assessed. 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 Environmental Protection (FDEP).

4.1.1 Proposed Action

Land Use

The Proposed Action would occur at SLC-20, which has been and is currently designated for space launch activities. Reusing the launch complex, renovating existing facilities, constructing related facilities, and conducting launch operations would be consistent with the 45 SW General Plan and the USAF mission at CCAFS. Activities at SLC-20 would be in conformance with its designated use for space vehicle launches. Coordination with KSC, FAA, MINWR, FDEP, and FCMP member agencies would be conducted as required at the time of permitting to ensure the Proposed Action is consistent with meeting the Florida CZMA plan objectives. Therefore, the Proposed Action would generate **negligible adverse impacts** on land use.

Visual Resources

The existing and proposed SLC-20 facilities and launch vehicle would not be visible by the public except possibly from the ocean. However, OLV launches and associated exhaust contrail would be visible in the sky by the public. The contrail visual impact would be similar to all other vehicle launches and would dissipate quickly as wind and air currents affect the trail. Local communities to the south and west have been acclimated to frequent launches of similar or larger size. Launch-related visual impacts would be temporary and relatively infrequent, with up to 24 launches per year. Therefore, the Proposed Action would generate **negligible adverse impacts** on visual resources within the flight range of the OLV vehicle. Section 4.3 discusses light impacts on nesting sea turtles.

4.1.2 No-Action Alternative

Under the No-Action Alternative, the reuse of SLC-20 and launch of OLVs would not be implemented. Therefore, **no impacts** to land use, visual resources, or coastal resources would occur.

4.2 NOISE

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, Biological Resources.

The Noise Control Act of 1972 (40 CFR part 209) identifies 65 DNL (dBA) or a CDNL of 61 dB relative to the carrier (dBC) as an acceptable noise level for compatible land uses for sonic booms or rocket noise. This level does not represent a noise standard; rather, it is a basis to set appropriate standards that should also factor in local considerations and issues.

In accordance with FAA Order 1050.1F, significant noise impacts would occur if the Proposed 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 project-related overpressures at 1 psf, the probability of a window breaking ranges from one in one billion to one in one million. In general, the threshold for building damage due to sonic booms is 2 psf, below which damage is unlikely.

4.2.1 Proposed Action

The Proposed Action includes noise generated by construction and launch operations.

Clearing and Construction-Related Noise

A temporary increase in ambient noise levels would occur at SLC-20 and the surrounding area during the refurbishment and enhancement of existing facilities and construction of new facilities. Noise impacts from the operation of construction equipment are typically limited to a distance of 1,000 feet (305 m) or less. Construction vehicles that would be used in support of the Proposed Action typically have noise levels between 65 dBA and 100 dBA at a distance of 50 feet (15 m). No residential areas or other sensitive receptors occur at or near SLC-20; therefore, refurbishment and construction noise would not impact either public or sensitive receptors (USAF 2019).

Temporary noise sources, such as refurbishment and demolition, would be considered significant if they resulted in noise levels 10 dB or more above 85 dB—a noise threshold limit value for construction workers in an 8-hour day. Pursuant to 29 CFR part 1910, worker protection against the effects of noise exposure would be provided. Feasible administrative and/or engineering controls would be used when workers are subjected to elevated sound levels from construction activities. If these controls would not reduce sound levels sufficiently, hearing protection would be provided and used to reduce exposure. Noise-level impacts on workers would be regulated by compliance with OSHA requirements to limit noise impacts, and OSHA standards would be followed to protect worker safety related to noise levels. Monitoring of worker exposure to noise would also be conducted, as required by OSHA. Accordingly, construction-related noise impacts are anticipated to be **temporary and minor**.

Operations and Launch Vehicle Related Noise

Blue Ridge Research and Consulting, LLC (BRRC) developed a 2019 technical report, *Noise Study for Firefly's Cape Canaveral Orbital Launch Site Environmental Assessment*, to assess launch and sonic boom noise as a result of the Proposed Action at SLC-20 (BRRC 2019). The potential impacts from propulsion noise and sonic booms were evaluated on a single-event and cumulative basis in relation to hearing conservation, structural damage, and human annoyance. Appendix B contains the report and the results are summarized below. BRRC developed and used their Launch Vehicle Acoustic Simulation Model (RUMBLE) noise model to predict the noise associated with the proposed Firefly launch operations. Based on BRRC's analysis, launch and sonic boom noise is not expected to be significant.

An upper limit noise level of LAmax 115 dBA is used as a guideline to protect human hearing from long-term continuous daily exposures to high noise levels. LAmax is the maximum A-weighted **sound** pressure level recorded over the period stated and is often used as a measure of the most obtrusive facet of the **noise**, even though it may only occur for a very short time.

A single Firefly Alpha launch event may generate levels at or above LAmax 115 dBA within 0.3 mile (0.5 km) of the launch site. A single Firefly Beta launch event may generate levels at or above LAmax 115 dBA within 0.5 mile (0.8 km) of the launch site. The 115 dBA contours associated with the launch and static fire events are entirely within the boundaries of CCAFS (Figure 4-1).

Structural damage claims were assessed by analyzing the 111 dB and 120 dB LAmax contours generated by Firefly Alpha and Beta launch events. 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 (Guest and Slone 1972). For the Alpha launch event, the modeled 120 dB and 111 dB LAmax contours are limited to radii of 0.6 mile (1 km) and 1.6 miles (2.6 km) from the launch site, respectively. For the Beta launch event, the modeled 120 dB and 111 dB LAmax contours are limited to radii of 1.5 miles (2.4 km) and 4.0 miles (6.4 km) from the launch site, respectively. The entire land area encompassed by the 111 dB noise contours resulting from the Alpha and Beta launch or static fire events lies within the CCAFS and KSC boundaries.

For impulsive noise events such as sonic booms, noise impacts to human annoyance and health and safety are not expected. There is potential for structural damage to glass, plaster, roofs, and ceilings for well-maintained structures for overpressure levels greater than 2 psf. Sonic booms resulting from Alpha and Beta launch operations are predicted to occur over the Atlantic Ocean for all proposed launch azimuths between 44 degrees and 110 degrees. Modeled sonic boom overpressure levels between 2 and 7.4 psf are directed easterly out over the Atlantic Ocean in the direction of the launch azimuth, making them inaudible on the mainland. Accordingly, noise impacts with respect to human annoyance, health and safety, or structural damage are not expected to result from the sonic booms produced by Alpha and Beta launch operations.

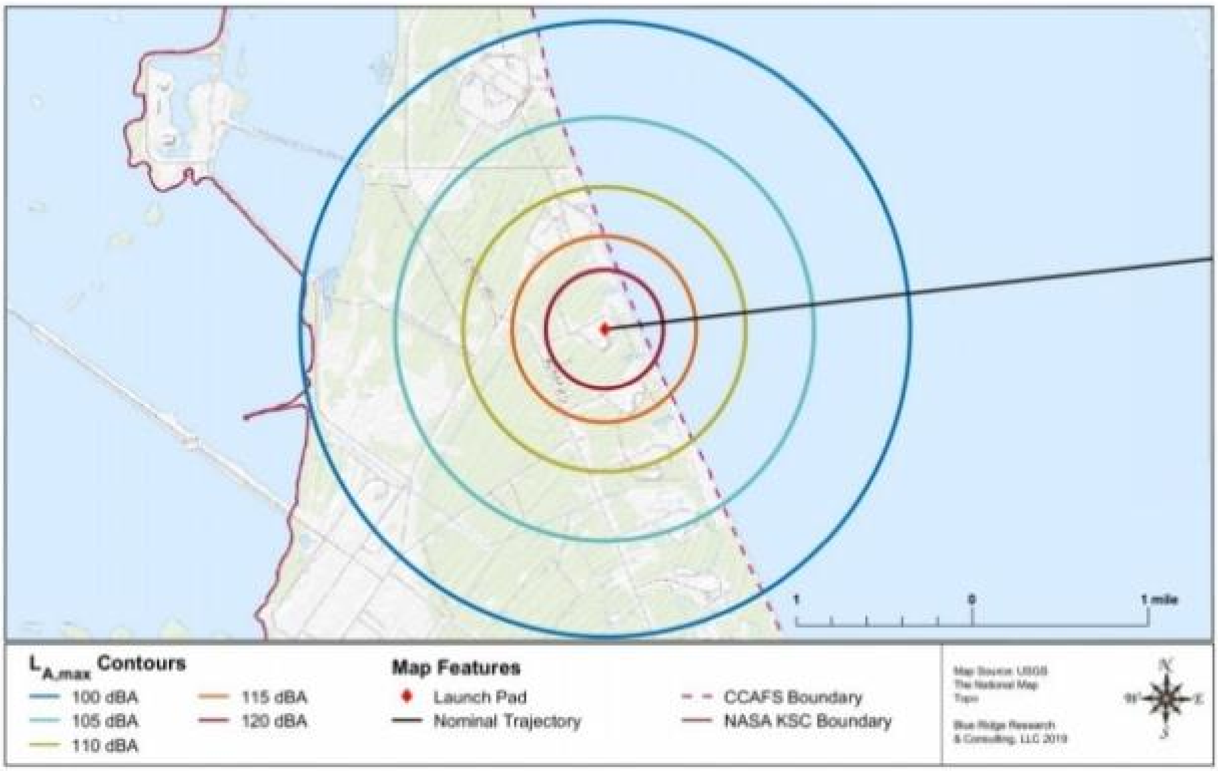

Figure 4-1 Noise Contour

As identified in the BRRC technical report, the DNL 65 and 60 dBA contours extend approximately 1.2 and 1.8 miles (1.9 and 2.9 km) from the launch site, respectively. This area does not encompass land outside the boundaries of CCAFS and KSC; therefore, no impact to residences would occur (Figure 4-2).

Airspace closures associated with launches could result in temporarily grounded aircraft at affected airports and re-routing of en-route flights on established alternate flight paths. The FAA has rarely, if ever, received reportable departure delays associated with launches at CCAFS and KSC. Aircraft could be temporarily grounded if airspace above or around the airport is closed. Ground delays are also used under some circumstances to avoid airborne reroutes. If aircraft were grounded, noise levels at the airport could temporarily increase as the planes sit idle. Also, depending on the altitude at which aircraft approach an airport, there could be temporarily increases in noise levels in communities around the airports. However, aircraft would travel on existing en-routes and flight paths that are used on a daily basis to account for weather and other temporary restrictions. Re-routing associated with launch-related closures represents a small fraction of the total amount of re-routing that occurs from all other reasons in any given year. Any incremental increases in noise levels at individual airports would only last the duration of the airspace closure on a periodic basis and are not expected to meaningfully change existing day-night average sound levels at the affected airports and surrounding areas. Therefore, airspace closures due to launches are not expected to result in significant noise impacts. Advancements in airspace management are expected to further reduce the number of aircraft that would contribute to noise at the affected airports and surrounding areas.

Accordingly, **minor adverse impacts** from noise generated by Firefly Alpha and Beta launch operations is anticipated.

4.2.2 No-Action Alternative

Under the No-Action Alternative, the reuse of SLC-20 and launch of OLVs would not be implemented. Therefore, no impacts to noise would occur.

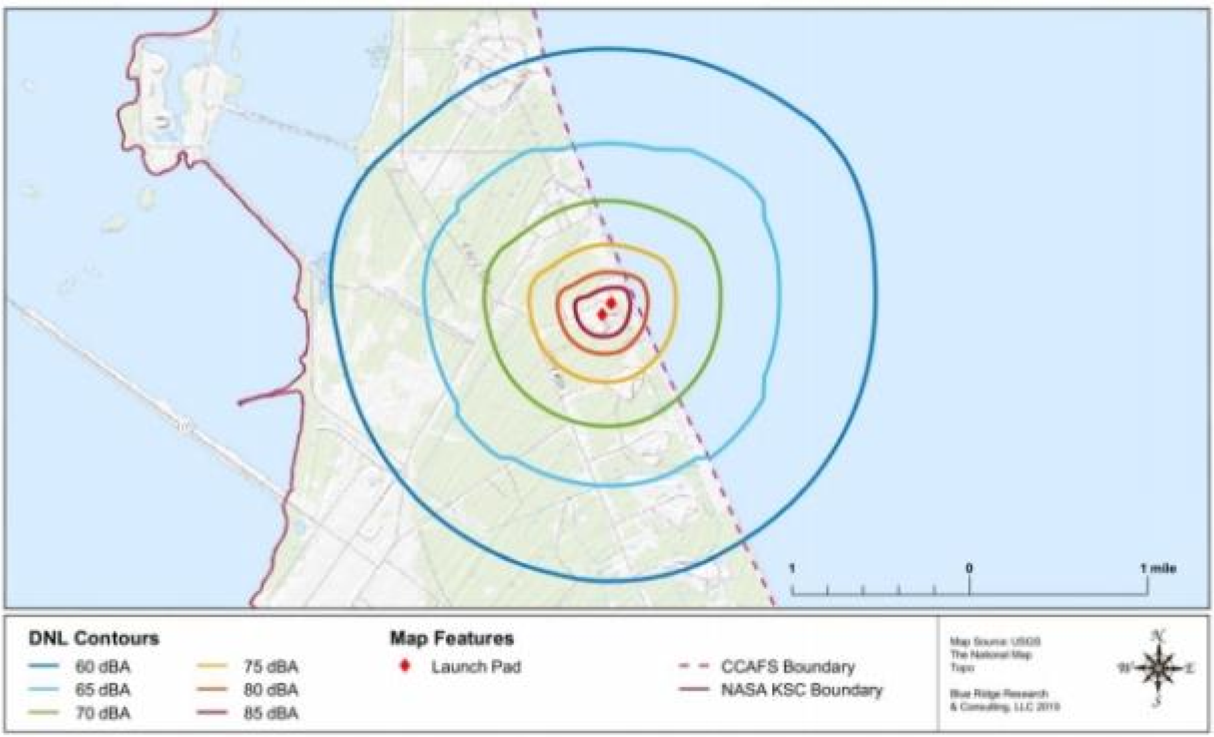

Figure 4-2 DNL Contours

4.3 BIOLOGICAL RESOURCES

An impact to biological resources may be considered significant if USFWS or the National Marine Fisheries Service (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 (FAA Order 1050.1F). Also, a biological resource impact may be considered significant if the action would substantially diminish habitat for a plant or animal species, substantially diminish a regionally or locally important plant or animal species, interfere substantially with wildlife movement or reproductive behavior, and/or result in a substantial infusion of exotic plant or animal species.

Any action that may affect federally listed species or their critical habitats requires consultation with USFWS under Section 7 of the ESA of 1973 (as amended). Also, the Marine Mammal Protection Act (MMPA) of 1972 prohibits the taking of marine mammals, including harassing them, and may require consultation with the NMFS. The NMFS is also responsible for evaluating potential impacts to Essential Fish Habitat (EFH) and enforcing the provisions of the 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) (50 CFR 600.905 et seq.). A Biological Assessment is provided in Appendix D and provides descriptions and analysis of listed wildlife species.

4.3.1 Vegetation

Construction

The Proposed Action would result in the clearing of approximately 0.3 acre (0.1 ha) of native live oak/saw palmetto hammock vegetation to accommodate construction of the new HIF. Previously cleared and maintained areas, which are dominated by primarily exotic herbaceous vegetation, would be removed for the construction of new facilities, and remaining areas would be graded with heavy equipment or mowed more frequently. Once vegetation is removed from this area using heavy machinery, much of it would be graded using large, heavy-tracked bulldozers. Material would be disposed of off-site or burned on location in accordance with USAF regulations.

Converting 0.3 acre (0.1 ha) of low-quality potential Florida scrub-jay habitat to allow for the construction of a new HIF would be compensated through the habitat improvements in LMU 22, which would compensate for potential take of beach mice and benefit scrub-jays. Section 4.3.3 provides additional information.

Launch Operations

Proposed Action launch activities could have some small impacts near the launch pad in association with the resulting fire and heat. Schmalzer et al. (1998) found vegetation scorching was limited to small areas (less than 2.5 acres [1 ha]) within 492 feet (150 m) of the launch pad for 14 Delta, 20 Atlas, and eight Titan launches from CCAFS.

The Proposed Action Concept A and B launch vehicles use liquid fuel (LOX, RP-1, and Liquid Natural Gas), which produce very little acid or particulate deposition. As a result, impacts to vegetation resulting from acid deposition are not expected with the Proposed Action.

4.3.2 Wildlife and Migratory Birds

4.3.2.1 Construction

Clearing and construction activities associated with the Proposed Action would occur over approximately 2 years. Wildlife present in the area also could be affected by construction noise. Wildlife response to noise can be physiological or behavioral. Physiological responses can range from mild, such as an increase in heart rate, to more damaging effects on metabolism and hormone balance. Behavioral responses to man-made noise include attraction, tolerance, and aversion. Each has the potential for negative and positive effects, which vary among species and among individuals of a particular species due to temperament, sex, age, and prior experience with noise. Responses to noise are species-specific; therefore, making exact predictions about hearing thresholds of a particular species based on data from another species is not possible, even those with similar hearing patterns (USAF 2010). Noise generated during construction activities of the Proposed Action would potentially have discernible, but temporary effects on wildlife occurring nearby. Buffering of noise with attenuation rates of up to 10 A-weighted decibels (dBA) per 328 feet (100 m) have been demonstrated in vegetated areas. Given that rate, noise would be expected to carry 984 to 1,312 feet (300 to 400 m) away from the construction sites. Most wildlife occurring closer to noise sources would be free to move away or find shelter (e.g., burrows). Therefore, the impacts would be expected to be minimal (NASA 2013).

In addition to construction-related noise, clearing would eliminate potential habitat for wildlife. The moderate level of noise generated from construction activities would be expected to act as a warning mechanism for wildlife within the construction site and should help minimize impacts to animals inhabiting land affected by the Proposed Action.

Mammals

Potential noise-related impacts to mammalian species during construction activities would include disruption of normal activities due to noise and ground disturbances. These impacts would be minor and short-term, and therefore would not cause significant impact to mammalian populations within the vicinity of the project area.

Reptiles and Amphibians

Potential impacts to reptiles and amphibians resulting from construction-and human-generated noise would primarily be a disruption in foraging. Reptile and amphibian hearing is poorly studied. However, reptiles and amphibians are sensitive to vibrations, which provide information about approaching predators and prey. As a result, vibration and noise associated with construction activities would potentially cause a temporary disturbance to amphibians and reptiles. These impacts would be short-term and would not cause a significant impact to reptilian and amphibian populations within the vicinity of the project area (USAF 2010).

Migratory Birds

Potential impacts to birds resulting from construction- and human-generated noise include disruption in foraging, roosting, and courtship activities. If construction was scheduled to occur during the avian breeding season, construction would occur in accordance with the MBTA to avoid impacts to nesting migratory birds. Despite the paucity of nest-site availability due to the lack of shrubs and trees, biological surveys would occur before commencement of construction activities and bird nests would be marked. In compliance with the MBTA, construction workers would not directly or indirectly disturb the nest or an adjacent area until a biologist determines that the nest is no longer in use. Impacts to migratory birds would be short-term and only affect individuals at or near the construction site. Thus, construction would not cause a significant impact to migratory bird populations. Monitoring during construction activities would identify any potential disturbances of nests so that measures could be implemented to avoid adverse effects, including take of migratory birds.

4.3.2.2 Launch Operations

Terrestrial and Avian Species

Launch operations would not be expected to significantly impact biological resources around SLC-20 including terrestrial native vegetation or listed wildlife species. Noise from launches and sonic booms have been studied for several avian species and beach mice; however, no adverse or direct impacts were observed (KSC 2003). Even the maximum number of 24 launches per year expected with the Proposed Action would result in only interrupting normal behavior approximately twice per month. No animal mortality has been observed at CCAFS that could be attributed to Delta, Atlas, or Titan launches (Schmalzer et al. 1998). Additionally, no negative effects have been observed after the Falcon 9 launches. Extrapolating these results to future Proposed Action launch vehicles is appropriate until further studies are completed at CCAFS.

Marine Life

Although spring and fall migration will see periodic groups of migrating North Atlantic right whales that follow the U.S. coastline to as far south as Cape Canaveral, since the sonic boom footprint occurs over 30 miles from CCAFS the sonic booms are not expected to negatively affect the survival of any marine species (USAF 1998). Because these sonic booms are infrequent, and the marine species in the ocean's surface waters are present in low densities, the effect on ocean species is not expected to be significant.

During nominal operations, the launch vehicle would fly over the Cape Canaveral coastal waters and into orbit without impacts of any kind on marine life or habitat. Reliability of the Proposed Action launch vehicles is also expected to be similar to other launch vehicle development programs, which range from 70-percent reliability in early development to 98-percent reliability as the program matures. Hence, a launch vehicle is unlikely to impact in the ocean due to launch termination. In the case that an airborne launch termination action does occur, the launch vehicle may survive and impact the water essentially intact. The launch vehicle may be carrying unused portions of liquid fuels. Concepts A and B launch vehicles will use a combination of LOX and RP-1 propellants, which are much less toxic than hypergolic propellants used by other launch vehicles. Upon contact with water, propellants would be very quickly diluted and buffered by seawater. As a result, negligible potential for harm to marine life exists. Debris from launch failures has a small potential to adversely affect managed fish species and their habitats in the vicinity of the project area. For an impact to occur to marine life due to a mishap over the ocean, which would be extremely rare, species would need to be present at or near the surface at the same time as the event.

In an August 8, 2016 letter, NMFS issued a Letter of Concurrence for commercial and government launches from KSC, CCAFS, and the SpaceX Boca Chica Launch Site, concurring with the action agencies' determination that launches, including discarding stages in the ocean, would not adversely affect listed species or critical habitat (see Appendix E). NMFS determined that all potential project effects to listed species and critical habitat were found to be discountable or insignificant.

4.3.2.3 No Action Alternative

Under the No Action alternative, no changes to the landscape and availability of habitat and nesting areas utilized by wildlife and migratory species would occur, and noise from construction or operation would also not occur. Therefore, a slight positive impact would be expected due to the CCAFS Natural Resource Program being able to conduct restoration activities in the Proposed Action area.

4.3.3 Threatened and Endangered Species

Table 4-1 summarizes the federal T&E wildlife species that occur or have the potential to occur within the project area of the Proposed Action or may be affected by the Proposed Action. The gopher tortoise is not a federally-listed species but is currently a candidate for listing and is listed by the State of Florida as Threatened. Since it is a state-listed species, the 45 SW will undertake special conservative actions consistent with state guidelines and requirements.

In accordance with ESA Section 7, USAF determined that the proposed project *may affect and is likely to adversely affect* the southeastern beach mouse and the loggerhead, green, leatherback, hawksbill, and Kemp's ridley sea turtles. USAF also determined that the Proposed Action *may affect but is not likely to adversely affect* the Florida scrub-jay, wood stork, red knot, piping plover, eastern indigo snake, and manatee. USFWS concurred with these determinations.

USAF prepared a BA and submitted it to USFWS on January 10, 2020 in accordance with Section 7 consultation. In response to this BA, Appendix C provides the USFWS BO issued on July 17, 2020.

Table 4-1 Summary of Potential Impacts to Federally Listed Wildlife Species for Proposed Action

Common Name *Scientific Name*	Status		Occurrence	Potential Impacts
	USFWS (Federal)	FWCC (State)		
American Wood Stork *Mycteria americana*	T	T	Potential	Disruption due to noise.
Eastern Indigo Snake *Drymarchon corais couperi*	T	T	Potential	Crushing by equipment.
Florida Scrub-Jay *Aphelocoma coerulescens*	T	T	Potential	Loss of potential habitat.
Gopher Tortoise *Gopherus polyphemus*	----	T	Documented	Conflicts with site development. Crushing by equipment. Loss of habitat.
Green Sea Turtle *Chelonia mydas*	T	E	Documented	Disruption and disorientation of nesting and hatching turtles due to light.
Hawksbill Sea Turtle *Eretmochelys imbricata*	E	E	Documented	Disruption and disorientation of nesting and hatching turtles due to light.
Kemp's Ridley Sea Turtle *Lepidochelys kempii*	E	E	Documented	Disruption and disorientation of nesting and hatching turtles due to light.
Leatherback Sea Turtle *Dermochelys coriacea*	E	E	Documented	Disruption and disorientation of nesting and hatching turtles due to light.
Loggerhead Sea Turtle *Caretta*	T	T	Documented	Disruption and disorientation of nesting and hatching turtles due to light.
North Atlantic Right Whale *Eubalaena glacialis*	E	E	Documented	Disruption of breeding habitat.
Piping Plover *Charadrius melodus*	T	T	Potential	Disruption due to noise.
Red Knot *Calidris canutus*	T	----	Potential	Disruption due to noise.

Common Name *Scientific Name*	Status		Occurrence	Potential Impacts
	USFWS (Federal)	FWCC (State)		
Southeastern Beach Mouse *Peromyscus polionotus niveiventris*	T	T	Documented	Crushing by equipment. Disruption due to noise.
American alligator* *Alligator mississippiensis*	S/A		No habitat	No affect.
West Indian Manatee *Trichechus manatus*	T	----	No habitat	No affect.

Note: The American alligator is protected due to its similarity of appearance to the American crocodile.

Specific to prescribed burning, the 45 SW has a CCAFS habitat management goal of burning 500 acres annually to manage habitat for threatened and endangered species. This goal has been established through consultation with federal resource agencies pursuant to Section 7 of the ESA. To achieve this goal, the 45 SW typically needs 6 to 8 days of prescribed burning per year. Burn window opportunities for the 45 SW have been periodically reduced due to numerous factors such as weather, payload transport, payload processing, payload storage at a launch pad, launches, wet dress, and static test fires, among others. Historically, the 45 SW has been relatively successful at meeting this objective. However, due to the current military project needs and increasing number of commercial aerospace customers, prescribed burning has and will become more difficult.

Historically, the 45 SW has maintained a launch table from which burn windows are identified. The increase in aerospace activities has reduced the availability of these windows due to reasons listed above as well as secondary impacts such as launch delays or improper weather conditions when a prescribed burn window arises. As a result, the 45 SW plans to revise its approach with current and future users and Space Florida to ensure adequate burn windows occur annually in an effort to prioritize this listed species management activity rather than it being secondary to launch operations. The 45 SW is currently working with senior CCAFS staff to develop operational controls that will block out a set number of days annually within which launches or other activities affected by prescribed burns cannot occur to allow 45 SW to meet its habitat management goals agreed to with the resource agencies. Operational controls will be implemented that will provide more assurance that CCAFS will meet its burning goals as part of its land management unit responsibilities. In addition, Space Florida will incorporate language into their tenant lease agreements that references the SW prescribed burn goal, listed species management responsibilities, and resulting annual restrictions (1 to 2 weeks) during a 45 SW predefined period. As part of the lease agreement with Space Florida, the tenants will have a contractual obligation to comply with the specified prescribed burn days schedule by providing adequate protection for their equipment (via containment or filtration systems) or moving sensitive equipment to another location while the prescribed burn days are in force. Therefore, implementation of this mitigation measure will reduce any impacts to prescribed burning to minor.

4.3.4 Florida Scrub-Jay

The clearing and subsequent site development for the Proposed Action would result in the loss of approximately 0.3 acre of low-quality, potential scrub-jay habitat. The 2018 Florida scrub-jay census did not reveal the presence of any scrub-jay groups or individuals within the proposed construction limits. As a result, direct impacts are not expected. However, a family was observed in 2018 between ICBM Road and the Proposed Action boundary in the proposed RPA boundary area (Figure 3-5).

Potential effects to the Florida scrub-jay during construction activities would include disruption of normal activities due to noise and ground disturbances. These impacts would be short-term and would elicit a *startle response* to avoid the noise. This would help the birds to avoid the threat and therefore would not cause a negative impact to populations near the project area. Noise associated with rocket launches may startle many species within the CCAFS area. However actual noise impact to the Florida scrub-jay is expected to be minimal. In addition, USAF (1998) studied Atlas, Titan, and Delta launches and did not document any animal mortality or a significant impact to wildlife on CCAFS.

Direct Effect

The Florida scrub-jay is found within much of the CCAFS, KSC, and CCNS scrub habitat. USAF conducts a yearly census of the Cape Canaveral population of scrub-jays in all suitable accessible jay habitat. In 2018, 136 Florida scrub-jay groups were identified, which has varied from 104 groups in 2000 to 157 groups in 1996 and 1997 (Figure 3-4). As previously stated, 2018 census data indicate the presence of a single group within the RPA boundary area just east of ICBM Road but over 1,300 feet west of the Proposed Action boundary (Figure 3-5). However, no documented Florida scrub-jays occupy the Proposed Action area.

The Proposed Action would involve clearing and regrading of portions of the legacy SLC-20 site to construct new facilities. Clearing and construction would result in the direct permanent loss of approximately 0.3 acre of low-quality potential scrub-jay habitat. As a result, direct impacts to this species are expected but are not expected to be significant.

Indirect Effect

Indirect effects are caused by or result from the Proposed Action, occur subsequent to implementation of the Proposed Action, and are reasonably certain to occur. Indirect effects may occur outside the area directly affected by the action and may include other federal actions that have not undergone Section 7 consultations. The indirect effects would occur in two ways: (1) operation of SLC-20 would add activity adjacent to occupied habitat, possibly resulting in scrub-jays being struck by vehicles or (2) Proposed Action operation may restrict habitat restoration efforts and therefore slow species recovery.

The proposed operations at SLC-20 would increase traffic slightly in the vicinity of the scrub-jay habitat and create the opportunity for a take due to road-kill mortality. Repurposing SLC-20 for use has the potential to reduce controlled burn opportunities that create and improve habitat for the Florida scrub-jay within the RPA boundary and areas adjacent to it. Accordingly, restricting or slowing habitat restoration efforts in the area could result in an indirect take of this species.

Mitigation Measures

USFWS and USAF have agreed to a mitigation formula for scrub-jay habitat impacts that mitigates loss of scrub or potential scrub habitat acreage by restoring degraded scrub habitat at a 2:1 ratio. The objective of CCAFS scrub habitat restoration is to restore, using fire and mechanical methods, the over-mature scrub to a condition suitable to support the Florida scrub-jay. Space Florida will conduct beach mouse habitat restoration within a portion of the area shown on Figure 4-3. This habitat enhancement will provide suitable habitat for the Florida scrub-jay to mitigate the proposed 0.3 acre (0.1 ha) of habitat impacts.

Space Florida would work with SLC-20 tenants to advise them of 45 SW's need to conduct vegetation management within the RPA boundary and areas south and north and ensure that proposed processing facilities can accommodate smoke that may occur as a result of a nearby prescribed fire. Space Florida would work closely with 45 SW and attend the CCAFS Controlled Burn Working Group meetings to stay abreast of prescribed fire schedules. Although the Proposed Action area is not suitable habitat nor currently occupied, scrub-jay surveying would be conducted before clearing to ensure that no jays are nesting within 300 feet (91 m) of clearing activities. All suitable scrub-jay habitat would be surveyed for nesting jays. Any nests encountered would be flagged and no clearing would be allowed within 300 feet (91 m) until all birds have fledged. If a dead scrub-jay is found at the project site, it will be collected and disposed of in accordance with proper protocols and the USFWS Jacksonville, Florida, office will be notified.

4.3.3.2 Southeastern Beach Mouse

The Proposed Action is expected to require clearing and grading portions of the existing SLC-20 and renovate several existing structures including the blockhouse. The southeastern beach mouse is known to inhabit existing facilities such as the Blockhouse. As a result, there could be a *take* associated with the Proposed Action.

Direct Effect

Construction and operations would occur at least 150 feet (46 m) west of the beach dune area, which is typical beach mouse habitat. The Proposed Action would not significantly impact the southeastern beach mouse population at CCAFS since no clearing or destruction of suitable habitat would occur. However, there could be a take of the southeastern beach mouse due to their use of the Blockhouse and disturbed habitats between this structure and the coast dunes. As a result, the Proposed Action could result in a take of beach mice due to the renovation of the Blockhouse.

Potential noise-related effects to the southeastern beach mouse during construction activities would include disruption of normal activities due to noise and ground disturbances. These impacts would be short-term and would elicit a *startle response* to avoid the noise. This would help the mice to avoid the threat and therefore would not cause an impact to the beach mouse within the vicinity of the Proposed Action. Actual noise impact to this species is expected to be minimal. Additionally, USAF (1998) found that current and past Atlas, Titan, or Delta launch programs have not been found to cause animal mortality or significant impacts to wildlife habitat at CCAFS.

Indirect Effect

The proposed operations at SLC-20 would increase traffic slightly in the vicinity of the southeastern beach mouse habitat and could create the opportunity for a take due to road-kill mortality.

Mitigation Measures

As compensation for the potential take of this species as a result of the Proposed Action, Space Florida will conduct beach mouse habitat restoration within a portion of the area shown on Figure 4-3. This habitat enhancement will help to provide high quality habitat and a corridor to additional suitable interior habitat.

If a dead beach mouse is found at the project site, it would be collected and disposed of in accordance with proper protocols and the USFWS Jacksonville, Florida, office would be notified.

Figure 4-3 Habitat Enhancement Location Map

4.3.3.3 Eastern Indigo Snake

The Proposed Action would result in the loss of approximately 0.3 acre of undisturbed potential eastern indigo snake habitat in addition to on-site disturbed habitat occupied by gopher tortoises. A take may occur as the result of habitat loss, although adjacent habitat is available. Eastern indigo snakes would also be vulnerable to mortality as a result of injuries sustained during construction activities.

Reptiles and amphibians are sensitive to vibrations, which provide information about approaching predators and prey. Vibration and noise associated with construction activities would elicit a *startle response* to avoid the noise. These impacts would be short-term and would not cause a negative impact to the eastern indigo snake within the vicinity of the project area (USAF 2010). Noise associated with rocket launches may startle many species within the CCAFS area. However, actual noise impact to this species is expected to be minimal. Additionally, USAF (1998) found that current and past Atlas, Titan, or Delta launch programs have not been found to cause animal mortality or significant impacts to wildlife at CCAFS.

Direct Effect

Clearing and construction activities have the potential to result in incidental take of some individuals of eastern indigo snake from disturbance and possible mortality during construction and operation of the Proposed Action. A take may occur as the result of this habitat loss, although adjacent habitat is available. Eastern indigo snakes would also be vulnerable to mortality as a result of injuries sustained during activities such as vegetation clearing and grading and increased vehicular traffic during operation.

The probability and level of incidental take depends on the number of eastern indigo snakes within the region, their ability to disperse, and the amount and distribution of available suitable habitat. As construction begins, this species may move away from the construction site. However, the USFWS expects that a *take* may occur. Incidental take in the form of eastern indigo snake mortality would be avoided through preconstruction surveys and relocation of any individuals present within the boundaries of the work area. Before any land disturbance activities, a 100-percent preconstruction gopher tortoise survey will be completed, and all gopher tortoises captured from burrows that will be impacted will be relocated. Any eastern indigo snakes encountered during gopher tortoise relocation efforts will be safely relocated outside the project area.

Indirect Effect

Indirect effects are expected to occur from increased traffic in and around SLC-20 due to the operation of the facility adjacent to occupied habitat, possibly resulting in indigo snakes being struck by vehicles. Since a portion of their suitable habitat would be impacted by the Proposed Action, the indigo snakes may have to go elsewhere and cause them to cross busy roads, which could result in road-kill mortality.

Mitigation Measures

Mitigation for direct impacts to the eastern indigo snake would help reduce or minimize impacts caused by the Proposed Action. This would be accomplished by presenting the 45 SW Indigo

Snake Protection/Education Plan to the tenant and construction contractor personnel. Educational signs would be posted at the site, which will inform personnel of the snake's appearance, protected status, and who to contact if any are spotted in the area. If any indigo snakes are encountered during clearing activities, they would be allowed to safely leave the area on their own. Furthermore, any indigo snakes encountered during gopher tortoise burrow excavation will be safely moved out of the project area. An eastern indigo snake monitoring report would be submitted if any indigo snakes are observed. If a dead indigo snake is found at the project site, it would be disposed of in accordance with proper protocols and the USFWS Jacksonville, Florida, office will be notified.

4.3.3.4 Marine Turtles

The proposed clearing and construction of new facilities would not directly impact the nesting beach. Exterior lighting proposed for the new facilities has the potential to be visible from the beach and could result in adult and/or hatchling disorientation adjacent to SLC-20. However, operation would occur primarily during daylight hours and lighting impacts would be minimized, limited, and regulated by a 45 SW and USFWS approved LMP.

Sea turtles are not expected to be affected by vibration and noise associated with construction activities since the project area is west of the beach and dune area. However, noise associated with rocket launches may startle many species within the CCAFS area, but this impact is expected to be minimal. Expected sonic boom noise during a launch in the area is minimal, and the large sonic booms up to 7.4 pounds per square foot (psf) would only occur 30 to 40 miles (48 to 64 km) offshore and would also have no effect. As a result, no significant impacts on marine turtles are expected.

Direct Effect

Clearing and construction of new facilities in association with the Proposed Action would not impact the nesting beach; however, temporary lighting might be needed for construction. A construction LMP would be required if any nighttime work (e.g., concrete pours) is expected during sea turtle nesting season. As previously mentioned, exterior lighting proposed for the new facilities has the potential to be visible from the beach. Lighting visible from the beach can cause adult and hatchling sea turtles to move landward, rather than seaward, which increases the chances of mortality. As a result, disorientation of adult or hatchling sea turtles could result in an indirect take on the adjacent beach. USFWS concurs with the 45 SW's determination that the proposed project *may affect and is likely to adversely affect* the loggerhead, green, leatherback, hawksbill, and Kemp's ridley sea turtles. However, a USFWS- and 45 SW-approved LMP would be prepared for the operation of SLC-20, which should minimize impact to the species of sea turtles that utilize the area.

Indirect Effect

Indirect effects are not expected as a result of the Proposed Action.

Mitigation Measures

To prevent or minimize impacts to sea turtles from facility operational lighting, all exterior lighting proposed for this project would be in accordance with the 45 SWI 32-7001, *Exterior*

Lighting Management, dated January 25, 2008. Additionally, an LMP would be required for the new facilities before construction. Adherence to an approved LMP would reduce the potential for disorientation. Strict adherence to the plan would be monitored by 45 SW to ensure disorientation is minimized.

4.3.3.5 Gopher Tortoise

The Proposed Action would result in the loss of occupied gopher tortoise habitat and burrows under existing roadways may be impacted due to the increased construction and subsequent operational vehicle traffic. All tortoises that may be impacted would be excavated by FWC-authorized gopher tortoise agents and relocated to an approved gopher tortoise recipient site on CCAFS property in accordance with FWC protocols. Relocation activities on military bases are exempt from FWC permitting and fees in accordance with the FWC Gopher Tortoise Management Plan. Additionally, USAF would include any such relocations in their annual report in accordance with the Gopher Tortoise Candidate Conservation Agreement. The Proposed Action could result in a direct take due to mortality or injuries sustained by heavy equipment.

Reptiles and amphibians are sensitive to vibrations, which provide information about approaching predators and prey. Vibration and noise associated with construction activities would potentially cause short-term disturbance to gopher tortoises. These impacts would be short-term and would not cause a significant impact to populations within the vicinity of the project area (USAF 2010). Noise associated with rocket launches may startle many species within the CCAFS area. However, actual noise impact to this species is expected to be minimal. Additionally, regarding current and past launch programs on CCAFS, Atlas, Titan, and Delta launches have been documented to not cause animal mortality or significant impact to wildlife on CCAFS (USAF 1998).

Direct Effect

A tortoise survey documented over 160 burrows in the Proposed Action boundary with a very high concentration adjacent to the access roads that serves Concepts A and B launch pads in the center of the site. The Proposed Action would involve clearing vegetation within proposed construction areas and likely improvements to existing roadways where numerous gopher tortoise burrows are concentrated. As a result, construction and road improvement activities have the potential to cause harm to gopher tortoises. This relocation would help to ensure gopher tortoise survival.

Indirect Effect

Indirect effects could occur from increased traffic in and around SLC-20 due to the operation of the facility adjacent to occupied habitat, possibly resulting in a gopher tortoise being struck by vehicles.

Mitigation Measures

To minimize impacts to gopher tortoises, gopher tortoise burrows will not be disturbed if a minimum of a 25-foot (7.6-m) buffer can remain as well as maintaining connectivity of this buffer to foraging areas in accordance with FFWCC guidelines. No more than 90 days before and no fewer than 72 hours before any clearing or construction, a 100-percent preconstruction survey in accordance with FFWCC guidelines will be conducted to locate and flag/stake all burrows. Tortoises that would be affected by construction or operation related activities would be captured via bucket trappings or burrow excavations in accordance with FWC guidelines and will be relocated to a nearby CCAFS-approved recipient site. CCAFS would include the results of the relocation efforts in their annual monitoring report to FWC as required by their Gopher Tortoise Candidate Conservation Agreement. A map showing the locations of the burrow and their occupancy status if a tortoise was captured will be provided to the construction contractor by the commercial space entity under lease agreement with Space Florida for SLC-20. Educational posters will be provided to construction personnel and future tenet personnel so that they are observant for any tortoises that may enter the construction site or during site operations. Any live or dead tortoises observed will be reported to the 45th Space Wing immediately.

4.3.3.6 Piping Plover

The Proposed Action boundary is 150 feet (45 m) or more west of the Atlantic coast beach areas, which is piping plover habitat. Noise associated with rocket launches may startle many species within the CCAFS area. However, actual noise impact to this species is expected to be minimal. Additionally, USAF (1998) documented that the Atlas, Titan, and Delta launches did not cause animal mortality or significant impact to wildlife on CCAFS. Expected sonic boom noise in the area is minimal, and large sonic booms up to 7.4 psf would only occur beyond 30 to 40 miles (48 to 64 km) offshore and would also have no effect to wildlife.

Direct Effect

Direct effects are expected to occur in the form of operational and launch-related noise associated with the Proposed Action. These effects may elicit a *startle* response. However, these effects would likely have a short duration and are not expected to cause lasting negative consequences.

Indirect Effect

No indirect effects are expected.

Mitigation Measures

The Proposed Action would not impact piping plover habitat. Noise effects would be minimal and only cause a *startle* effect. Due to these factors, mitigation would not be required.

4.3.3.7 American Wood Stork

The Proposed Action area does not contain wetland or surface waters that would be used by the American wood stork. Noise associated with rocket launches may startle this species if they were to be found within the CCAFS area. However, actual noise impact to this species is expected to be minimal. As previously stated, studies on current and past launch programs on CCAFS have been documented to not cause animal mortality or significant impact to wildlife on CCAFS (USAF 1998). Sonic boom noise may only occur well offshore, and its impact on this species is expected to be minimal.

Direct Effect

Direct effects relating to the American wood stork are expected to be in the form of noise. Noise from site operation and launches are expected to elicit a *startle* response. However, these effects are predicted to be short in duration and are not expected to cause lasting negative consequences.

Indirect Effect

Indirect effects may occur from increased operational traffic coming to and from the SLC-20, possibly resulting in wood storks being struck by vehicles.

Mitigation Measures

No mitigation measures should be necessary since no effect to wood stork foraging or nesting habitat is predicted as a result of the Proposed Action.

4.3.3.8 Red Knot

The Proposed Action would not come within 150 feet or less of the Atlantic coast beach areas, which is red knot habitat. Noise associated with rocket launches may startle many species within the CCAFS area. Actual noise impact to this species is expected to be minimal. Additionally, regarding current and past launch programs on CCAFS, the Atlas, Titan, and Delta launches have been documented to not cause any animal mortality or significant impact to wildlife on CCAFS (USAF 1998). Expected sonic boom noise in the area is minimal, and large sonic boom up to 7.4 psf may only occur beyond 30 to 40 miles (48 to 64 km) offshore and would also have no effect on wildlife.

Direct Effect

Direct effects are expected in the form of operational and launch noise associated with the Proposed Action. These effects may elicit a *startle* response. However, these effects will likely have a short duration and are not expected to cause lasting negative consequences.

Indirect Effect

No indirect effects are expected.

Mitigation Measures

No red knot habitat is expected to be impacted as a result of the Proposed Action. Noise effects would be minimal and only cause a *startle* effect. Due to these factors, mitigation is not proposed.

4.3.3.9 West Indian Manatee

The Proposed Action is not likely to have an adverse effect on manatees in the area. Manatees are not expected to be affected by vibration and noise associated with construction and launch activities since they are not in the area continuously and the project area would be west of and beyond the beach and dune area.

Direct Effect

Direct effects are not expected from the Proposed Action.

Indirect Effect

Indirect effects are not expected from the Proposed Action.

Mitigation Measures

No mitigation measures should be necessary as no effect is predicted due to the Proposed Action.

4.3.3.10 American Alligator

The Proposed Action is not likely to negatively impact the American Alligator as no suitable on-site habitat exists. The alligator is not expected to be affected by the vibration and noise associated with construction activities. Noise from construction and post-construction operations may startle individuals that may occur outside the Proposed Action boundary; however, these effects are predicted to be minimal and would not induce long-term consequences. Additionally, regarding current and past launch programs on CCAFS, the Atlas, Titan, and Delta launches have been documented to not cause any animal mortality or significant impact to wildlife on CCAFS (USAF 1998). Expected sonic-boom noise in the area is minimal, and large sonic booms up to 7.4 psf may only occur beyond 30 to 40 miles (48 to 64 km) offshore and would also have no effect.

Direct Effect

Direct effects are not expected from the Proposed Action as no habitat to support this species occurs within the Proposed Action footprint.

Indirect Effect

Indirect effects are not expected from the Proposed Action.

Mitigation Measures

No mitigation measures should be necessary as no effect on this species or its habitat is predicted due to the Proposed Action.

4.3.3.11 North Atlantic Right Whale

The Proposed Action is not expected to have an impact on right whales in the area, and this species was not specifically mentioned in the BA or in the BO. Whales are not expected to be affected by vibration and noise associated with construction activities since they are not in the area continuously and the project area would be west of and beyond the beach and dune area. However, noise associated with rocket launches may startle individuals in the near-shore area during migration season. However, current and past launch programs on CCAFS have been documented to not cause any animal mortality or significant impact to wildlife on CCAFS (USAF 1998). Expected sonic boom noise in the area is minimal and large sonic boom up to 7.4 psf may only occur beyond 30 to 40 miles (48 to 64 km) offshore, which is beyond the typical migration routes of the whale and would therefore have no effect. Launch operations are one of the aspects discussed in ESA Section 7 Consultation between the FAA, NASA, and the National Marine Fisheries Service (NMFS) in 2016 and NMFS concurred with NASA’s and the FAA’s determinations that launch operations are "not likely to adversely affect listed species and critical habitat under NMFS's purview." (Appendix E).

Direct Effect

Direct effects are not expected from the Proposed Action.

Indirect Effect

Indirect effects are not expected from the Proposed Action.

Mitigation Measures

No mitigation measures are proposed as no effect is expected as a result of the Proposed Action.

In summary, **minor adverse impacts** to vegetation, wildlife, and listed wildlife species are expected as a result of the Proposed Action.

4.3.3.12 No Action Alternative

Under the No Action Alternative, no changes to the landscape, land, and/or vegetation would occur. Therefore, a **slight positive impact** would be expected due to the CCAFS Natural Resource Program being able to conduct restoration activities within the Proposed Action area. These positive impacts would be expected for the Florida scrub-jay, southeastern beach mouse, eastern indigo snake, gopher tortoises, Florida pine snake, Florida mouse, gopher frog, American alligator, wood stork, piping plover, and red knot. No impact would be expected for any marine turtles or for the North Atlantic right whale.

4.4 CULTURAL RESOURCES

4.4.1 Proposed Action

A Determination of Eligibility for SLC-20 was prepared by the 45 SW CRM in 2015 and submitted to the Florida SHPO for review. In response, the SHPO sent a letter on April 8, 2015, to the CRM stating the majority of the facilities, including the Control Cableway (BR3151), LH2 Holding Area (BR3152), Retaining Wall (BR3153), Launch Stand and Ramp (BR3154), Payload Assembly Building (BR3156), Facility 15540 – Launch Pad A-BMDO, Facility 15541 – Equipment Building, Facility 156 – Power Center, Facility 15609 – Control Center, Facility 15640 – Launch Pad B – BDMO, Facility 15611 – Equipment Building, Facility 18705 – Warehouse, and Facility 18803 – Guard House, did not meet the criteria for listing on the NRHP. Specific to the Blockhouse (8BR315), the SHPO's letter stated,

> *It is the opinion of this office that the Launch Complex 20 Blockhouse (BR3155) appears to meet the criteria for listing under Criterion A for Military and C for Architecture and Engineering. Although identical historic properties have been documented and/or mitigated, blockhouses are very rare and distinctive buildings that are increasingly being demolished.*

Further, *the reuse of LC-20 or the construction of a new launch complex adjacent to LC-20 may constitute an adverse effect on the Blockhouse*. Appendix F provides a copy of that letter. However, regarding the interior of the Blockhouse, substantial alterations to accommodate missions have occurred, and the interior is not important in defining the overall historic character of the building.

Under the Proposed Action, the Blockhouse would be used for the same purpose it was historically intended, which is to provide a safe launch facility at the complex for onsite operational managers and technicians. The external structure of the Blockhouse has remained generally intact over the years and major exterior renovations to the structure are not expected under the Proposed Action. Any roof repairs would use materials of similar appearance to the original roof. Removal of vegetative growth in seams on the roof would be required. Any painting of the exterior walls to refresh the building would be performed in a manner that results in the color and texture that is consistent with the appearance of the original structure. Any patching or repair of minor cracks in the exterior walls would also be performed in a way that the appearance of the structure remains true to the original exterior appearance. Due to the fact that the interior of the Blockhouse has been altered substantially for multiple missions since original construction and is not important in defining the overall historic character of the building, no interior features would need to be preserved during renovation of this historic building.

In June 2019, the 45 SW CRM performed a Phase 1 cultural resource assessment (CRA) for the entire area included in the Proposed Action. A Technical Memorandum (TM) was prepared that summarized the findings regarding SLC-20 regarding its cultural resource value and determination of whether any of the facilities or cultural resources may be considered eligible for listing in the NRHP. On September 12, 2019, the SHPO concurred with the findings of the CRM that the Proposed Action reuse of the SLC-20 Complex would not result in an adverse effect to its facilities and cultural resource. Further, the intended use of the Blockhouse under the Proposed Action is consistent with the historical nature of that facility and the proposed measures to maintain the historical integrity of the external appearance of the Blockhouse is a beneficial and acceptable mitigating measure for this structure. No other cultural resources, either historical or archaeological, were found during the 2019 CRA. Appendix F contains a copy of the SHPO's 2019 concurrence letter and the SLC-20 TM as well as a 2020 concurrence letter to the Florida State Clearinghouse.

Regarding Tribal cultural resources at SLC-20 and noted previously, the Seminole Tribe of Florida and Seminole Nation of Oklahoma verbally stated in 2011 that they have no TCPs on CCAFS. (45 SW CRM personal communication to W. Puckett, September 2019). The 45 SW updated its ICRMP in 2015, which also stated that no TCPs are present at CCAFS. Therefore, no TCPs are expected to be adversely affected by the Proposed Action.

In summary, **a negligible adverse to beneficial impact** to cultural resources is expected from the Proposed Action.

4.4.2 No-Action Alternative

Under the No Action Alternative, the reuse of SLC-20 and launch of OLVs would not be implemented. Therefore, no impacts to cultural resources would occur.

4.5 AIR QUALITY

The ROI for air quality includes all of CCAFS and Brevard County. The air-quality impacts analyzed are those that occur at altitudes of 914 m (3,000 feet) or less, where NAAQS would be applicable. USEPA has accepted this height as the nominal height of the atmospheric mixing layer for assessing contributions from launch emissions to ground-level ambient-air quality under the Clean Air Act (CAA) (USEPA 1992). Brevard County is in attainment for all criteria pollutants; therefore, the General Conformity rule does not apply. For this EA, impacts to air quality would be considered significant if the Proposed Action resulted in one or more of the NAAQS being exceeded (FAA Order 1050.1F), or increased the frequency or severity of any such existing violations. Further, with respect to stationary sources, air emissions would be considered minor if the Proposed Action did not exceed an increase of 250 tons per year of any criteria pollutant (e.g., CO). USEPA uses this value in its New Source Review standards as an indication for impact analysis for new source stationary sources in areas that are in attainment with the NAAQS. USEPA does not have a similar regulatory threshold for mobile sources such as launch vehicles.

Air emissions from the Proposed Action would result from construction activities, pre-launch site operations, and launch operations from SLC-20.

4.5.1 Proposed Action

This section discusses the expected air-quality impacts from criteria pollutants, hazardous air pollutants (HAPs), and GHG-emissions from the Proposed Action. The CEQ-issued NEPA guidance for considering the effects of climate change and GHG emissions was withdrawn on March 28, 2017. CEQ subsequently issued draft guidance on this topic in 2019 (CEQ 2019). There are currently no accepted methods of determining significance applicable to commercial space launch projects given the small percentage of emissions they contribute. There is a considerable amount of ongoing scientific research to improve understanding of global climate change and FAA guidance will evolve as the science matures or if new federal requirements are established.

4.5.1.1 Construction

Construction-related impacts to air quality would occur from minor increases in particulate matter (PM) due to facility renovations, limited demolition, clearing, grading, movement of construction vehicles, and short-term generator use. Fossil-fueled vehicles and equipment would release carbon dioxide (CO_2), carbon monoxide (CO), nitrous oxide (NOx), and hydrocarbons into the ambient air during the approximately 18 months of construction. These releases of air pollutants would be relatively minor and are not expected to result in any exceedance for any of the criteria pollutants listed in the NAAQS. Therefore, there would be **negligible adverse impacts** to air quality resulting from construction activities under the Proposed Action.

4.5.1.2 Operations

Airspace closures associated with launches would result in additional aircraft emissions primarily from aircraft being re-routed and subsequently expending additional fuel. However, emissions from aircraft being re-routed would occur above 3,000 feet (914 m) (the mixing layer) where NAAQS would not be applicable; therefore, no impact to air quality would occur from aircraft re-routing from airspace closures.

With regards to departure delays, airspace-related impacts could increase up to a maximum of 24 times per year; however, given that Brevard County is in attainment for all criteria pollutants, only a negligible amount of emissions would be generated from any aircraft departure delays associated with launches at CCAFS and KSC. Therefore, any air emissions increase from departure delays are not expected to result in an exceedance of a National Ambient Air Quality Standard for any criteria pollutant. Emissions from aircraft being re-routed would occur above 3,000 feet (914 m) (the mixing layer) and thus would not affect ambient air quality. Therefore, airspace closures associated with launches are **not expected to result in significant air quality impacts**.

Daily operations and prelaunch activities, such as ground support operations and refueling operations, are expected to generate PM, volatile organic compounds (VOCs), NOx, sulfur oxides (SOx), HAPs, CO_2, and CO from a variety of sources including on-site traffic, mobile equipment emissions, surface-coating applications, ground-support equipment, maintenance painting, *de minimis* fugitive emissions from liquid fuels storage and transfer, and diesel fuel use. The relatively small emissions associated with ground support operations or refueling operations would have **negligible impacts** to air quality, especially given Brevard County is in attainment for all criteria pollutants.

With regards to engine testing, static-fire tests may be conducted at the launch site, where the vehicle is fully fueled and the engine ignited and run for up to 5 seconds as a thorough test of all systems. Static-fire tests may be discontinued as the program matures. In addition, two-stage acceptance testing would occur at SLC-20 approximately once or twice per month. Stage 1 would occur with four Reaver engines for 30 seconds, and Stage 2 would occur with one lighting engine for 60 seconds for each test. This limited testing would also have little impacts in an area that presently meets air quality standards. No NAAQS exceedances during operations are expected and **minor adverse impacts** to existing air emissions on CCAFS would occur from the implementation of the Proposed Action.

4.5.1.3 Launch Vehicles

The launch vehicles are considered mobile sources and are not subject to air-permitting requirements. The Concept A and B vehicles use RP-1 and LOX as propellants; additionally, Concept B variants 2 and 3 use RP-1, LOX, and LCH4. The primary emission products from these propellants include CO_2, CO, water vapor, and small amounts of NOx and PM. Nearly all the emitted CO oxidizes rapidly to CO_2 during afterburn in the exhaust plume, which would then be dispersed in the atmosphere and have no impact on air quality. The only pollutant not converted is NOx (FAA 2020a).

The proposed engines to be used at SLC-20 under the real property transfer are currently evolving and the "envelope concept" is applied in this EA. The envelope concept facilitates the environmental analysis process by providing a threshold, below which, if not exceeded under a worst-case scenario for the Proposed Action due to previous NEPA analysis of similar engines, further in-depth NEPA analysis is not needed. For the purposes of this EA, the analysis documented by the FAA (2020a) for the SpaceX Falcon and Falcon Heavy Program is used as the envelope concept and is hereby incorporated by reference.

Under the Proposed Action, the maximum propellant scenario involving LOX/RP-1 for Concept A or Concept B is the Beta Variant 1 Combined Vehicle with a maximum propellant quantity of 435,000 lbs (197,312 kg). In FAA (2020a), it was documented that the Falcon 9 and Falcon Heavy launch vehicles use Merlin engines and the propellants for both are LOX and RP-1. The combined total propellant for the Falcon 9 engine is 1,135,925 lbs (515,247 kg), and the combined total propellant for the Falcon Heavy is 2,937,950 lbs (1,332,632 kg) (FAA 2020a).

In FAA (2020a), air emissions were calculated for all 9 engines for the Falcon 9 and 27 engines for the Falcon Heavy. Since the Falcon liquid engines use RP-1 and LOX, the analysis documented in FAA (2020a) is hereby incorporated by reference as it is considered a comparable approach for estimating the potential impacts to air quality from the proposed Concept A and B vehicles. The launch of the Falcon 9 would be expected to reach the upper limit of the mixing area (i.e., 3,000 feet (914 m)) within 23 seconds, and the Falcon Heaving within 21 seconds (FAA 2020a). As stated previously, since nearly all the emitted CO oxidizes rapidly to CO_2 during afterburn in the exhaust plume, the only pollutant not converted is NOx. For the maximum launch frequency of 60 Falcon 9 launches per year, the Falcon 9 would emit approximately 6.5 tons of NOx per year. Further, for the maximum launch frequency of 10 Falcon Heavy launches per year, the Falcon Heavy would emit approximately 3.0 tons of NOx per year (FAA 2020a). Therefore, the NOx emissions from a combined 70 Falcon 9 and Falcon Heavy launches would be less than 10 tons per year. In addition to the air emission estimates documented in FAA (2020a), launch vehicles would accelerate rapidly and the high temperatures of the exhaust products will cause their air emissions to rise quickly and disperse with the prevailing winds. Since the potential NOx emissions from the Merlin engines is less than 10 tons per year, it is reasonable to assume NOx emissions from the Concept A and B engines would be less than 10 tons per year. Therefore, operation of launch vehicles is expected to have a minor adverse impact on air quality.

4.5.2 No-Action Alternative

Under the No Action Alternative, neither Concept A nor Concept B would be implemented and no new construction would occur to support them and no launch operations would occur. Accordingly, **no impacts** to air quality would occur under the No Action Alternative.

4.6 CLIMATE

4.6.1 Proposed Action

There are currently no quantities or thresholds of GHG emissions established by USAF that would be considered *significant* relating to potential impacts to human health or the environment. According to FAA (2015), *There are no significance thresholds for aviation or commercial space launch GHG emissions, and it is not currently useful for the NEPA analysis to attempt to link specific climate impacts to the proposed action or alternative(s) given the small percentage of emissions aviation and commercial space launch projects contribute*. Furthermore, in June 2019, CEQ issued a revised draft memorandum for National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions. (This new draft replaced the previously issued final guidance issued August 1, 2016.) This new guidance states:

> *Under CEQ regulations and the 'rule of reason' that bounds all NEPA analysis, impacts of a proposed action should be discussed in proportion to their significance, and there should only be brief discussion of issues that are not significant. As with all NEPA analyses, the rule of reason permits agencies to use their expertise and experience to decide how and to what degree to analyze particular effects. Agencies preparing NEPA analyses need not give greater consideration to potential effects from GHG emissions than to other potential effects on the human environment" (CEQ 2019).*

Emissions of GHGs and Ozone Depleting Substances (ODS) are of concern in the upper atmosphere. The stratosphere begins just above the troposphere and extends to 31 miles (50 km) high and contains the ozone layer. The mesosphere starts above the stratosphere and extends to 53 miles (985 km) high. The ionosphere stretches from about 30 miles (48 km) above the Earth's surface to the edge of space at about 600 miles (965 km). The potential emissions that may affect global climate change directly include CO_2, oxygen (H_2O), and carbon particles (a component of PM). In addition, CO and NOx can influence the creation and destruction of GHGs.

According to the United Nations 2018 Quadrennial Global Ozone Assessment, rocket launches have a small effect (much less than 0.1 percent) on total stratospheric ozone (World Meteorological Organization [WMO] 2018). The contribution of emissions from implementation of the Proposed Action would be similar to those documented in other recent NEPA documents. Specifically, the emissions would be small and are considered having a negligible impact on global climate change.

Airspace closures associated with launches would result in additional aircraft emissions mainly from aircraft being re-routed and expending more fuel. These emissions include carbon dioxide (CO_2), which is a GHG. Based on Space Florida's proposal, airspace-related impacts could increase up to a maximum of 24 times per year. The amount of time that affected aircraft spend being re-routed would be short-term. In addition, the number of aircraft that would be impacted per launch would not be expected to produce additional emissions that would have a notable impact on climate. Therefore, the increases in GHGs caused by short-term airspace closures during launches is not expected to result in significant climate-related impacts.

Using the envelope concept discussed in Section 4.5, with regards to GHG emissions associated with launches, FAA (2020a) estimated the amount of GHG emissions generated from a maximum of 60 Falcon 9 and 10 Falcon Heavy launches per year is 34,839 metric tons of CO_2e. The total GHG emissions are a fraction of global and U.S. CO_2e emissions. The propulsion systems used by the Falcon 9 and Falcon Heavy emit a variety of gases and particles directly into the stratosphere, including CO2, water vapor, NOx, and soot (carbon). Moreover, a large fraction of these emissions is chemically inert and do not affect ozone levels directly. Other low reactive emissions, such as H_2O, have an impact on ozone globally since they react with ozone destroying gases known as radicals. A small fraction of rocket engine emissions are highly reactive radical compounds that attack and deplete ozone in the plume wake immediately following launch. Particulate emissions, such as carbon (soot), may also be reactive in enabling important reactions that would not proceed otherwise. These emissions are a small fraction of the total emissions and are below the CO_2e emissions described above.

The scientific community is continuing efforts to better understand the impact of aviation emissions on the global atmosphere. The FAA is leading and participating in a number of initiatives intended to clarify the role that commercial aviation plays in GHG emissions and climate. The FAA, with support from the U.S. Global Change Research Program and its participating federal agencies, has developed the Aviation Climate Change Research Initiative in an effort to advance scientific understanding of regional and global climate impacts of aircraft emissions.

Given the above guidance by the FAA and CEQ, and the analysis documented in FAA (2020a), the Proposed Action would **result in negligible adverse impact** to climate.

4.6.2 No-Action Alternative

Under the No Action Alternative, the reuse of SLC-20 and launch of OLVs would not be implemented. Therefore, no impacts to climate would occur.

4.7 HAZARDOUS MATERIALS, HAZARDOUS WASTE, AND SOLID WASTE

Specific to this EA, a project may result in a significant impact from hazardous materials/ hazardous waste if it increases the potential for exposure to hazardous materials/waste or increases the likelihood of a hazardous materials release to the environment. Impacts on hazardous materials and waste management would also be considered significant if they resulted in noncompliance with applicable regulatory guidelines or increased the amounts generated beyond available waste management capacity.

4.7.1 Proposed Action

The Proposed Action would not be expected to result in significant impacts due to hazardous materials and solid waste. If contaminated soils are determined to be present at SLC-20, all construction debris, root balls, etc. determined to contain contaminated soils above regulatory thresholds will be retained on site or would be handled and disposed of in accordance with the requirements established by Resource Conservation and Recovery Act (RCRA) and OSHA (Hazardous Materials) and transported in accordance with DOT regulations for shipping hazardous substances. Space Florida’s tenant(s) would develop a Hazardous Materials Contingency Plan and develop and implement proper handling procedures for any payloads containing hypergolic fuels or liquid rocket propellant. Changes in quantities of fuel would be addressed by revising required procedures appropriately. All applicable federal, state, and local rules and regulations would continue to be followed for the proper storage, handling, and usage of hazardous materials by Space Florida’s tenant(s) launch program. Therefore, **negligible adverse impacts** due to hazardous materials management would occur under the Proposed Action.

The approximate quantities of materials that would be used during processing of a routine payload spacecraft would remain the same as for other similar launch vehicles and operations.

Space Vehicle Processing Hazardous Waste Production

The hazardous materials used to process routine payload spacecraft could potentially generate hazardous waste. Space Florida’s tenant(s) would conduct operations with hazardous waste in accordance with existing requirements. Class I ODSs would not be allowed to be used in the payload processing facilities. The approximate quantities of materials that would be used during processing of a routine payload mission would remain the same as for other similar launch vehicles.

Solid waste would be expected to increase slightly with increased launch activities. The amount of solid waste generated would still be handled under existing collection and disposal operations. Space Florida's tenant(s) would develop a Pollution Prevention Management Plan, in coordination with CCAFS pollution prevention plans and goals, and comply with all federal, state, and local regulations. Space Florida's tenant(s) would track the usage of all Environmental Planning and Community Right-to-Know Act (EPRCA)-listed chemicals and report emissions to the responsible government organization at CCAFS. Therefore, **negligible adverse impacts** due to space vehicle hazardous waste production would occur under the Proposed Action.

4.7.2 No-Action Alternative

Under the No-Action Alternative, the Space Florida launch program would not be implemented; therefore, **no impacts** on hazardous materials or hazardous waste management would occur.

4.8 WATER RESOURCES

Specific to this EA, a project may have a significant impact on water resources if it substantially affects a significant water body, such as an ocean, stream, lake, wetland, or bay; causes substantial flooding or exposes people to reasonably foreseeable hydrologic hazards such as flooding; substantially affects surface or groundwater quality or quantity; or exceeds the existing potable water or wastewater system capacities for CCAFS.

This section presents the potential effects to surface-water and groundwater, (including hydrology and water quality), wetlands, and floodplains resulting from implementation of the Proposed Action and 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.*

4.8.1 Proposed Action

Surface Waters

The engine testing and launch operations associated with the Proposed Action are not expected to have any effect on the IRL and BRL due to distance. While the proposed launch vehicle transportation route does pass over the IRL, no impacts are expected as a result of this activity.

The Proposed Action area has been previously disturbed as a result of grading and facility construction. As a result, natural drainage patterns no longer exist. The Proposed Action would not directly impact water resources in or adjacent to SLC-20 or around CCAFS. Only a small 0.19-acre man-made upland cut drainage swale exists within the Proposed Action boundary that would likely remain.

The Proposed Action site development plan would be designed and require an ERP from the SJRWMD with the 45 SW as co-applicant before construction can commence. A stormwater management system would be required to treat stormwater runoff from new proposed impervious surface construction at the launch site. The construction of new impervious surfaces (buildings, roads, etc.) in association with the Proposed Action renovation and repurpose of the SLC-20 area would require State permits that will require a stormwater management system (SMS) to treat and store stormwater based on the proposed site development. This SMS would store and treat stormwater generated from site improvements and will be operated and maintained by Space Florida or the tenant. The SMS would store and filter much of the suspended solids out of the water percolating into the ground, and biological and chemical processes in the SMS would reduce the amount of contaminants found in runoff and minimize pollutants that infiltrate into the water table. Stormwater would infiltrate into the surficial aquifer and not be discharged to downstream surface waters. In addition, a Stormwater Erosion and Pollution Prevention Plan (SWPPP) would be required to address sedimentation and erosion to protect water quality before, during, and after construction. Since the disturbed area is greater than 1 acre, a National Pollutant Discharge Elimination System (NPDES) Stormwater Construction Permit would be required by FDEP and a SWPPP would be implemented. These permit review and issuance processes ensure that the design complies with current and applicable stormwater and wastewater regulations, and is protective of wetlands and surface waters.

Under the Proposed Action, launch deluge wastewater generated by engine testing and launch operations would be contained in new, separate deluge (impermeable concrete) basins. Collected water would be tested, then released to the stormwater retention basins or may be reused and pumped back to the storage tank. Any discharge to the ground surface would require an Industrial Waste Water permit from FDEP and require coordination with 45 SW CES/CEIE. A No Exposure Certification for exclusion from NPDES stormwater permitting would also be required. Space Florida would continue discussions with FDEP and pursue all required permitting for stormwater discharge associated with industrial activity. In addition, SJRWMD ERP #75436 is at the proposed location of the Concept A Pad and the Deluge Containment. Coordination with 45 SW CES/CEIE would occur to modify the permit as needed. With an approximate deluge basin capacity of 45,000 gallons (170,344 L), inadvertent discharge of deluge wastewater from the basin is highly unlikely before testing and controlled discharge to stormwater retention basins.

The intermittent drainage from SLC-20 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. Since the Concept A and B launch vehicles use only LOX, RP-1, and LNG propellants, the exhaust cloud would consist of steam only and would not contain any significant amounts of hazardous materials. The resulting volume of water condensing from the exhaust cloud is expected to be minimal and temporary. Therefore, the Proposed Action is anticipated to result in **negligible adverse impacts** on surface water quality at SLC-20 and surrounding areas.

Groundwater

Neither the Proposed Action nor the No Action Alternative use groundwater for any purpose. Potable water would be supplied by the existing water distribution systems at CCAFS and the Proposed Action would have **no adverse impacts** on system capacity or groundwater resources.

Wetlands

No USACE or SJRWMD jurisdictional wetlands occur within the Proposed Action site and therefore **no impacts** to this resource category are expected.

Floodplains

No floodplains occur within the Proposed Action site and therefore **no adverse impacts** to this resource category are expected. Furthermore, the Proposed Action would not result in new areas being subject to 100-year floods nor would it result in existing areas subject to 100-year floods becoming more flood-prone.

4.8.2 No-Action Alternative

Under the No-Action Alternative, the reuse of SLC-20 and launch of OLVs would not be implemented Therefore, **no impacts** on hydrology, water quality, or floodplains would occur.

4.9 GEOLOGY AND SOILS

Specific to this EA, a project may result in a significant geologic impact if it increases the likelihood of, or results in exposure to, foundation instability, land subsidence, or other severe geologic hazards. It may also be considered a significant geologic impact if it results in the loss of soil use for agriculture or habitat, loss of aesthetic value from a unique landform, loss of mineral resources, or causes severe erosion or sedimentation.

4.9.1 Proposed Action

The Proposed Action is not expected to impact geology and soils. No unique geologic features of exceptional interest or mineral resources occur in the Proposed Action area. Contaminated sediments have recently been removed, which is documented in an EBS (GEAR 2019). As a result, **negligible adverse impacts** to geology or soils is expected.

Operation of the Proposed Action would not affect geology or soils at or near SLC-20. Therefore, **no adverse impacts** on these resources is expected as a result of the operation of the Proposed Action.

4.9.2 No-Action Alternative

Under the No-Action Alternative, the reuse of SLC-20 and launch of OLVs would not be implemented; therefore, no impacts on geology and soils would occur.

4.10 TRANSPORTATION

This section discusses the projected traffic conditions along roadways that may be affected by the Proposed Action.

4.10.1 Proposed Action

The Proposed Action may impact transportation, and an evaluation of current pavement conditions and related infrastructure should be undertaken to assess any changes to roadway structural capacities before any launch vehicle transports. Since the existing transport routes expected to be used were designed to FDOT design standards, no adverse impacts are expected as transport loads are expected to stay within legal limits. Staying within legal load limits would be achieved by using transport vehicles that distribute points load to those below HS-20 design vehicle loads. KSC provided concurrence stating *there are no issues with the transportation route relative to the planned transport and cargo. The vehicle weight and type is within the design parameters of the roadway, and in general the vehicle and cargo is typical to those FDOT roadways* (Appendix G). However, Space Florida tenant(s) would be required to obtain a *Permit for Overweight/Oversize Roadway Vehicle at KSC* when the Firefly program is ready to begin transporting launch vehicles to SLC-20. Correspondence with CCAFS is also provided in Appendix G.

Each transported load would require a slower than posed speed, and in some areas counterflow traffic would need to be blocked and/or re-routed. To reduce any slow-pace traffic effects, vehicle transport would be scheduled in *off-hours* and would avoid peak-flow periods, generally from 6:00 to 9:00 AM and from 3:30 to 5:30 PM. Shipment of these components to CCAFS and to the site would occur no more than 24 times a year. As a result, the Proposed Action would have no significant impacts on traffic in the region.

Traffic volume increases for Proposed Action launches would be expected, but initially are expected to be less than that of a Shuttle launch. In addition, Space Florida tenant(s) would continue to coordinate transportation planning through the appropriate 45 SW and NASA KSC channels, including Cape Support and the KSC Center Planning Office and Construction of Facilities office to minimize transportation operational impacts. Therefore, **negligible adverse impacts** to transportation are expected as a result of the construction and **minor adverse impacts** as a result of the operation of the Proposed Action.

4.10.2 No-Action Alternative

Under the No-Action Alternative, the reuse of SLC-20 and launch of OLVs would not be implemented. Space Florida tenant(s) would not need to transport equipment from Exploration Park to SLC-20 nor launch their vehicles from SLC-20. Therefore, no impacts on transportation would occur.

4.11 UTILITIES

Utility systems evaluated include water (potable and fire protection), wastewater (collection and treatment), electrical supply, and solid waste. Each utility capability was evaluated on the basis of the ability to provide service to CCAFS and to the individual operational launch pad sites such as SLC-20. Attributes considered include processing, distribution/storage capacities, and related factors, such as average daily consumption and projected peak demand. Historic and projected utility use was determined from records of purveyors, regulatory compliance reports, and the application of generally accepted average growth rates.

Specific to this EA, a project may have a significant impact on the water distribution or supply system, wastewater collection or treatment system, solid waste management, and electrical supply system if it substantially affects the capacity of the systems to maintain existing services, substantially affects surface or groundwater quality or quantity, or exceeds the existing potable water or wastewater system capacities for CCAFS. Several state permits may be required based on the final required utility level of service as stated by the July 1, 2020 correspondence with the Florida State Clearinghouse (Appendix H). Proposed Action

Water Distribution and Supply

The potable and non-potable water supply SLC-20 would support the testing of various engines; onsite infrastructure improvements would also be completed to ensure adequate water requirements are met to accommodate up to 45 people. Based on available information, domestic water service to accommodate this demand is estimated to be approximately 1,500 to 2,000 (gal/d) (5,678 to 7,570 L/d) during peak launch operations with the full complement of 45 people present at the site. However, these demands and the adequacy of existing systems would be confirmed upon design development. Currently, 12-inch onsite combined water and fire protection lines serve the facility. The Space Florida launch program's dependence on the water supply would be relatively small and therefore would have **negligible adverse impact.**

Wastewater Collection or Treatment

The wastewater collection and treatment capabilities for operation at SLC-20 were designed to support portions of the Atlas program. Space Florida would reconnect and rehabilitate SLC-20 to the onsite septic tanks. Wastewater collection and treatment for any launch event would be approximately equal to past events. Based on available information, the domestic sanitary service is estimated to be 1,200 to 1,700 gal/d (4,542 to 6,435 L/d) during peak launch operations with the full complement of 45 people present at the site. However, these demands and the adequacy of existing systems would be confirmed upon design development. Sewer service is provided via four onsite septic systems and drain fields. Initially, minor maintenance and renovation of these septic systems may be required for initial operations. However, if offsite sanitary collection services become available along ICBM Road, an onsite lift station, force main, and sewer service lines may be installed to connect to the offsite system. Any future industrial wastewater permits would be obtained by the commercial launch operator with Space Florida for onsite treatment or USAF for transmission to and treatment at the CCAFS WWTP.

Wastewater needs for SLC-20 would have **negligible adverse impact** on available septic tank capabilities or for a future connection to the CCAFS WWTP for the Proposed Action.

Electrical Power

The electrical power capabilities for operation at SLC-20 were designed to support portions of the Atlas program. SLC-20 is currently connected to the electrical supply system. Based on available information, an assumed build-out load of 2,000 to 2,700 kilowatts (kW) would be required for the central pad (Alpha and Beta). Of this load, approximately 750 kW of load would be considered critical load and would be supported with on-site backup diesel-powered generators. This power usage during normal operation and in support of any launch event would be approximately equal or slightly greater than past events.

On-site standby power would also be required using standby diesel generators to accommodate critical systems. A minimum of 3 days' worth of diesel fuel storage (3,000 gal/ 11,356 L) would be required to account for extended storm outages. As discussed with CCAFS personnel, needs for SLC-20 would result in a **negligible adverse impact** on available electrical power capabilities for the Proposed Action.

Natural Resources and Energy Supply

As previously stated, launch complexes on CCAFS draw required electrical power from the City of Cocoa. No new energy supply expansion to those existing power sources would be required to support the Proposed Action and thus **negligible adverse impacts** to natural resources are expected from the construction and operation of SLC-20.

Solid Waste Management

Specific to this EA, impacts on solid waste would be considered significant if they resulted in noncompliance with applicable regulatory guidelines or increased the amounts generated beyond available waste management capacities. Operation of the Evolved Expendable Launch Vehicle (EELV) Program was expected to generate approximately 0.3 ton of solid waste per day (USAF 1998). Operation of the Proposed Action is expected to generate less solid waste than the EELV Program. The Proposed Action is not expected to increase solid waste; therefore, the it would generate **negligible adverse impacts** on solid waste. Space Florida would also develop pollution prevention measures and recycling programs that would reduce overall waste.

4.11.1 No-Action Alternative

Under the No-Action Alternative, the reuse of SLC-20 and launch of OLVs would not be implemented; therefore, **no impacts** on utility systems would occur.

4.12 HEALTH AND SAFETY

Any commercial space firm which enters into a Real Property Agreement with Space Florida is responsible for protecting worker health and safety in accordance with OSHA regulations found in 29 CFR 1926, Safety and Health Regulations During Construction. Specific to this EA, a health and safety impact would be considered significant if the Proposed Action created a substantial or potential hazard to personnel or the general public.

4.12.1 Proposed Action

Construction

On-site facilities will be reviewed for potential hazards at a future date, and Space Florida tenant(s) will work with 45 SW to ensure safety compliance. A project-specific health and safety plan would be developed before any construction activity. In general, health and safety plans identify potential health and safety hazards, fall protection associated with cranes or platforms, electrical hazards, mechanized equipment and hand and power tools risks; define fire and rescue protection and prevention including water safety; outline safety inspections; establish safety equipment requirements such as personal protective equipment, lighting, signs, and barricades; designate materials containment, including handling, storage, use, and disposal processes; and provide necessary training and communication to ensure the safety of construction workers, working personnel, and visitors. In addition, all construction activities would be conducted in accordance with OSHA regulations and the 45 SW safety program. Therefore, implementation of the Proposed Action would have **negligible adverse impacts** to health and safety.

Operations

As described in Section 3.12, AFSPCI 91-701, *Launch and Range Safety Program Policy and Requirements,* and AFSPCMAN 91-710, *Range Safety User Requirements Manual,* provide common requirements for all vehicle classes to ensure operations are conducted safety (Eastern and Western Range [EWR] AFSPCMAN 91-710V2, 2017). The Proposed Action launch providers will be compliant with AFSPCMAN 91-710, which specifies that all facilities, including launch complexes, used to store, handle, or process ordnance or propellants shall be properly sited and approved in accordance with DoD quantity distance criteria and explosive safety standards specified in DoD 6055.9-STD and implemented in Air Force Manual 91-201. The range users are required to submit documentation before use, to include an Operations Safety Plan, Danger Area Information Plan, and Facility Emergency Operating Plan.

The 45 SW Wing Safety office will review, approve, and monitor all prelaunch and launch operations conducted at SLC-20 under the Proposed Action and will impose safety holds if necessary. The intent of a safety hold is to ensure that there are no hazards that are exposed to the public, launch base, launch area, launch complex and range assets greater than those considered to be acceptable by military regulations, state requirements, or public law. These references include, but are not limited to, 42 USC, Chapter 116 Emergency Planning and Community Right to Know; 29 CFR Part 1910.119, Process Safety Management of Highly Hazardous Chemicals; 40 CFR Part 355, Emergency Planning and Notification; 40 CFR Part 68, Subpart G, Risk Management Plan; and Executive Order 12856, Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements. (AFSPCMAN 2016)

The commercial space firm using SLC-20 will be required to coordinate its planned launch schedule with the 45 SW Wing Safety to ensure proper notification of the FAA to allow air traffic control hazard avoidance as well as coordination with the US Coast Guard for timely notification of ship traffic potentially at risk due to overflight scenarios.

Impact debris corridors for launch vehicles would be similar to those regularly established for launch vehicles previously launched from SLC-20 and other CCAFS launch complexes. Debris data developed for other vehicles in compliance with AFSPCMAN 91-710 also satisfies FAA requirements. Impact debris corridors would be established off the coast of Brevard County, Florida to meet security requirements and reduce the hazard to persons and property similar to a launch-related activity. Structure heights of the Proposed Action lightning protection system would be designed to avoid impacts on airfield (Skid Strip [KXMR]) operations.

A common safety practice is to establish restricted-access hazard arcs around the facilities where potentially dangerous explosive materials are present. The purpose of defining these safety arcs, known as an Explosive Quantity-Distance Safety Arc, is to separate the hazardous procedures from other operations and from the general public. For example, regarding launch pads and launch vehicles, before a launch vehicle is erected on a launch pad, a hazard arc is calculated based on the potential hazards of that vehicle (e.g., the types and quantities of propellant onboard, rocket reliability, flight trajectory, and types of debris expected if the flight were terminated) is activated around the launch pad. Operational controls (e.g., evacuation areas, temporary road closures) are established within and at the perimeter of the hazard arc to minimize the potential hazards associated with the operations of the launch range. All payload processing and launch facilities used to store, handle, or process ordnance items or propellants must have an Explosive Quantity-Distance Site Plan. Figure 4-4 and Figure 4-5 provide the maximum quantity-distance safety arc for Concept A for the north pad on SLC-20 for Phase 1 and the Concept B safety arc for the refurbished central pad in Phase 2 of the Proposed Action, respectively. These arcs are based on the maximum amount of explosive material used for either concept as provided in Table 2-3.

All payload and launch programs that use toxic materials must have a Toxic Release Contingency Plan for facilities that use the materials. A Toxic Hazard Assessment must also be prepared for each facility that uses toxic propellants. The Toxic Hazard Assessment identifies the safety areas to be controlled during the storage, handling, and transfer of the toxic propellants. In addition, FAA would conduct a safety review of operations as part of their license application review process.

Hazardous materials such as propellant, ordnance, chemicals, and booster/payload components are transported in accordance with FDOT regulations for inter-state shipment of hazardous substances (Title 49 CFR 100–199). Hazardous materials, such as liquid rocket propellant, are transported in specially designed containers to reduce the potential of a mishap should an accident occur. Rocket engine testing or the operation and launch of Concept A or B vehicles will comply with all applicable federal, state, and local safety regulations for storage, use, and transfer of hazardous materials.

Flight-related risks for each type of launch vehicle at CCAFS are distinct. The 45 SW Safety Office coordinates all operations, including those from SLC-20, with the FAA, US Coast Guard, and other organizations as required to clear potential hazard areas. If necessary, Notice to Mariners (NOTMARs) and Notice to Airmen (NOTAMs) depicting the hazard areas are published at least 24 hours before an operation. A NOTAM is an unclassified notice filed with an aviation authority to alert aircraft pilots of potential hazards along a flight route or at a location that could affect the safety of a given flight by aircraft potentially at risk while in the vicinity of CCAFS.

Additionally, the 45 SW regularly distributes electronic notices of launch-related hazard areas that include local watermen, marinas, and marine transportation companies. Risk criteria have been established by CCAFS to protect the public, mission essential and critical operations personnel, and property from risks associated with operations that occur within CCAFS. These criteria are consistent with the National Range Commanders Council guidelines.

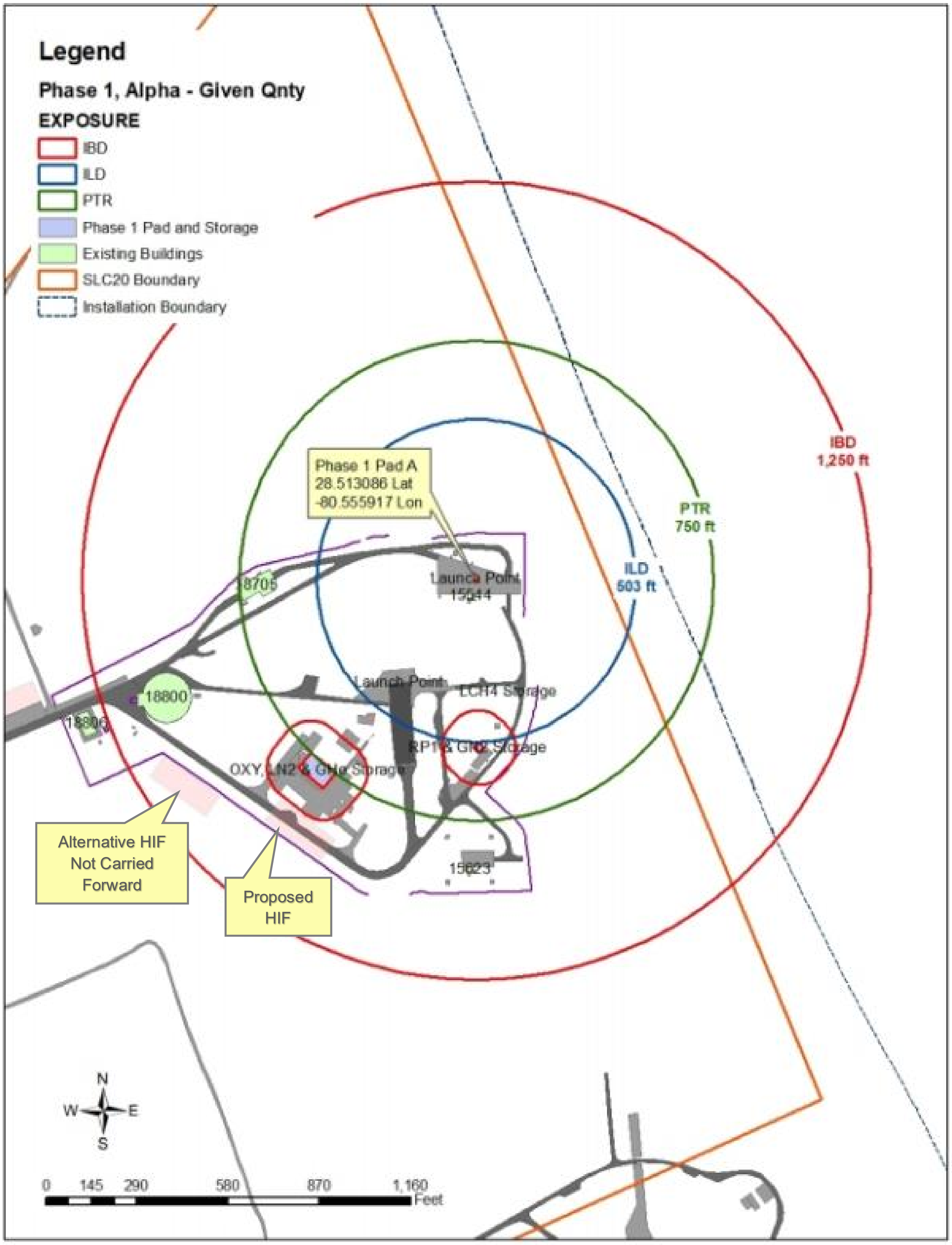

Figure 4-4 Concept A Vehicle Nominal Siting Map (A-P-T Research, Inc., 2020)

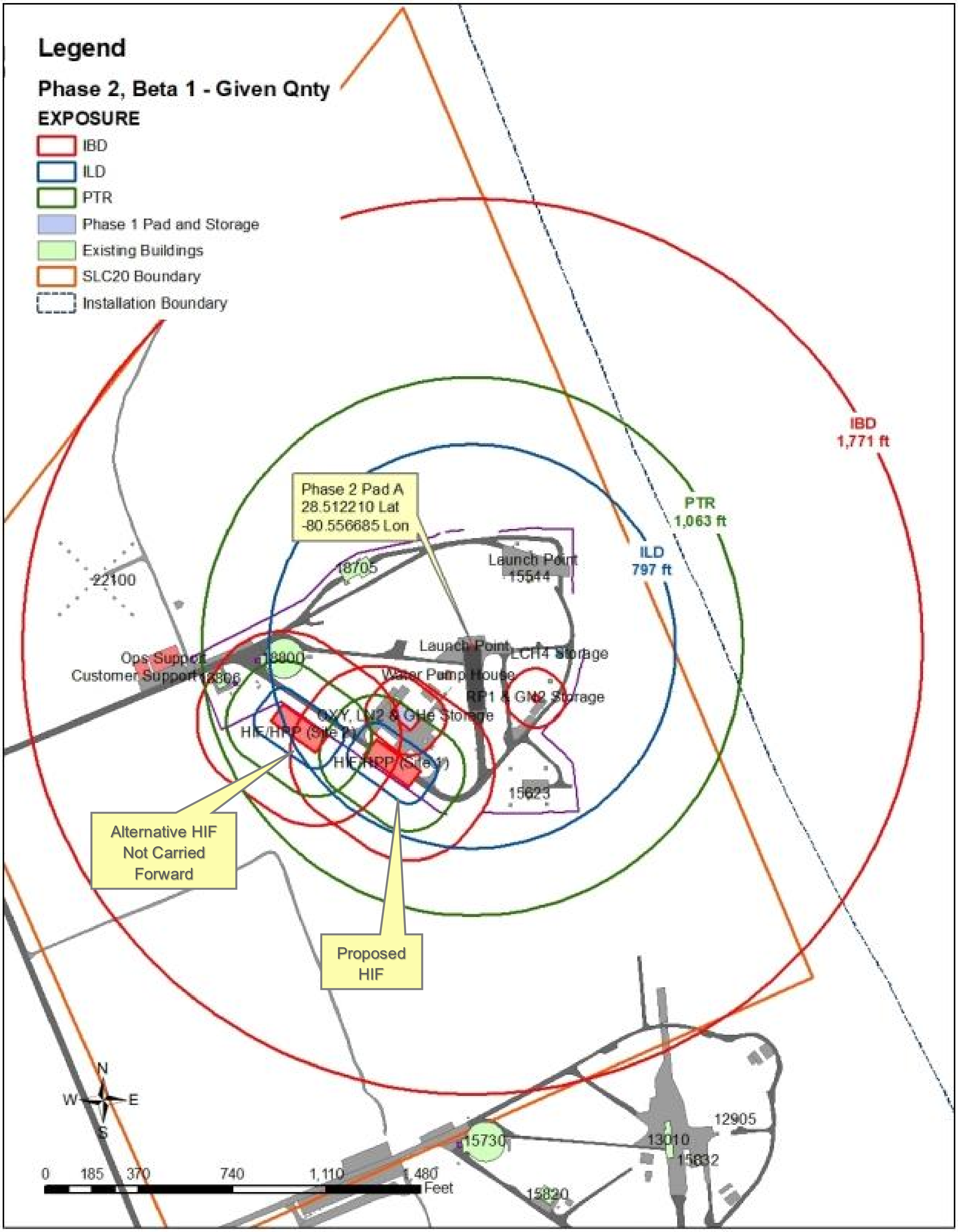

Figure 4-5 Concept B Vehicle Nominal Siting Map (A-P-T Research, Inc. 2020)

Notes: IBD – Inhabited Building Distance; ILD – Intraline Distance; PTR – Public Transportation Route.

A trajectory analysis would be completed before each flight to define the flight safety limits for the launch vehicles at SLC-20 and coordinate that analysis would be coordinated with 45 SW Range Safety for approval. The Proposed Action includes launch vehicles with Flight Termination Systems or Thrust Termination Systems that control the termination by destruction of the vehicle if the flight is deemed erratic or crosses the established destruct boundary. Flight termination boundaries are designed to protect the public and personnel by ensuring that vehicle destruction occurs within a predetermined safety zone.

As a safety measure regarding lightning, the SLC-20 launch complex would be designed to include a Lightning Protection System (LPS). Since the Concept B launch vehicle has a height of approximately 140 feet (42.7 m), the actual maximum height of the LPS at SLC-20 is expected be in the 220- to 250-foot (67 to 76 m) range. Since SLC-20 is approximately 14,000 feet (4,267 m) from the Skid Strip (KXMR) and below the height limitations of 350 to 400 feet (107 to 122 m) across, no impacts to the safety requirements for the airfield would occur from the LPS at SLC-20.

In summary, **negligible adverse impacts** to human health and safety would be expected from the implementation of the Proposed Action.

4.12.2 No-Action Alternative

Under the No-Action Alternative, the reuse of SLC-20 and launch of OLVs would not be implemented. Therefore, no health and safety impacts would occur.

4.13 SOCIOECONOMICS

Specific to this EA, socioeconomic impacts would be considered significant if they:

- Substantially altered the location and distribution of the local population.
- Caused the population to exceed historic growth rates.
- Decreased jobs so as to substantially raise the regional unemployment rates or reduce income generation.
- Substantially affected the local housing market and vacancy rates.
- Resulted in the need for new social services and support facilities.

4.13.1 Proposed Action

The Proposed Action would support the local economy as reconstruction of the SLC-20 launch site would enable other users to assemble, process, test, and launch vehicles for space exploration. The construction phase of this project is expected to generate jobs for the local workforce, along with permanent jobs once construction is complete. Although there may be a slight increase to the local population from the Proposed Action, the growth rate would not be significant. The Proposed Action would not significantly affect the local housing market and would not negatively affect the local economy.

Purely social and economic effects are not required to be analyzed under NEPA. Even if NEPA recognizes socioeconomic impacts from re-routing aircraft due to launches, such impacts would be similar to re-routing aircraft for other reasons (e.g., weather issues, runway closures, wildfires, military exercises, and presidential flights). Potential socioeconomic impacts include additional airline operating costs for increased flight distances and times resulting from re-routing aircraft and increased passenger costs as a result of impacted passenger travel, including time lost from delayed flights, flight cancelations, and missed connections. Alternatively, restricting or preventing a launch event would have socioeconomic impacts on Space Florida, the commercial user for SLC-20, commercial payload providers, and consumers of payload services. Operations would not result in the closure of any public airport during the operation nor so severely restrict the use of the surrounding airspace as to prevent access to an airport for an extended period of time. Given existing airspace closures for launches are temporary and the FAA's previous analyses related to the National Airspace System (NAS) have concluded minor or minimal impacts on the NAS from launches, the FAA does not expect airspace closures from Space Florida's proposal would result in significant socioeconomic impacts. Furthermore, local air traffic controls would coordinate with airports and aircraft operators to minimize the effect of the launch operations on airport traffic flows as well as traffic flows in en-route airspace.

Therefore, the Proposed Action would generate **no negative socioeconomic impacts** on the region and may generate a **negligible positive impact**.

4.13.2 No-Action Alternative

Under the No-Action Alternative, the reuse of SLC-20 and launch of OLVs would not be implemented. SLC-20 would remain under the control of USAF and would not be used by multiple users for space exploration. No construction would occur, and no jobs would be generated by the reconstruction of the SLC-20. There would be no impact on socioeconomics.

4.14 ENVIRONMENTAL JUSTICE

Specific to this EA, a significant impact to environmental justice would occur if:

- There was a significant adverse impact to the natural or physical environment or to health that affected a minority or low-income population or children.
- There was a significant adverse environmental impact on minority or low-income populations or children 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.
- A health or environmental effect occurred in a minority or low-income population affected by cumulative or multiple adverse exposures from environmental hazards.

4.14.1 Proposed Action

Minority and low-income populations exist in Brevard County; however, the Proposed Action is entirely within the boundaries of the CCAFS. No minority or low-income populations reside within CCAFS, and the Proposed Action is not expected to result in any significant impacts. Therefore, the Proposed Action would not disproportionately affect any minority or low-income population or community. Refurbishment and enhancement of SLC-20 is expected to provide additional rocket launch opportunities. Launch noise generated from the Proposed Action is estimated to be lower than launch noise generated from nearby launch sites at CCAFS that use larger launch vehicles. Space Florida does not expect any adverse impacts on public health and/or the socioeconomic environment would appreciably alter the physical and social structure of the nearby minority or low-income populations or communities. Therefore, the Proposed Action would result in **negligible adverse impacts** to environmental justice.

4.14.2 No-Action Alternative

Under the No-Action Alternative, the reuse of SLC-20 and launch of OLVs would not be implemented. SLC-20 would remain under the control of USAF and would not be used by multiple users for space exploration. Therefore, no environmental justice impacts would occur.

4.15 SECTION 4(f) PROPERTIES

According to FAA Order 1050.1F, impacts to Section 4(f) properties would be significant if the action results in 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. Substantial impairment occurs when the activities, features, or attributes of the resource that contribute to its significance or enjoyment are substantially diminished.

4.15.1 Proposed Action

Construction

No designated Section 4(f) properties, including public parks, recreation areas, or wildlife refuges, exist within the boundaries of the Proposed Action or CCAFS. The Merritt Island National Wildlife Refuge (MINWR) is adjacent to KSC and CCAFS, and the Canaveral National Seashore is adjacent to KSC and north of CCAFS. MINWR overlaps the northwest portion of KSC and all areas not directly used for NASA operations are managed by MINWR and NPS. The nearest public park, Jetty Park, is about 5 miles south of SLC-20 in the City of Cape Canaveral. Other public parks within an approximate 15-mile (24.1 km) radius of the Proposed Action include Kelly Park, KARS Park, Kings Park, and Manatee Cove Park. As a result, the construction of the Proposed Action would have **no impact** or effect on Section 4(f) properties.

Operation

Section 4(f) properties within an approximately 15-mile radius of SLC-20 would experience temporary operation-related noise as a result of launches. The increased noise level would only last a few minutes and would occur up to 24 times a year under the Proposed Action.

All pre-launch operations and effects would occur within or very close to the boundaries of SLC-20. Launch vehicles would be launched from SLC-20 and accelerate over the Atlantic Ocean and away from Section 4(f) lands. The above-referenced Section 4(f) properties have been experiencing operational launch noise from CCAFS and adjacent KSC for decades. Therefore, the FAA has determined the Proposed Action would not substantially diminish the use of the protected activities, features, or attributes of any of the Section 4(f) properties identified, and thus would not result in substantial impairment of the properties. The Proposed Action would not result in a constructive use of these Section 4(f) properties and would not invoke Section 4(f) of the DOT Act. The Proposed Action would **not result in significant impacts** on Section 4(f) properties.

4.15.2 No-Action Alternative

Under the No-Action Alternative, the reuse of SLC-20 and launch of OLVs would not be implemented. As a result, no Section 4(f) impacts would occur.

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5.0 CUMULATIVE IMPACTS

5.1 DEFINITION OF CUMULATIVE IMPACTS

The approach taken in the analysis of cumulative impacts in this document follows the objectives of NEPA, CEQ regulations, and CEQ guidance. Cumulative impacts are defined in 40 CFR Section 1508.7 as follows:

> *The impact on the environment that results from the incremental impact of the action when added to the other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.*

Cumulative impacts are most likely to arise when a relationship or synergism exists between a proposed action and other actions expected to occur in a similar location or during a similar time period. Actions overlapping with or near the proposed action would be expected to have more potential for a relationship than those more geographically separated. Similarly, relatively concurrent actions would tend to offer a higher potential for cumulative impacts. To identify cumulative impacts, the analysis needs to address the following three fundamental questions:

1. Does a relationship exist such that impacts to affected resource areas by the proposed action might interact with the impacts to resources of past, present, or reasonably foreseeable actions?
2. If so, what would the combined impact be?
3. Are there any potential significant impacts not identified when the proposed action is considered alone?

5.2 ACTIONS AFFECTING RESOURCES OF CONCERN

The overall geographic scope of analysis consists of CCAFS and the immediately surrounding area. The timeframe for the analysis must include the past, present, and future. For most resource areas, the period within the last 5 years at CCAFS marks the past temporal boundary for the cumulative impacts analysis. The future temporal boundary includes the life of the proposed action (i.e., 2020–2025) and other reasonably foreseeable actions within the overall timeframe. The temporal boundary for the present is defined by actions in detailed planning, under construction, or that have been recently initiated. Since the potential effects to resources carried forward in the cumulative impacts analysis may require several years to recover following the end of the Launch Site Operator’s License (LSOL), the future temporal boundary is bound by activities that can be reasonably foreseen, as well as the standard FAA license duration, which is approximately 5 years.

The Proposed Action was found to result in no, negligible, or minor direct/indirect adverse impacts to the resource categories analyzed in this EA. Since the direct and/or indirect impacts to these resource areas are localized and temporary and the respective resources are expected to recover within a short period of time, another action would need to occur in the same localized area at the same time for cumulative impacts to be possible.

5.2.1 Past Actions

In accordance with CEQ's guidance, past actions are relevant and useful in analyzing if the reasonably foreseeable effects of the Proposed Action may have a continuing, additive, and significant relationship to those effects. Table 5-1 provides a list of current and vehicle launches in the past 5 years at KSC and CCAFS.

Table 5-1 Past Vehicle Launches at KSC and CCAFS

Year	Total Number of Launches			
	Delta IV	Atlas V	Falcon 9 (LC 40) and Falcon Heavy (LC 39A)	Total
2014	4	6	6	16
2015	2	8	8	18
2016	3*	7	8	18
2017	1	4	13	18
2018	1	4	15	20
2019	2	-	11	13
Totals	**13**	**29**	**61**	**103**

Note: * One Delta launch in 2011 was a Delta II 7000.
Sources: 45 SW, 2019; FAA, 2019a; SpaceX, 2019.

5.2.2 Present and Reasonably Foreseeable Actions

Present actions include those actions that are undergoing detailed planning phases, under construction, or that have been recently initiated. Table 5-2 lists the eight active licenses at CCAFS. In addition, Table 5-3 lists the planned vehicle launches at CCAFS.

Figure **5-1** shows the planned future launches and potential future launches.

Table 5-2 Active Commercial Space Transportation Licenses at CCAFS

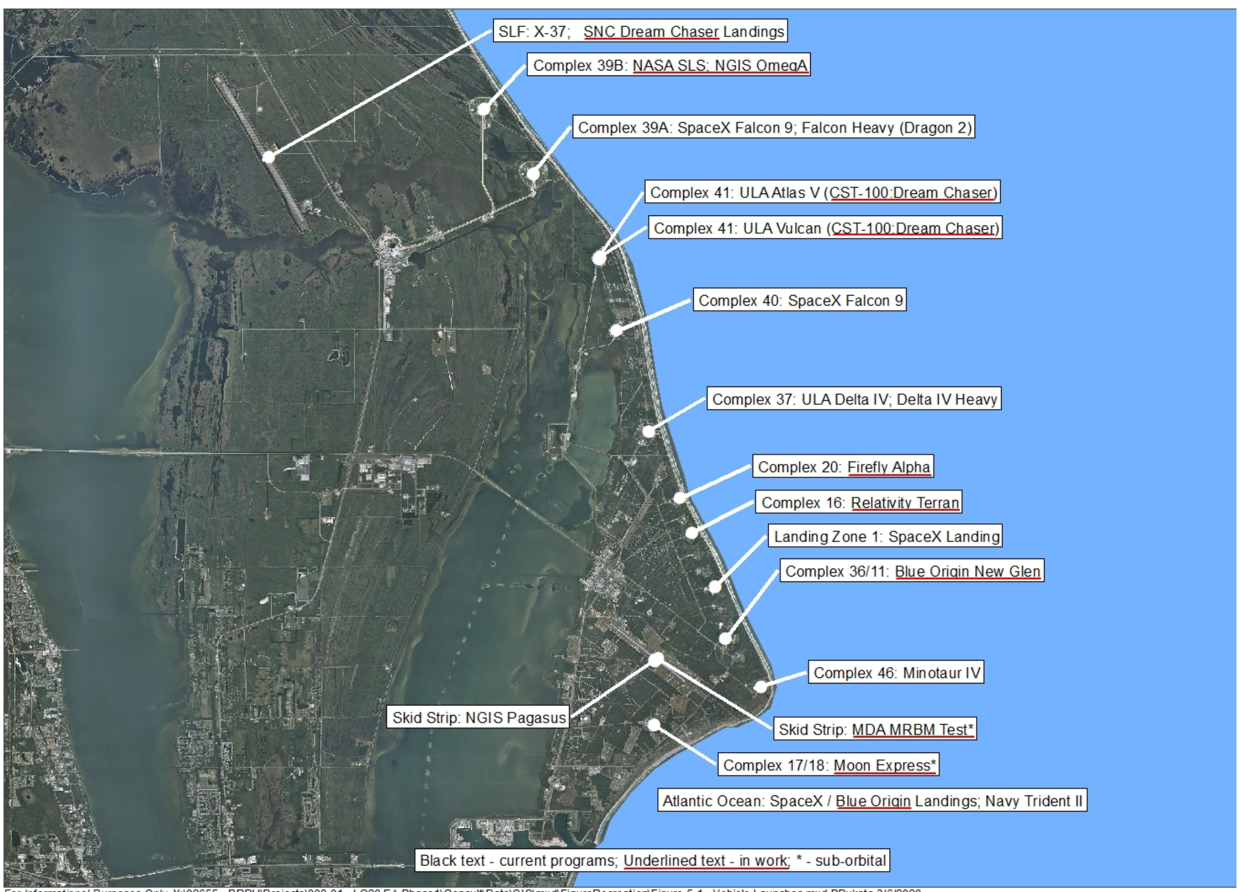
Company	License Number	Vehicle	Launch Complex	License Expiration
Space Exploration Technologies Corporation (SpaceX)	LLO 19-110 (Rev 1)	Falcon 9	39A	February 14, 2024
United Launch Alliance	LLO 18-113	Atlas IV	37	May 31, 2023
SpaceX	LLO 18-105 (Rev 1)	Falcon 9	40	January 18, 2023
Orbital Sciences Corp	LLO 17-099	Minotaur IV	46	February 9, 2022
Lockheed Martin Commercial Launch Services	LLO 01-064	Atlas V	-	December 13, 2021
Orbital Sciences Corp	LLO 01-059 (Rev 2)	Pegasus	Skid Strip	March 17, 2021
United Launch Alliance	LLS 17-098	Atlas V-401	41	February 1, 2021
SpaceX	LLS 20-119)	Falcon 9 and Dragon-2	39A	January 16, 2021

Source: FAA 2019b; FAA 2020b

Table 5-3 Future Planned and Projected Vehicle Launches at CCAFS

Year	Launch Vehicles (Anticipated Number of Launches)						Total
	Firefly A/B	Delta IV	Vulcan Centaur	Atlas V	Falcon 9 (LC 40), Falcon Heavy (LC 39A), and Starship Super Heavy (LC-39A)	Blue Origin	
2020	24	1	2	6	38	1	72
2021	24	-	8	2	64	4	102
2022	24	-	10	2	64	8	108
2023	24	-	12	2	70	10	118
2024	24	-	14	2	70	12	122
Total Maximum Annual Launches Based on Drive to 48 Goal							**522**

Sources: 45 SW, 2017; 45 SW, 2019; FAA, 2019a; FAA, 2019b; NASA 2019; SpaceNews, 2018; Space Florida, 2018.



For Informational Purposes Only Y:\02655 - BRPH\Projects\008-01 - LC20 EA Phase1\Consult\Data\GIS\mxd\FigureRecreation\Figure 5-1 - Vehicle Launches.mxd BBukata 3/6/2020

Figure 5-1 Past and Reasonably Foreseeable Vehicle Launches

5.3 CUMULATIVE IMPACT ANALYSIS ON RESOURCE AREAS

5.3.1 Land Use/Visual Resources

The Proposed Action would not result in any significant impacts to land use compatibility since the Proposed Action site is an existing abandoned launch complex and CCAFS and KSC currently allow space vehicle operations. The Proposed Action would not generate impacts on visual resources locally due to the presence of other launch complexes in the vicinity or regionally (within the flight range) other than a possible short-lived visible vehicle contrail.

Cumulative impacts on land use from increased launch vehicle and landing operations at KSC and CCAFS would be minimal since the site is a former launch complex. Development of a manufacturing facility at Exploration Park Phase I will have no effect on land use since the site is already cleared and utilities installed for a development. As a result, the overall cumulative effect of other past, present, and reasonably foreseeable future actions on land use and visual resources is considered negligible. When considered with other past, present, and foreseeable future actions, the Proposed Action would not contribute a noticeable incremental impact. Accordingly, the Proposed Action will not result in a significant impact on land use and visual resources.

5.3.2 Noise

A short-term, small increase in the noise level received in the community from launches resulting from the Proposed Action may occur; however, the event would be similar to other launches and would be a relatively short-term impact. The sonic booms that may occur would be over the ocean, and would not be considered a significant impact. Construction-related noise would be local, short term, and would be managed using OSHA guidance.

As a result, the overall cumulative effect when combined with other past, present, and reasonably foreseeable future actions from noise is considered minor and not significant. Additionally, two simultaneous launches in the ROI would never occur. When considered with other past, present, and foreseeable future actions, the Proposed Action would not contribute a noticeable incremental impact.

5.3.3 Biological Resources

The launch event would not be expected to have a significant impact on terrestrial vegetation, wildlife, marine species, or protected wildlife species beyond similar launch activities that occur at CCAFS or KSC. In the event of a mishap down range over the open ocean, impact to wildlife would not be significant given the relatively low density of species within the surface waters of these open ocean areas (USAF 1998).

The Proposed Action would primarily occur within a previously cleared and developed former launch complex but would result in clearing of 0.3 acre (0.1 ha) of natural scrub habitat. This habitat would result in a reduction of scrub habitat acreage for future restoration. Space Florida will conduct beach mouse habitat restoration within a portion of the area shown on Figure 4-3.

Cumulative impacts on the gopher tortoise are not expected with the Proposed Action. Gopher tortoise burrows to be impacted by ground disturbance or at risk of burrow collapse due to transportation of launch vehicle to pads would be excavated and relocated to a 45 SW-approved recipient site.

Cumulative impacts on southeastern beach mice are not expected for the Proposed Action. Although southeastern beach mice are known to occur in the area, no clearing or construction in dune habitat is proposed. Regardless, Space Florida will conduct beach mouse habitat restoration within a portion of the area shown on Figure 4-3. This habitat enhancement will help to provide high quality habitat and a corridor to additional suitable interior habitat.

Preparation of and adherence to a LMP and 45 SW lighting policies would minimize impacts to marine turtles. Amber LED lighting would be used to minimize potential adverse impacts on nesting turtles and/or their young. According to Section 3 of the USFWS BO (Appendix C), no known state, local, or private actions are reasonably certain to occur in the action area that would result in cumulative effects to the Florida scrub-jay, southeastern beach mouse, eastern indigo snake, and sea turtles. Additionally, cumulative impacts on American alligator, wood stork, piping plover, and red knot are not expected to occur with the Proposed Action.

Mitigation actions discussed in Section 4.3 of this EA and the USFWS BO (Appendix C) would be accomplished to minimize the effect on threatened and endangered species due to construction activities. Impacts from other construction-related actions would not be significant. The numbers of listed species that occur within the former launch complex are low, and loss of 0.3 acre (0.1 ha) of native upland scrub habitat would not contribute to the decline of any protected species populations. Loss of scrub habitat would be small and will be mitigated through the enhancement of dune and coastal scrub habitat as previously discussed. Specific to prescribed burning, the 45 SW will revise its approach with current and future users and Space Florida to ensure adequate burn windows occur annually to allow 45 SW to meet its habitat management goals agreed to with the resource agencies. Operational controls will be implemented that will provide more assurance that CCAFS will meet its burning goals as part of its land management unit responsibilities. In addition, Space Florida will incorporate language into their tenant lease agreements that references the 45 SW prescribed burn goal, listed species management responsibilities, and resulting annual restrictions (1 to 2 weeks) during a 45 SW predefined period. As part of the lease agreement with Space Florida, the tenants will have a contractual obligation to comply with the specified prescribed burn days schedule by providing adequate protection for their equipment (via containment or filtration systems) or moving sensitive equipment to another location while the prescribed burn days are in force.

The overall cumulative effect of other past, present, and reasonably foreseeable future actions on biological resources are considered minor and not significant given the scrub-jay/southeastern beach mouse and sea turtle mitigation measures. When considered with other past, present, and foreseeable future actions, the Proposed Action would not contribute a noticeable incremental impact on biological resources.

5.3.4 Cultural Resources

As stated in Section 4.4.1, no adverse impacts to cultural resources would result from the implementation of the Proposed Action. Therefore, there is no potential for cumulative impacts when considered with other past, present, and reasonably foreseeable actions.

5.3.5 Air Quality

In terms of short-term cumulative impacts, the construction projects proposed under the Proposed Action and other regional projects could produce short-term additive amounts of emissions if they are concurrent. For the reasons stated in Section 4.5.1, the emissions resulting from implementation of the Proposed Action would be minor. Therefore, air emissions from other past, present, and future actions are not expected when considered incrementally with the Proposed Action would not be significant.

In terms of long-term cumulative impacts, operational emissions associated with the Proposed Action and other present and reasonably foreseeable projects are expected to be temporary especially considering the launch vehicles would accelerate rapidly and the high temperatures would cause the air emissions to rise and disperse with the prevailing winds. No other long-term emission sources have been identified. Therefore, no significant cumulative impacts to air quality are expected from implementation of the Proposed Action.

5.3.6 Climate

According to the WMO's 2018 Quadrennial Global Ozone Assessment, rocket launches have a small effect (much less than 0.1 percent) on total stratospheric ozone. Overall, future cumulative impacts are dependent on rocket design, launch vehicle sizes, launch rates, spaceport locations, and fuel types. Gaps remain in understanding rocket emissions and their combined chemical, radiative, and dynamical impacts on the global stratosphere and in projections of launch rates; however, cumulative impacts are not expected to be significant.

5.3.7 Hazardous Materials and Hazardous Waste

The Proposed Action would have operations that use products that could contain hazardous materials, including paints, solvents, oils, lubricants, acids, batteries, propellants, ordnance, and chemicals, which are routinely used at CCAFS. Numerous types of hazardous materials are used to support the missions and maintenance operations at CCAFS and KSC. Existing handling and management procedures for hazardous materials, hazardous wastes, and solid wastes generated would continue to be required to limit the potential for impacts. Management of hazardous materials is the responsibility of each individual or organization and is regulated under RCRA (40 CFR 260-280) and Rule 62-730, FAC. Although releases of hazardous materials and wastes can occur in the environment, substantial contamination concerns are not expected as a result of the Proposed Action. Procedures are in place to minimize the release of toxic chemicals into the environment, and rapid emergency response plans are used to ensure that accidental spills would be cleaned up quickly.

Land clearing, recontouring, removing, or excavating soils would fall under Land Use Control restrictions; therefore, coordination for any off-site disposal will be required. All soils will be retained within the SWMU boundary and within or close to the contaminated area to prevent the spread of contamination to uncontaminated areas. As a result, the overall cumulative effect when combined with other past, present, and reasonably foreseeable future actions from hazardous materials and waste are not significant. Therefore, the Proposed Action would have a negligible contribution to impacts from hazardous materials and waste.

5.3.8 Water Resources

No USACE or SJRWMD wetlands or floodplains occur within the Proposed Action boundary. As a result, current and future launch events would not have a significant impact on wetlands and floodplains within the Proposed Action boundary or in adjacent areas. Cumulative loss of floodplain function and values in the area may occur due to additional unrelated development (from several projects) in the floodplain. Although floodplains are generally avoided, State and Federal regulations would require on-site compensation of the floodplain loss if construction is permitted in the floodplain.

As stated in Section 4.8.1, the construction of new impervious surfaces (buildings, roads, etc.) in association with the Proposed Action renovation and repurpose of the SLC-20 area would require State permits that will require a SMS to treat and store stormwater based on the proposed site development. This SMS would store and treat stormwater generated from site improvements and will be operated and maintained by Space Florida or the tenant. The SMS would store and filter much of the suspended solids out of the water percolating into the ground, and biological and chemical processes in the SMS would reduce the amount of contaminants found in runoff and minimize pollutants that infiltrate into the water table. Stormwater would infiltrate into the surficial aquifer and not be discharged to downstream surface waters. When considered with other past, present, and foreseeable future actions, the Proposed Action would not contribute a noticeable incremental impact on water resources. As a result, the overall cumulative effect when combined with other past, present, and reasonably foreseeable future actions on water resources is not significant.

5.3.9 Geology and Soils

The Proposed Action would not impact geology and soils. Therefore, there is no overall cumulative effect to this resource.

5.3.10 Transportation

The Proposed Action would negligibly increase traffic for CCAFS employees and contractors but not the public since CCAFS is a restricted area. KSC and CCAFS traffic may be affected during transport of launch vehicle stages to SLC-20. However, time of transport would avoid heavy morning and late afternoon traffic.

The Proposed Action would not contribute a noticeable incremental impact on transportation. As a result, the overall cumulative effect on transportation is considered negligible when combined with other past, present, and reasonably foreseeable future actions.

5.3.11 Utilities

There would be a low demand for additional electrical power for the Proposed Action and therefore direct cumulative impacts would be negligible.

Water for CCAFS and KSC is acquired from the City of Cocoa’s municipal potable water distribution system under a long-term agreement, which has over a 37-million-gallon-per-day (MGD) capacity. The City’s contract is with the US Government and includes KSC, CCAFS, and Patrick Air Force Base. A total of 6.5 MGD is allocated for all three facilities. Historically, total water consumption by all three facilities has averaged only 3.7 MGD. Current and future actions would require a water supply to successfully function. However, water supply requirements would be minimal compared to available supply.

Wastewater from the Proposed Action would be treated with on-site septic system until centralized sewer service lines are installed along ICBM Road. Thus, the CCAFS wastewater plant would not need to accommodate this facility.

The Proposed Action would not contribute a noticeable incremental impact on utilities. As a result, the overall cumulative effect when combined with other past, present, and reasonably foreseeable future actions on utilities is considered negligible.

5.3.12 Health and Safety

Similar to all other launch and hazardous operations at CCAFS, the Proposed Action must account for public safety distances and may require road closures. Road closure is not expected for engine test periods. Similar to other launch vehicle providers at CCAFS and KSC who close roads periodically to assure public safety, Space Florida would implement engineering design controls to limit impacts of payload processing such that road closures would be avoided. Coordination would be developed to minimize impact when considered in context with other CCAFS clients. The Proposed Action does not require transportation mitigation measures beyond that of similar launch activities that occur at CCAFS or KSC.

Space Florida tenant(s) would follow the existing rigorous USAF launch safety certification process and would be required to gain a launch license from the FAA, both of which would require a detailed public safety risk assessment to assure that safety impacts to the public meet Federal and USAF standards. Public clear distances to be implemented on launch days would be limited to CCAFS. Over time, this impact is expected to be no greater than current launch operations at CCAFS. The Proposed Action would not result in a substantial increase in potential impacts to health and safety of the public.

When considered with other past, present, and foreseeable future actions, the Proposed Action does not significantly impact health and safety.

5.3.13 Socioeconomics

Short-term beneficial impacts from the Proposed Action and other similar efforts would occur from past, present, and reasonably foreseeable projects. However, the overall scope of the construction associated with the proposed action is relatively small in scope and short in duration. While there would be an increase in construction spending resulting from a short-term demand for construction and secondary jobs, it is anticipated the regional labor force would absorb the increased demand for direct construction and associated secondary jobs. Furthermore, construction spending, as well as additional taxes would accrue to federal, state, and local governments as a result of the increased construction activities; however, these would be minor and temporary.

Long-term cumulative impacts are associated with the Proposed Action and other similar efforts from present and reasonably foreseeable projects as a result in an increase of space tourism. According to Visit Florida (2019), more than 126 million tourists visited Florida in 2018, an increase of 7.2 percent over 2017. Specific to Brevard County, tourism is a $2.1 billion-a-year industry and is responsible for 26,000 jobs (Florida Today 2019). As part of Brevard County's 2019-2020 proposed plan, efforts are underway to grown tourism further. The beneficial cumulative impacts associated with the Proposed Action and other past, present, and future actions would not be significant as plans are in place to ensure the proper infrastructure exists to accommodate the increase. Therefore, the beneficial socioeconomic impact from other past, present, and future actions when considered incrementally with the Proposed Action would not be significant.

5.3.14 Environmental Justice

The Proposed Action would not result in disproportionate impacts to minority or low-income populations or communities. The operations at SLC-20 would be consistent with historical and current launch noise. Therefore, there would be no significant cumulative impacts to Environmental Justice as a result of implementing the Proposed Action.

5.3.15 Section 4(f) Properties

No designated Section 4(f) properties, including public parks, recreation areas, or wildlife refuges, exist within the boundaries of the Proposed Action or CCAFS. The MINWR is adjacent to KSC and CCAFS, and the Canaveral National Seashore is adjacent to KSC and north of CCAFS. The nearest public park, Jetty Park, is about 5 miles (8.0 km) south of SLC-20 in the City of Cape Canaveral. Other public parks within an approximate 15-mile (24.1 km) radius of the Proposed Action include Kelly Park, KARS Park, Kings Park, and Manatee Cove Park.

As stated in Section 4.15, the construction of the Proposed Action would have no impact or effect on Section 4(f) properties. Section 4(f) properties within an approximately 15-mile radius of SLC-20 would experience temporary operation-related noise as a result of launches. The increased noise level would only last a few minutes and would occur up to 24 times a year under the Proposed Action. As a result, the Proposed Action would not substantially diminish use of the protected activities, features, or attributes of any of the Section 4(f) 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 Section 4(f) properties, would not invoke Section 4(f) of the DOT Act, and thus would result in negligible adverse impacts. When combined with other past, presents, and future actions at CCAFS, the Proposed Action would result in added operational launch noise, since noise has been historically associated with launches from CCAFS and adjacent KSC. The additional noise from operation of SLC-20 is not expected to result in a significant adverse cumulative impact since the launches would accelerate over the Atlantic Ocean and away from these properties.

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APPENDIX A

Exploration Park Phase I Record of Environmental Consideration

APPENDIX B

BRRC Noise Report

APPENDIX C

USFWS Biological Opinion

APPENDIX D

Biological Assessment

APPENDIX E

NMFS Consultation

APPENDIX F

Cultural Resource Documents

APPENDIX G

Transportation Concurrence Correspondence

APPENDIX H

Florida State Clearinghouse Correspondence

APPENDIX A

Exploration Park Phase I Record of Environmental Consideration

Avoid Verbal Orders

TO: Space Florida/Pete Eggert **DATE: 08/20/2019**
FROM: SI-E3/Environmental Management Branch
SUBJECT: KSC Record of Environmental Consideration (REC) **REC #: 10766**

1. PROJECT INFORMATION

Project Title: Firefly Aerospace Manufacturing Facility

Project Lead: Pete Eggert, Space Florida, 321-730-5301 x123 **Project No.:** SPFL_Firefly_8-15-2019

Project Description:
Construction of approximately 182K sq ft Manufacturing Facility in Exploration Park Phase 1. Please see aerial photos, location, and conceptual layout/site plan attached to checklist for details.
Future expansion development is also shown, but Space Florida or Tenant would request update of REC when required, only included for reference at this time.

EPB Reviewer: LPH **Facility No.:** Firefly Manufacturing Facility

2. NEPA DETERMINATIONS

- ☐ **a. Categorical Exclusions per 14 CFR Part 1216.304(d)**
- ☐ **b. Environmental Assessment (EA) Required**
- ☐ **c. Environmental Impact Statement (EIS) Required**
- ☑ **d. Existing FONSI or ROD**
- ☐ **e. Centerwide EIS**
- ☐ **f. AF Project on KSC/813**
- ☐ **g. NASA Project on CCAFS/813**

3. ENVIRONMENTAL REQUIREMENTS

a. Non-Permit Requirements	☑ **YES**	☐ **NO**
b. Permit Requirements	☑ **YES**	☐ **NO**

2.a.1. ENVIRONMENTAL ASSESSMENT (EA): The proposed action under the Firefly Aerospace Manufacturing Facility construction project was covered under the original Finding of No Significant Impact (FONSI) for the EA developed for Exploration Park - Phase 1 in December 2008. For additional information, please contact Don Dankert of the NASA Environmental Management Branch (SI-E3, 861-1196).

3.a.1. MANHOLE DEWATERING POTENTIAL RELEASE LOCATION (PRL): This project may include work within the boundary of PRL 204, Manhole Dewatering Operations. There is an institutional control being implemented on the soil within a 25 ft radius of manholes on KSC. The soil adjacent to telecommunications and electrical manholes is contaminated with barium, copper, lead and polynuclear aromatic hydrocarbons. The maximum concentrations found are barium at 410 mg/kg, copper at 440 mg/kg, lead at 4,900 mg/kg and B(a)P Equivalent at 35.4 mg/kg. If handling the soil (excavation or any other activity in which the soil is disturbed and handled by workers) within 25 ft of a manhole, contact your company's Safety and Health Office for recommendations on appropriate personal protective equipment (PPE). All soil being disturbed within 25 ft of the manhole being dewatered must remain within that 25 ft radius. If this is not possible the soil must be properly disposed. All efforts should be made to cause the dewatered effluent to be discharged in a sheet flow along grade and not be allowed to scour the soil at the discharge point. Erosion protection will be provided as needed and applicable to prevent the disturbance/erosion of soil due to construction activities and dewatering near manholes. For more information, or if soil must be disturbed, please contact Mike Deliz (SI-E2, 867-6971) to discuss control/disposal options.

3.a.2. HAZARDOUS/NON-HAZARDOUS WASTE: All hazardous and non-hazardous wastes must be properly containerized, stored, labeled, manifested, shipped, and disposed of by Space Florida or their tenant Firefly Aerospace in full regulatory compliance. Hazardous wastes generated by this activity must be manifested, shipped, and disposed of under the Space Florida or Firefly Environmental Protection Agency (EPA) identification number for the premises. Firefly shall maintain copies of waste management records and manifests onsite and make them available for review by NASA upon request. Firefly is responsible for any spills, releases, or other environmental contamination that occurs as a result of the proposed activities. A KSC Pollution Incident Report (PIR) Form (KSC Form 21-555) must be completed and submitted to the NASA Environmental Assurance Branch (EAB) within three (3) calendar days of the incident. All releases must be reported immediately by calling 321-867-7911, and then to the NASA EAB by calling 321-867-9005. A Pollution Incident Report (PIR) Form (KSC Form 21-555) must be completed and submitted to the NASA EAB within three (3) calendar days of the incident at KSC-DL-NASA-Env-Spill@mail.nasa.gov.

3.a.3. HAZARDOUS AND CONTROLLED WASTE (PAINT): This project will involve the application of paint coatings. All practical precautions must be taken to eliminate the possibility of a release of material or waste into the environment (primers/paints) from the paint surface preparation and painting operation. Paint chips, rust, debris, blast media, wastewater, etc. generated during preparation of surfaces will be contained and disposed of according to waste management guidelines given above in item 3.a.2.

3.a.4. PAINT DISTURBANCE/REMOVAL: Any future project involving disturbance/removal of paint coatings at this facility has the potential to encounter the 8 RCRA hazardous metals (Ag, As, Ba, Cd, Cr, Hg, Pb, and Se) and PCBs. Materials with coatings which contain heavy metals or PCBs must be managed and disposed in accordance with OSHA standards and hazardous waste regulations. Disposal of painted materials: Painted construction and demolition waste items will be accepted at the KSC Class III Landfill without PCB or TCLP analysis but must be managed according to PCB bulk product waste storage regulations in 40 CFR Part 761 until disposal in the landfill. This includes covering the materials and storing them on an impermeable surface for protection against precipitation and prevention of soil contamination. Guidelines for disposal of items at the KSC Class III Landfill are outlined in Kennedy NASA Procedural Requirements (KNPR 8500.1, Chapter 14). Contact Zach Hall (SI-E2, 867-5178) for the current version of these requirements.

3.a.5. STORAGE TANKS: The NASA Environmental Assurance Branch (SI-E2) considers Firefly Aerospace to be the responsible party to ensure regulatory compliance associated with the proposed installation of the petroleum storage tank system or any petroleum storage tank systems in accordance with the requirements of Florida Administrative Codes 62-761 and 62-762. Depending on the size of the petroleum storage tank it may be required to be registered with the State of Florida. The Florida Department of Environmental Protection (FDEP) has contracted the responsibility to ensure registered storage tank compliance in Brevard County to Brevard County Natural Resource Management Department (BCNRMD).

3.a.6. SPILL PREVENTION, CONTROL, AND COUNTERMEASURES (SPCC) PLAN: Owners or operators of a facility that produces, stores, or consumes oil or petroleum products in amounts of 1,320 gallons or greater, and could potentially discharge oil in quantities that may be harmful, are required by the U. S. Environmental Protection Agency to prepare a spill prevention, control, and countermeasures (SPCC) plan. An SPCC plan documents the procedures for the prevention, response, control, and reporting of spills of oil to navigable waters or adjoining shoreline. This plan serves as a guide for personnel and organizations responsible for ensuring that all measures are taken to prevent and contain spills and leaks of oil in accordance with Chapter 40, Code of Federal Regulations (CFR) Part 112. Fuel transfers from the storage tank to mobile refuelers would also require spill prevention procedures and countermeasures, such as spill kits, to be available during fuel transfers. In most cases, a professional engineer is required to prepare and/or amend an SPCC plan. Firefly Aerospace is responsible for the development of their SPCC Plan.

3.a.7. THREATENED AND ENDANGERED/PROTECTED SPECIES: Operations and development at the Firefly Aerospace Manufacturing Facilty site have the potential to impact protected or threatened and endangered wildlife species including the Eastern indigo snake and the gopher tortoise. Measures must be taken to minimize impacts to the wildlife and their habitat. If indications of activity by any protected species are present in the project area, possible impacts must be evaluated, and in the case of the gopher tortoise, the burrows must be identified and avoided if possible. If identified burrows are within the area of construction, relocation of animal in question will be required.

Relocation of gopher tortoises requires a Florida Fish and Wildlife Conservation Commission permit. Additional information on gopher tortoise permits can be found at http://myfwc.com/license/wildlife/gopher-tortoise-permits/.A biological survey will be required to identify potential impacts to habitat within the two weeks immediately preceding start of site work. After the survey has been performed and if gopher tortoise burrows are observed please contact Becky Bolt (IMSS-200, 867-7330). If any indigo snakes are observed, halt all work until the snake has left the area and please inform Becky of the sighting. Do not harm or harass the snakes. Becky is available to conduct a brief wildlife awareness training session for workers either on site or at another location. Please contact Becky at 867-7330 to schedule this wildlife awareness briefing prior to starting land disturbance and equipment mobilization.If vegetation clearing or any disturbance of vegetated areas is necessary, a biological survey will be required to identify potential impacts to habitat and wetlands prior to disturbances.

3.a.8. EXTERIOR LIGHTING: The installation/modification and use of any lighting that is visible from the exterior of a facility or structure must be in compliance with the requirements in the KSC Exterior Lighting Guidelines in Chapter 24 of KNPR 8500.1 Rev. E, and requirements of the US Fish and Wildlife Service Biological Opinion for KSC regarding dark skies and artificial lighting. Safety and hazardous operations can apply for a waiver to allow for use of non-compliant lighting; however, justification must be provided to the NASA Environmental Office. Development of a lighting operations manual (LOM) that meets these criteria is required for all new structures or facilities. Please contact Don Dankert, NASA Environmental Management Branch (SI-E3) at 861-1196 for additional information, and for guidance on development of a LOM or for a copy of the referenced documents.

3.a.9. EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICES (BMPs): Precautions must be made to eliminate or reduce to the greatest extent possible any discharge of sediments outside established project boundaries. This can be accomplished by initiating proactive erosion control BMPs. Installation and maintenance of appropriate erosion/sediment control devices (such as wattles, turbidity screens, silt fences, inlet protectors, floating turbidity booms, etc.) must be completed prior to initial land disturbance where the possibility of sediment discharge could impact surrounding stormwater conveyances and other surface waters. The BMPs must be maintained so they remain functional until such time that the newly exposed soils are stabilized with sod or natural vegetation.

3.a.10. CONCRETE WASHOUT: Water used to rinse out concrete trucks and other equipment used for concrete work must not be allowed to discharge to surface waters. Concrete washout water shall be diverted to a settling pond where suspended material will settle out and the water can percolate into the ground. Contact Doug Durham (SI-E2, 867-8429) with any question on this requirement. Remove and dispose of hardened concrete waste consistent with your handling of other construction wastes. After drying/settling, the residue may be disposed of at the Diverted Aggregate Reclamation and Collection Yard (DARCY); and the ground restored. Clean, unstained, unpainted concrete residue is accepted at the DARCY without any sampling and analysis. Contact Zach Hall (SI-E2, 867-5178) with any questions on this requirement.

3.b.1. EXCAVATION PERMIT: A KSC Excavation Permit will be required for any digging proposed by this project. Please contact the Utility Locate/Excavation Permit Request Customer Helpline at 867-2406 or go to website at http://epr.ksc.nasa.gov/Home/ for an underground utility scan and dig permit. NOTE: If a trench or pit is to be left open all day or overnight, the trench/pit must be checked for trapped animals at the beginning and end of each work shift. If an animal is observed trapped, contact Becky Bolt (IMSS-200, 867-7330) or the Duty Office (861-5050, email KSC-ISC-DutyOffice@mail.nasa.gov) to arrange removal/release. Do not handle the animal(s).

3.b.2. PERMITTED STORMWATER ERP: The project area is covered under an existing Environmental Resource Permit (ERP) stormwater system (Exploration Park I, #69567-2) issued to Space Florida by the St. Johns River Water Management District (SJRWMD) and is subject to periodic inspection by the regulator. Information should be provided to

SJRWMD at the design phase for a permit modification determination. Ensure the final configuration of the stormwater system swales/slopes/berms, etc., and final dimensions of the structures meet the engineering requirements of the permitted stormwater facility. For more information, contact SJRWMD. Please coordinate with NASA Environmental Assurance, Doug Durham (SI-E2, 867-8429).

3.b.3**.** FDEP NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) CONSTRUCTION ACTIVITY PERMIT: This project may require an NPDES Phase II construction permit. If 1 acre or more of land will be disturbed, a NPDES Construction Activity Permit from the Florida Department of Environmental Protection (FDEP) is required under F.A.C. 62-621.300(4), Notice of Intent to Use Generic Permit for Stormwater Discharge from Large (If over 5 Acres) and Small (1 Acre To 5 Acres) Construction Activities. http://www.dep.state.fl.us/water/stormwater/npdes/forms/cgp_noi.pdf. This includes construction activity which will disturb less than one acre of land area that is part of a larger common plan of development that will ultimately disturb equal to or greater than one acre of land. Construction activity does not include routine maintenance that is performed to maintain the original line and grade, hydraulic capacity, or original purpose of the site. A condition of this permit is to provide a Stormwater Pollution Prevention Plan (SWPPP) detailing erosion and turbidity controls for the site. Information on completing the permit application and development of the SWPPP can be obtained by contacting Doug Durham (SI-E2, 867-8429).

3.b.4. DEWATERING: Construction dewatering is exempted from permitting under conditions of Rule 40C-2.051 (7) providing the conditions of exemption are met including: limiting withdrawal methods, limiting withdrawal to less than 300,000 gpd and limiting withdrawal to 30 days. Additional limitations are placed on discharge of produced water to prevent harm to the environment. If conditions of the exemption cannot be met, a construction dewatering general permit is required from SJRWMD using Form 40C-2.900(12). No dewatering may begin until 10 days after submittal of the complete form.If the dewatering activity does not qualify for a general permit by rule under Rule 40C-2.042(9), F.A.C., you must complete and submit a SJRWMD application for an individual Consumptive Use Permit pursuant to Rule 40C-2.041, F.A.C. Approval of the application must be obtained before starting the dewatering activity.If produced water discharge will reach surface waters, an FDEP permit may be required under Rule 62-621.300-2. Contact Doug Durham (SI-E2, 867-8429) with questions related to these requirements.

3.b.5. WATER RESOURCE PERMITTING (Domestic Wastewater): Proposed activities may require a permit from FDEP for the alteration or installation of utilities for transport of domestic wastewater. The organization responsible for the work will ensure that best engineering practices, codes, specifications and standards are followed. Additional flow to the sanitary sewer system will require coordination and approval from the KSC domestic wastewater collection/transmission system operator and the Cape Canaveral Air Force Station (CCAFS) domestic wastewater treatment plant operator. Upgrades to the KSC and CCAFS infrastructure, beyond the Firefly domestic wastewater collection/transmission system, may be required for connection of the Firefly facilities to the KSC sanitary sewer system. These upgrades may include increasing the ability of the KSC domestic wastewater collection/transmission system to transmit, store, and equalize the flow to the CCAFS plant, and possibly contributing funding to increase the treatment capacity.

Firefly shall obtain all required environmental permits, prepare application, and pay application fees. The NASA EAB will sign permit application as landowner or utility system owner if legally required, contact Doug Durham (SI-E2, 867-8429) for assistance. Firefly shall submit courtesy copies of all applications to the NASA EAB within five (5) working days after submission to FDEP. Firefly shall submit courtesy copies of the permit to the NASA EAB within five (5) working days after receipt from FDEP.

3.b.6. INDUSTRIAL WASTEWATER DISCHARGE: Firefly Manufacturing Facility processes may generate industrial wastewater. State of Florida regulations define industrial wastewater as any wastewater that is not classified as domestic wastewater. An Industrial Wastewater Permit may be required for discharge. Firefly shall follow FDEP's Guide to Permitting Wastewater Facilities or Activities under Chapter 62-620 when preparing the application package. The designs, site plans, specifications, drawings, documents, or forms required by FAC 62-620 must be signed and sealed by a P.E. registered in the state of Florida. The NASA Environmental Assurance Branch (EAB) will sign permit applications as landowner or utility system owner if legally required. Contact Doug Durham (SI-E2, 867-8429) for assistance. Permit applications must be submitted to FDEP at least 180 days before a discharge occurs and at least 90 days prior to commencing construction. Firefly shall submit courtesy copies of all applications to the NASA EAB within five (5) working days after submission to FDEP. Firefly shall submit courtesy copies of the permit to the NASA EAB within five (5) working days after receipt from FDEP. In some instances, industrial wastewater may be approved for discharge to the sanitary sewer system. For discharges to the sanitary sewer system, Firefly shall obtain approval from both Base Operations and Spaceport Services (BOSS) and CCAFS wastewater treatment plant operator. Contact Doug Durham (SI-E2, 867-8429) for additional assistance.

3.b.7. WATER RESOURCE PERMITTING (Potable Water): The proposed project may require a permit for the alteration or installation of utilities for transport of potable or FIREX water. Any work done will be per standards and criteria set forth in the permit requirements, and not jeopardize the health and safety of personnel due to effects of the construction/modification on the KSC potable water system (i.e. disinfection and verification prior to use). Upgrades to the KSC infrastructure, beyond the Firefly Manufacturing Facility potable water system, may be required for connection to the KSC water system.

Firefly Aerospace shall obtain all required environmental permits, prepare application, and pay application fees. The proposed connection to the potable water system must be coordinated with the KSC public water system operator. The NASA EAB will sign permit applications as landowner or utility system owner if legally required. Contact Doug Durham (SI-E2, 867-8429) for assistance. Firefly shall submit courtesy copies of all applications to the NASA EAB within five (5) working days after submission to FDEP. Firefly shall submit courtesy copies of the permit to the NASA EAB within five (5) working days after receipt from FDEP, and ensure that all operations, activities, equipment, and facilities are in full compliance with all permit conditions. Firefly shall maintain copies of all records required to demonstrate compliance with the permit onsite and make them available for review by NASA upon request.

3.b.8. AIR EMISSIONS: NASA KSC holds a facility-wide Federal Clean Air Act Title V Air Operation Permit issued by the Florida Department of Environmental Protection (FDEP) that governs air emissions from dozens of regulated emission sources and hundreds of insignificant emission sources across KSC. Space Florida and tenants are independent from NASA regarding air emissions permitting and compliance. Space Florida and Firefly Aerospace shall contact the NASA EAB prior to:

-The operation, reactivation, or modification of an existing emission source/activity,

-The construction of any new air emission source, and/or

-The initiation of an activity producing air emissions.

Space Florida and Firefly will coordinate with the FDEP to determine applicable air emissions permitting and compliance requirements for future activities, and may be required to obtain separate air permits for these activities.

3.b.9. TRANSFORMERS/GENERATORS: The temporary operation of portable generators during construction is allowed and is not considered a stationary source of air emissions. New generators proposed for permanent use at the facility, and associated air emissions must be reviewed for determination of construction permit and RICE (Reciprocating Internal Combustion Engine) NESHAP (National Emission Standards for Hazardous Air Pollutants) requirements. If a new transformer or generator using a volume of oil equal to or greater than 55 gallons is to be installed, it is subject to SPCC rules.

3.b.10. RADIATION: Use of ionizing or non-ionizing radiation sources on KSC must comply with KNPR 1860.1 and 1860.2. This project may involve the generation of a radiation source which must be evaluated by the Health Physics Group. A Radiation Use Authorization is required before operations begin. Information describing work to be performed and use of x-ray machine must be submitted to the KEMCON/IMSS Health Physics Office. Contact KEMCON/IMSS Health Physics (IMSS-023, 867-2400) with questions.

Avoid Verbal Orders

TO: Space Florida/Pete Eggert **DATE: 08/20/2019**

FROM: SI-E3/Environmental Management Branch

SUBJECT: KSC Record of Environmental Consideration (REC) **REC #: 10766**

No other environmental issues were identified based upon the information provided in the KSC Environmental Checklist. This Record of Environmental Consideration (REC) does not relinquish the project lead from obtaining and complying with any other internal NASA permits or directives necessary to ensure all organizations potentially impacted by this project are notified and concur with the proposed project.

Due to potential changes in regulations, permit requirements and environmental conditions, statements in this REC are valid for 6 months, and subject to review after this period. It is the responsibility of the project lead to submit current project information for a REC update prior to project commencement if REC is older than 6 months; and also to notify the Environmental Management Branch (SI-E3) if the scope of the project changes at any time after the REC is issued.

4. Upon evaluation of the subject project, the above determinations have been made and identified. Contact the Environmental Management Branch (SI-E3) at 861-1196 for re-evaluation should there be any modifications to the scope of work.

08/20/2019 00:00

James Brooks **Date**

APPENDIX B

BRRC Noise Report

Blue Ridge Research and Consulting, LLC

Technical Report

Noise Study for Firefly's Cape Canaveral Orbital Launch Site Environmental Assessment

April 27, 2020

Prepared for:
Brian Gulliver, P.E
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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
CDNL	C-weighted Day-Night Average Sound Level
dB	Decibel
dBA	A-weighted Decibel Level
dBC	C-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
Hz	Hertz
KSC	John F. Kennedy Space Center
lbf	Pound Force
lbs	Pound Mass
$L_{A,max}$	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
Pa	Pascal
psf	Pounds per Square Foot
RUMBLE	The Launch Vehicle Acoustic Simulation Model

1 Introduction

This report documents the noise study performed as part of Firefly's efforts on the Environmental Assessment (EA) for proposed operations at Cape Canaveral Air Force Station (CCAFS). Firefly plans to conduct static test and vertical launch operations for both Alpha and Beta launch vehicles. The two vehicles are depicted in Figure 1-1. Both the static fire and launch events will occur at Firefly's CCAFS SLC-20 facility. 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 Firefly operations. Section 2 describes the proposed Firefly 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 and sonic boom modeling results. A summary is provided in Section 6 to document the notable findings of this noise study.

Figure 1-1. Rendering of Firefly's Alpha launch vehicle (top) and Beta launch vehicle (bottom) (credit: Firefly)

2 Firefly Operations

Firefly plans to conduct Alpha operations for up to 10 pre-launch static fire engine tests, 24 acceptance static fire engine tests, and 10 vertical launches per year. Beta operations are planned for up to 18 pre-launch static fire engine tests, 24 acceptance static fire engine tests, and 18 vertical launches per year. The annual operations are presented in Table 2-1 in terms of acoustic time of day. The Alpha static fire and launch events will occur at Firefly's CCAFS SLC-20A (28.513086°N, 80.555917°W), whereas the Beta operations will occur at SLC-20B (28.512221°N, 80.556685°W). Pre-launch and acceptance static engine tests of all four engines will last five seconds and 60 seconds, respectively. Alpha and Beta launch operations will be unique to the vehicle configuration, mission, and environmental conditions. Therefore, a range of launch azimuths between 44° and 110° were simulated using the 85° nominal trajectory provided by Firefly.

Table 2-2 presents Alpha and Beta modeling input parameters used to estimate noise emissions from the proposed Firefly operations. Although the vehicles' sea level (S.L.) thrust is provided in Table 2-2, the model uses a time-varying thrust profile based on the trajectory. The maximum modeled vehicle thrust reaches approximately 165,500 lbf and 617,300 lbf during the first stage launch of the Alpha and Beta, respectively. All operational modeling parameters and trajectories were provided by Firefly personnel.

Table 2-1. Proposed Firefly Alpha and Beta operations

Vehicle	Event	Annual Operations Daytime 0700 – 1900	 Nighttime 2200-0700	 Total
Alpha	Pre-Launch Static Fire	10	0	10
	Acceptance Static Fire	24	0	24
	Launch	7	3	10
Beta	Pre-Launch Static Fire	18	0	18
	Acceptance Static Fire	24	0	24
	Launch	12	6	18

Table 2-2. Firefly Alpha and Beta modeling parameters

Vehicle	Modeling Parameters	Values
Alpha	Manufacturer	Firefly Aerospace, Inc.
	Name	Alpha
	Length	95 ft
	Diameter	6 ft
	Gross Vehicle Weight	119,019 lbs
	Engines	Firefly Reaver (Qty. 4) 35,613 lbf S.L. Thrust/Engine
	Vehicle's S.L. Thrust	142,452 lbf
Beta	Manufacturer	Firefly Aerospace, Inc.
	Name	Beta
	Length	117 ft
	Diameter	10 ft
	Gross Vehicle Weight	467,419 lbs
	Engines	Name To Be Determined (Qty. 4) 138,906 lbf S.L. Thrust/Engine
	Vehicle's S.L. Thrust	555,624 lbf

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.

3.1.1 Intensity

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:

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

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:

$$50.0\text{ dB} + 60.0\text{ dB} = 60.4\text{ dB.}$$

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]. 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].

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 [4].

3.1.2 Frequency

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 by humans 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 3-1, 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.

Note, "unweighted" sound levels refer to levels in which no weighting curve has been applied to the spectra. Unweighted levels are appropriate for use in examining the potential for noise impacts on structures.

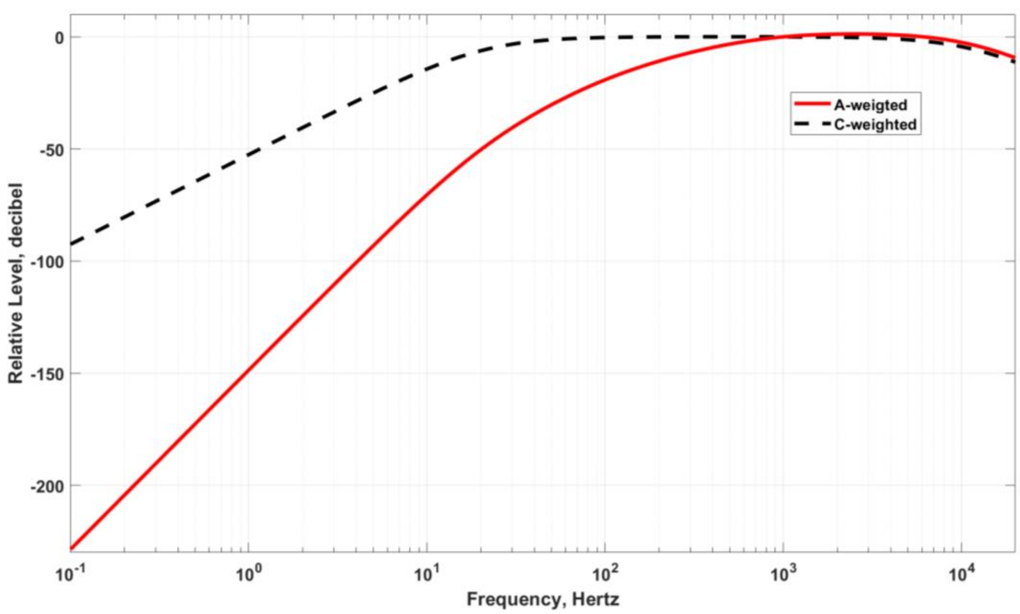

Figure 3-1. Frequency adjustments for A-weighting and C-weighting [5]

3.1.3 Duration

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. 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]. Sonic booms are considered low-frequency impulsive noise events with durations lasting a fraction of a second.

3.1.4 Common Sounds

Common sources of noise and their associated levels are provided for comparison to the noise levels from the proposed action.

A chart of A-weighted sound levels from everyday sounds [7] is shown in Figure 3-2. 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" [8].

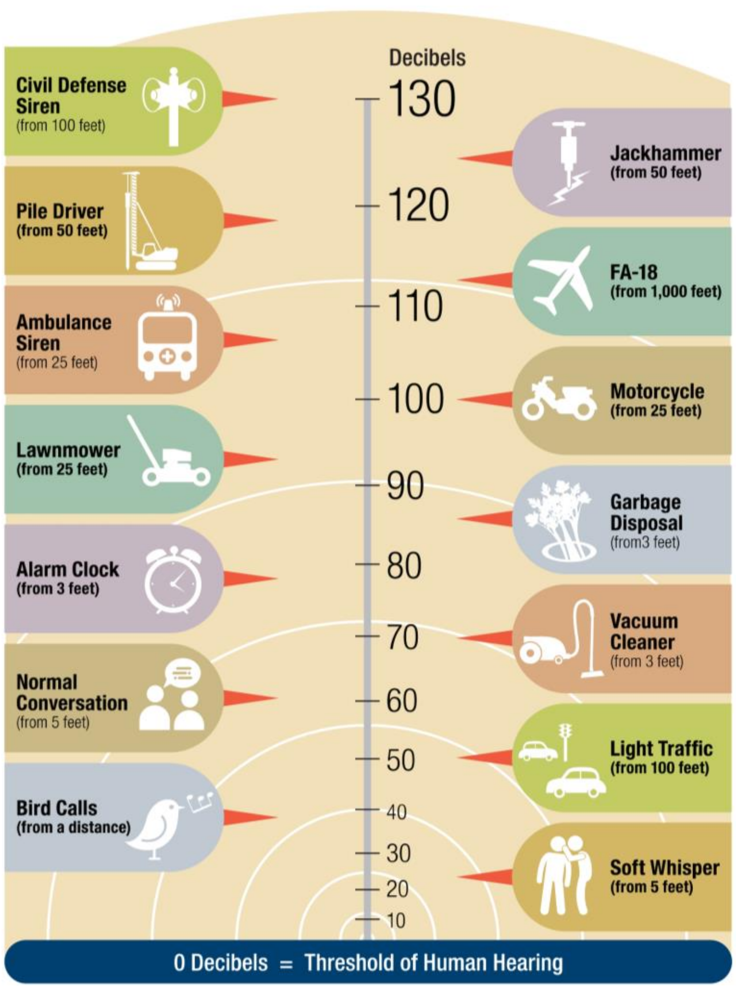

Figure 3-2. Typical A-weighted sound levels of common sounds [9]

A chart of typical impulsive events along with their corresponding peak overpressures in terms of psf and peak dB values are shown in Figure 3-3.

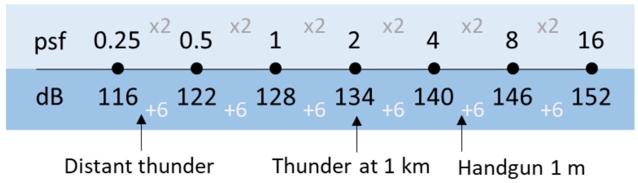

Figure 3-3. Typical impulsive event levels [10]

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 unweighted 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) and Community Noise Equivalent Level (CNEL)

Day-Night Average Sound Level is a cumulative metric that accounts for all noise events in a 24-hour period. To account for 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. DNL represents the average sound level exposure for annual average daily events. DNL does not represent a level heard at any given time but represent 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" [11].

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 [12, 13]. 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 "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" [11]. However, DNL is the most widely accepted metric to estimate the potential changes in long-term community annoyance.

For impulsive noise sources with significant low-frequency content such as sonic booms, C-weighted DNL (CDNL) is preferred over A-weighted DNL [14]. In terms of percent highly annoyed, DNL 65 dBA is equivalent to CDNL 60 dBC [15].

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) [16], National Institute for Occupational Safety and Health (NIOSH) [17], and the Department of Defense (DoD) Occupational Hearing Conservation Program [18]. The most conservative of these upper noise level limits has been set by OSHA at 115 dBA. 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.

Sonic Booms

Multiple federal government agencies have provided guidelines on permissible noise exposure limits on impulsive noise such as sonic booms. In terms of upper limits on impulsive or impact noise levels, NIOSH [17] and OSHA [19] 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" [20] 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 examined the relationship between structural damage claims and overall sound pressure level and concluded "the probability of structural damage [was] proportional to the intensity of the low frequency sound" [21]. This relationship estimated that one damage claim in 100 households exposed is expected at an average continuous sound level of 120 dB (unweighted), and one in 1,000 households at 111 dB (unweighted). 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 modeled mean sound levels.

It is important to highlight the difference between the static ground tests on which the rate of structural damage claims is based and the dynamic events modeled in this noise study. During ground tests, the engine/motor remains in one position, which results in a longer-duration exposure 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 [21] 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 (unweighted) and 111 dB (unweighted) are used in this report as conservative thresholds for potential risk of structural damage claims.

Sonic Booms

High-level sonic booms are also associated with structural damage. Most damage claims are for brittle objects, such as glass and plaster. Table 3-1 summarizes the threshold of damage that may be expected at various overpressures [22]. Additionally, Table 3-1 describes example impulsive events for each level range. 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 [23] to one in a million [24]. These damage rates are associated with a combination of boom load and glass condition. At 10 psf, the probability of breakage is between one in 100 and one in 1,000. Laboratory tests involving glass [25] 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, 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 [22], below which damage is unlikely.

Table 3-1. Possible damage to structures from sonic booms [22]

Nominal level	Damage Type	Item Affected
0.5 – 2 psf 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 cap gun/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 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 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

An overview of the propulsion noise and sonic boom modeling methodologies used in this noise study are presented in Section 4.1 and 4.2, respectively.

4.1 Propulsion 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.

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 4-1 and are described in the following subsections.

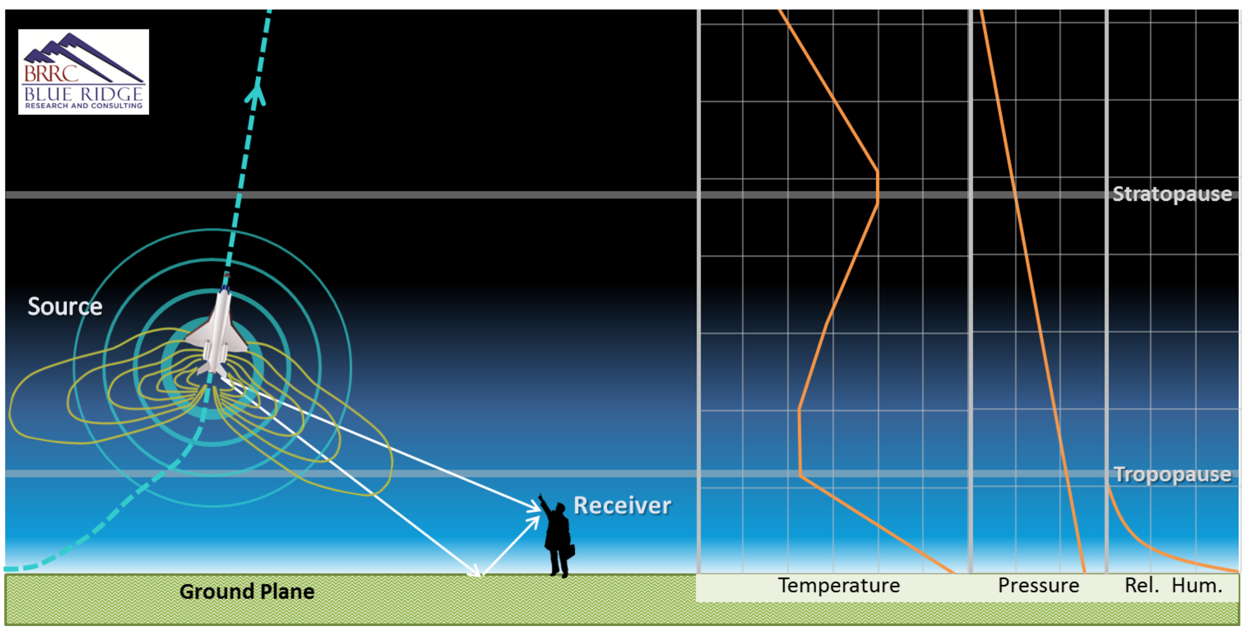

Figure 4-1. Conceptual overview of rocket noise prediction model methodology

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) [26] 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 [27]. 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 [28]. Typical acoustic efficiency values range from 0.2% to 1.0% [26]. 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 [26]. 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 [29, 30, 31, 32]. 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. Conversely, for a vertical landing, the rocket exhaust and ambient airflow travel in opposing directions, yielding an increased relative velocity differential. 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) [33]. 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 [34] 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 4-2 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.

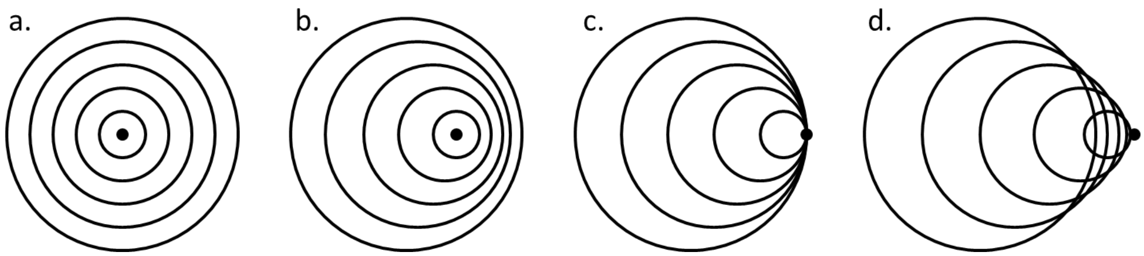

Figure 4-2. Effect of expanding wavefronts (decrease in frequency) that an observer would notice for higher relative speeds of the rocket relative to the observer for: a) stationary source b) source velocity < speed of sound c) source velocity = speed of sound d) source velocity > speed of sound

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 [35, 36, 37, 38] 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 [39] as they travel through the medium. These nonlinear effects are counter to the effect of atmospheric absorption [40, 41]. However, recent research shows that nonlinear propagation effects change the perception of the received sound [42, 43], but the standard acoustical metrics are not strongly influenced by nonlinear effects [44, 45]. The overall effects of nonlinear propagation on high-amplitude sound signatures and their perception is an ongoing 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 4-1. 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 [46, 47] 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 [46, 48].

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 Boom Modeling

A vehicle creates sonic booms during 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.

A brief sonic boom generation and propagation modeling primer is provided in Section 4.2.1 to describe relevant technical details that inform the sonic boom modeling. The primer also provides visualizations of the boom generation, propagation, and ground intercept geometry. An overview of the sonic boom modeling software used in the study, PCBoom, and a description of inputs are found in Section 4.2.2.

4.2.1 Primer

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. 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 4-3 shows the generation and evolution of a sonic boom N-wave under the vehicle.

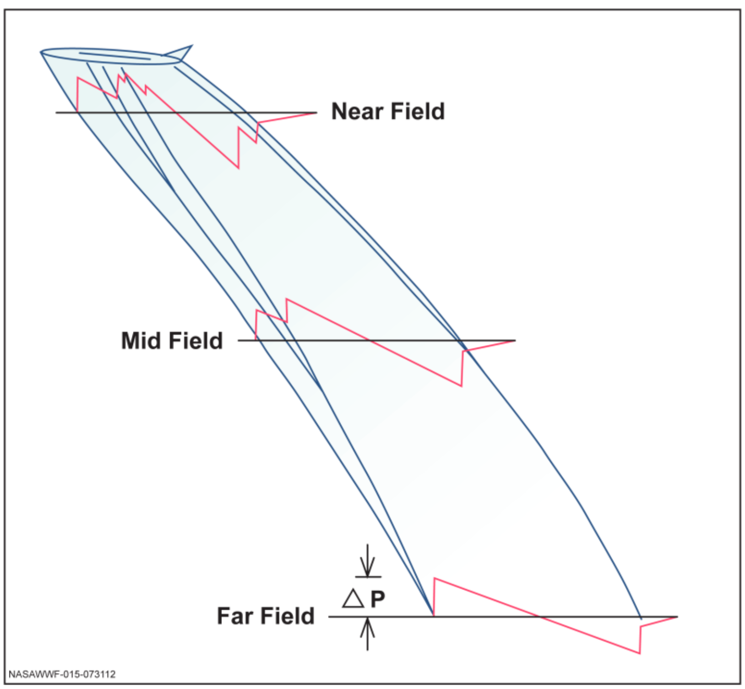

Figure 4-3. Sonic boom generation and evolution to N-wave [49]

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. If the plume volume is significantly larger than the vehicle, its shocks will be stronger than the shocks generated by the vehicle.

Figure 4-4 shows the sonic boom wave cone generated by a vehicle in steady (non-accelerating) level supersonic flight. The wave cone extends toward the ground and 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 levels as the lateral distance increases to the cut-off edge of the "carpet."

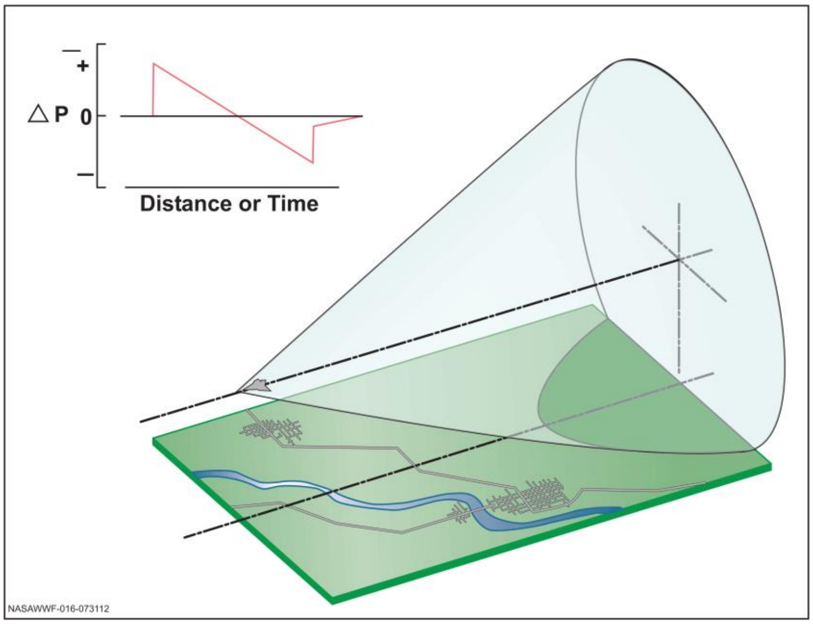

Figure 4-4. Sonic boom carpet for a vehicle in steady flight [50]

Although the wave cone can be calculated from an aircraft-fixed reference frame, the ray perspective is more convenient when computing sonic boom metrics in a ground-fixed observer's reference frame [51]. Both perspectives are shown in Figure 4-5. The difference in wave versus ray perspectives is described for level, climbing, and diving flight, in the PCBoom Sonic Boom Model User Guide [51]:

> Sonic boom wave cones are not generated fully formed at a single point in time, instead resulting from the accumulation of all previous disturbance events that occurred during the vehicle's time history. […] Unlike wave cones, ray cones are fully determined at a single point in time and are independent of future maneuvers. They are orthogonal to wave cones and represent all paths that sonic boom energy will take from the point they are generated until a later point in time when they hit the ground. The ray perspective is particularly useful when considering refraction due to atmospheric gradients or the effect of aircraft maneuvers, where rays can coalesce into high amplitude focal zones.

When the ray cone hits the ground, the resulting intersection is called an "isopemp." The isopemp is forward-facing [as shown in Figure 4-5] and falls a distance ahead of the vehicle called the "forward throw." At each new point in the trajectory, a new ray cone is generated, resulting in a new isopemp that strikes the ground. These isopemps are generated throughout the trajectory, sweeping out an area called the "boom footprint."

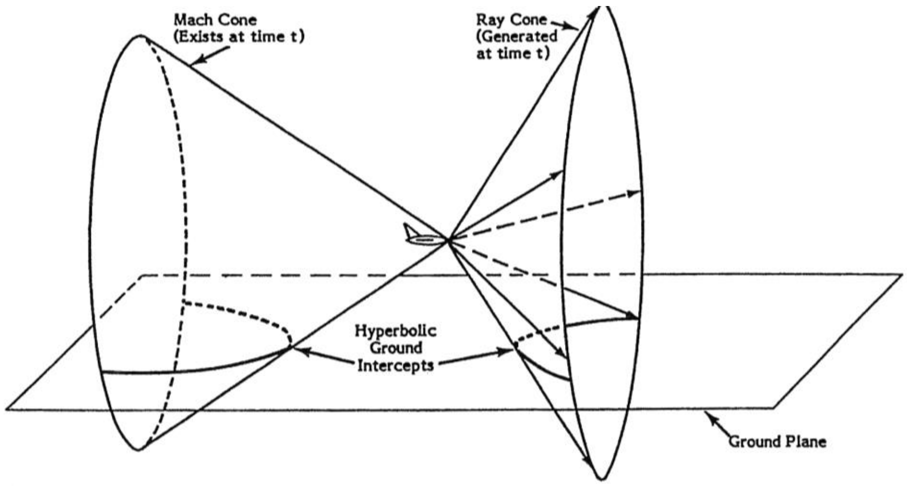

Figure 4-5. Mach cone vs ray cone viewpoints

Figure 4-4 and Figure 4-5 may give the impression that the boom footprint is generally associated with rays generated from the bottom of a vehicle. This is the case for vehicles at moderate climb and dive angles, or in level flight as shown in Figure 4-5. For a vehicle climbing at an angle steeper than the ray cone half angle, such as in the left image of Figure 4-6, rays from that part of its trajectory will not reach the ground. This is important for vertical launches, where the ascent stage of a launch vehicle typically begins at a steep angle. In these cases, sonic booms are not expected to reach the ground unless refracted back downwards by gradients in the atmosphere. Conversely, if a vehicle is in a sufficiently steep dive, such as in the right image of Figure 4-6, the entire ray cone may intersect the ground, resulting in an elliptical or even circular isopemp. This is of importance for space flight reentry analysis, where descent may be nearly vertical.

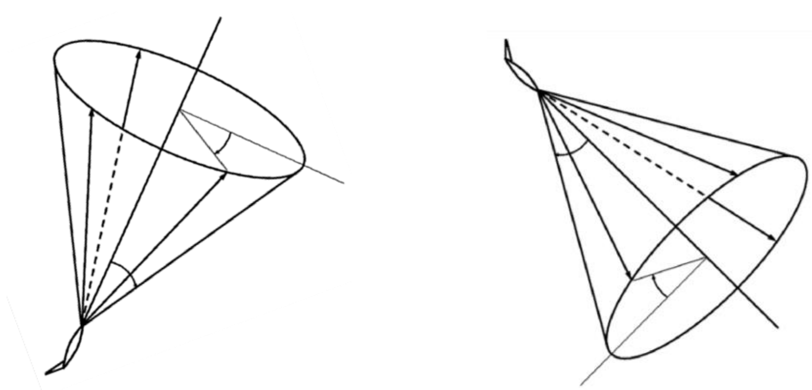

Figure 4-6. Ray cone in climbing (left) and diving (right) flight

4.2.2 PCBoom

The single-event prediction model, PCBoom [52, 53, 54], is a full ray trace sonic boom program that is used to calculate the magnitude, waveform, and location of sonic boom overpressures on the ground from supersonic flight operations. Additionally, PCBoom accounts for the effect of rocket exhaust plumes on the boom [55].

Several inputs are required to calculate the sonic boom impact, including the geometry of the vehicle, the trajectory path, and the atmospheric conditions. These parameters along with time-varying thrust, drag, and weight are used to define the PCBoom starting signatures used in the modeling. The starting signatures are propagated through the US Standard atmospheric profile.

5 Results

The following sections present the results of the environmental propulsion noise and sonic boom impacts associated with the proposed Firefly 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.

5.1 Single Event Noise

Single event propulsion noise and sonic boom modeling results are presented in Sections 5.1.1 and 5.1.2, respectively.

5.1.1 Propulsion Noise

Individual launch site and static operations are evaluated using maximum A-weighted and unweighted sound levels for propulsion noise. The composite noise contour maps are provided representing the maximum sound levels over the range of launch azimuths proposed (between 44° and 110°).

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

The modeled $L_{A,max}$ contours associated with the launch and static fire operations at Firefly's CCAFS SLC-20 facility for each vehicle are presented in Figure 5-1 through Figure 5-4. 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 NIHL. The 115 dBA contours associated with the launch and static fire events are entirely within the boundaries of CCAFS. Thus, the potential for impacts to people in the community with regards to hearing conservation is negligible.

<u>Launch Operations</u>

The Alpha launch event generates modeled levels at or above an $L_{A,max}$ of 115 dBA within 0.3 miles of the launch site. The Beta launch event generates modeled levels at or above an $L_{A,max}$ of 115 dBA within 0.5 miles of the launch site. The 115 dBA contours for the Alpha and Beta launch events are shown in Figure 5-1 and Figure 5-2, respectively.

<u>Static Fire Operations</u>

The Alpha and Beta static fire event noise contours are more directive than the launch event noise contours because the plume is redirected in-line with the deflector heading. A receptor located along the peak directivity angle may experience an $L_{A,max}$ of 115 dBA at approximately 0.2 miles away from the Alpha and approximately 0.4 miles away from the Beta during a static fire event. The 115 dBA contours for the Alpha and Beta static fire events are shown in Figure 5-3 and Figure 5-4, respectively. Note, the levels produced by static fire events will remain constant over the duration of the event, whereas the levels produced by launch events will decrease as the rocket moves further away from the receptor.

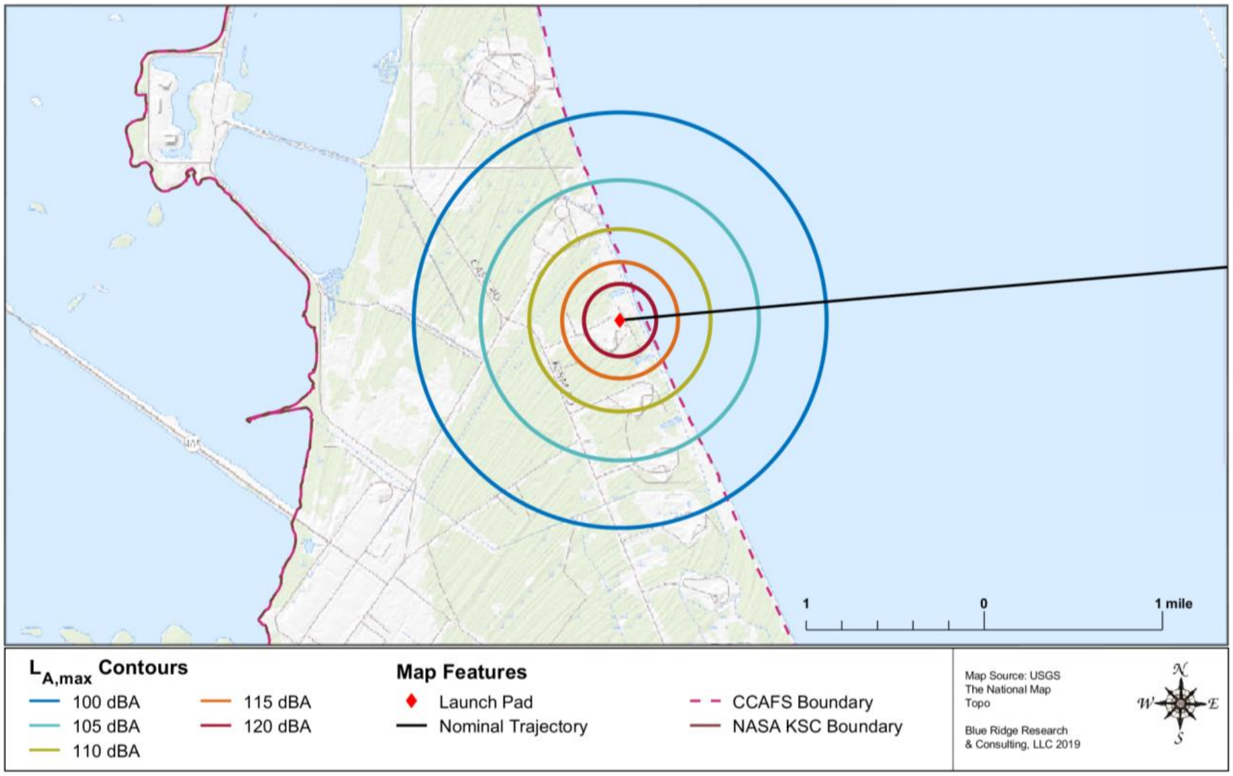

Figure 5-1. $L_{A,max}$ contours for the Alpha launch from Firefly's CCAFS SLC-20A

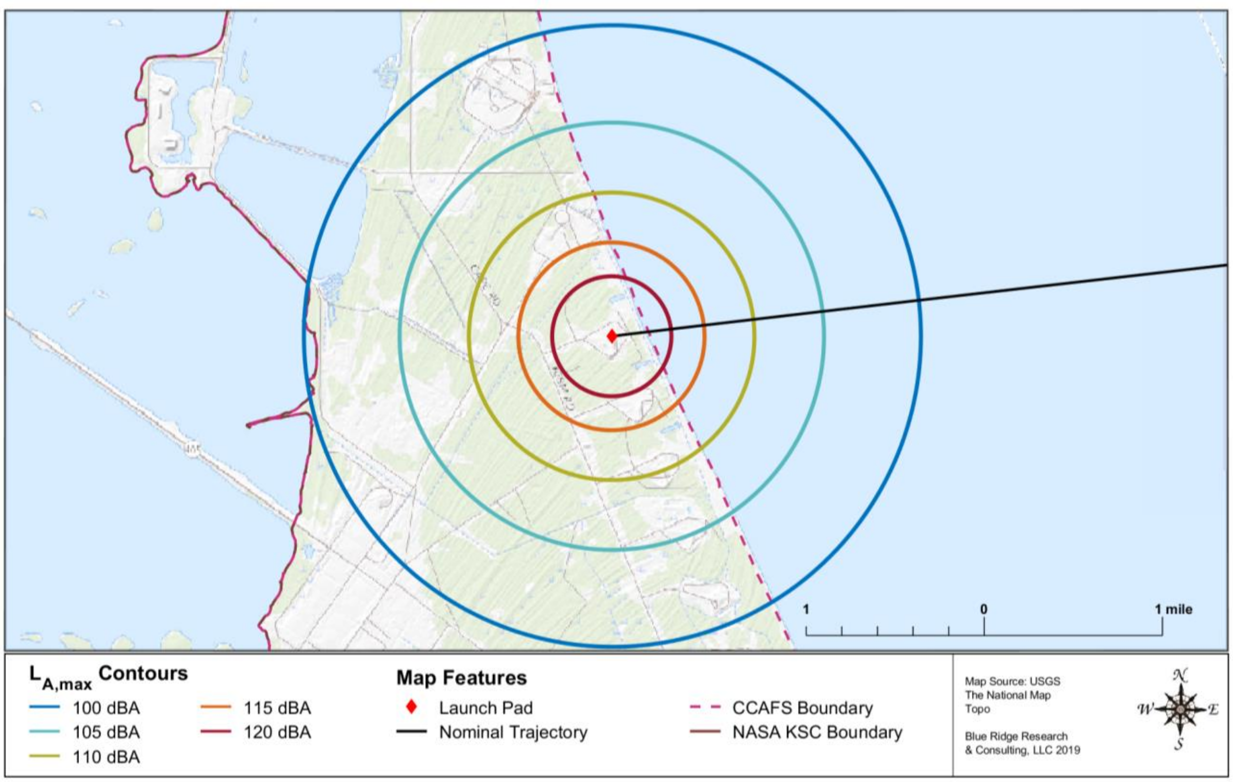

Figure 5-2. $L_{A,max}$ contours for the Beta launch from Firefly's CCAFS SLC-20B

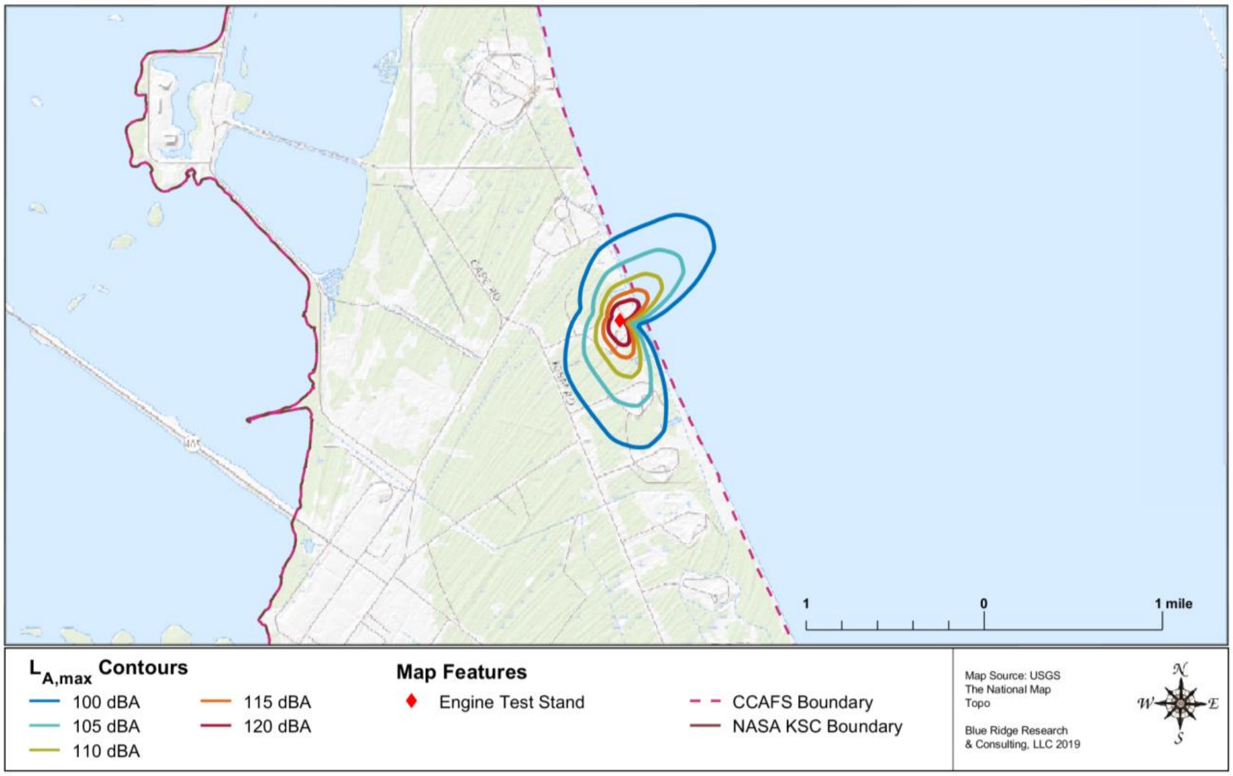

Figure 5-3. $L_{A,max}$ contours for all Alpha static fire operations at Firefly's CCAFS SLC-20A

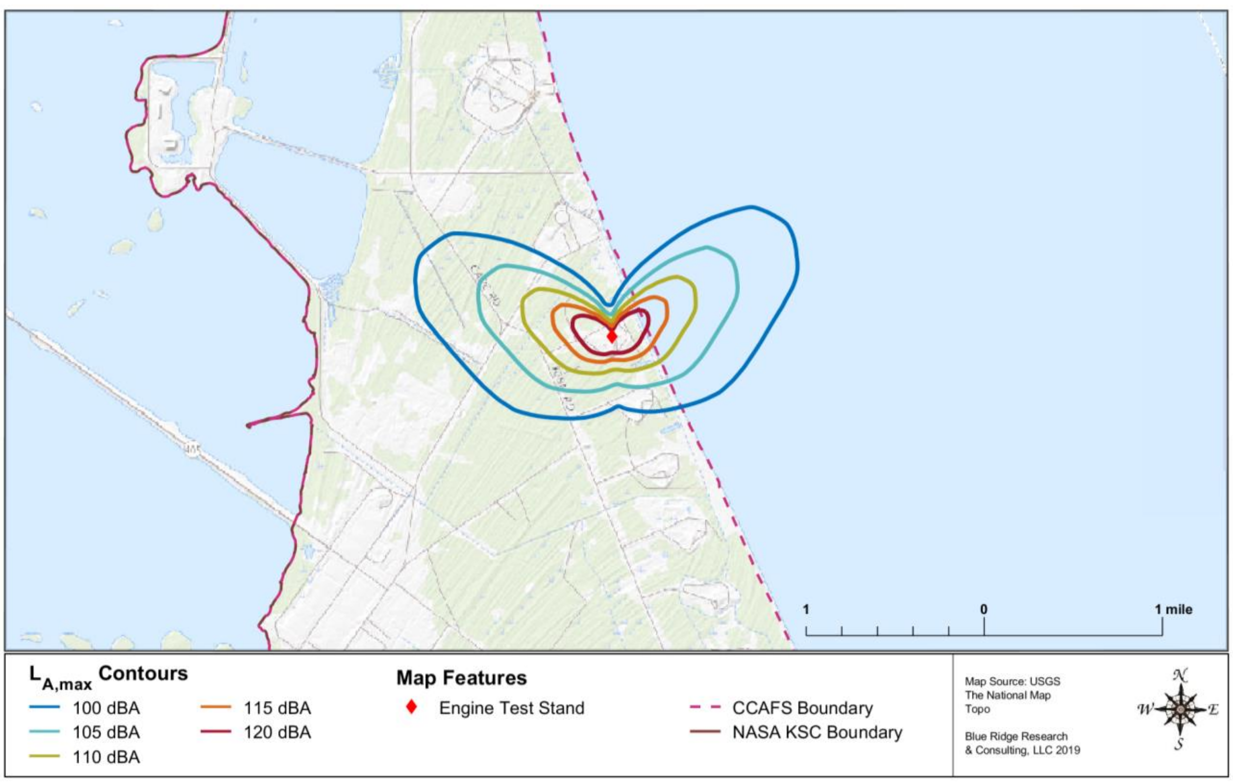

Figure 5-4. $L_{A,max}$ contours for all Beta static fire operations at Firefly's CCAFS SLC-20B

Maximum Unweighted Sound Level (L_{max})

The modeled L_{max} contours associated with the Alpha and Beta launch and static fire operations from Firefly's CCAFS SLC-20 facility are presented in Figure 5-5 through Figure 5-8. For reference, 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 [21]. The entire land area encompassed by the 111 dB noise contours resulting from the Alpha and Beta launch or static fire events lies within the CCAFS and National Aeronautics and Space Administration (NASA) John F. Kennedy Space Center (KSC) boundaries.

<u>Launch Site Operations</u>

For the Alpha launch event, the modeled 120 dB and 111 dB L_{max} contours are limited to radii of 0.6 miles and 1.6 miles from the launch site, respectively, as shown in Figure 5-5. For the Beta launch event, the modeled 120 dB and 111 dB L_{max} contours are limited to radii of 1.5 miles and 4.0 miles from the launch site, respectively, as shown in Figure 5-6.

<u>Static Fire Operations</u>

For the Alpha static fire, a receptor located along the peak directivity angle may experience L_{max} values of 120 dB and 111 dB at approximately 0.6 miles and 1.5 miles from the launch site, respectively, as shown in Figure 5-7. For the Beta static fire, a receptor located along the peak directivity angle may experience L_{max} values of 120 dB and 111 dB at approximately 1.5 miles and 3.5 miles from the launch site, respectively, as shown in Figure 5-8.

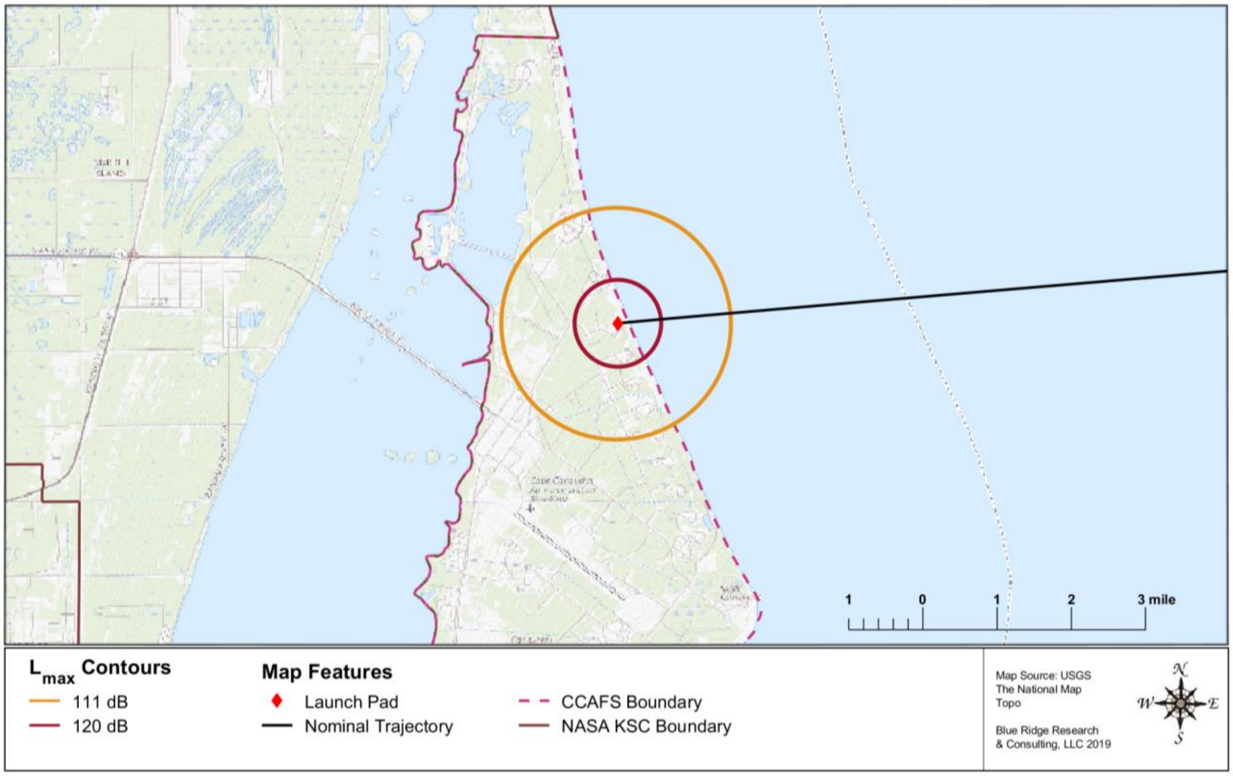

Figure 5-5. L_{max} contours for the Alpha launch from Firefly's CCAFS SLC-20A

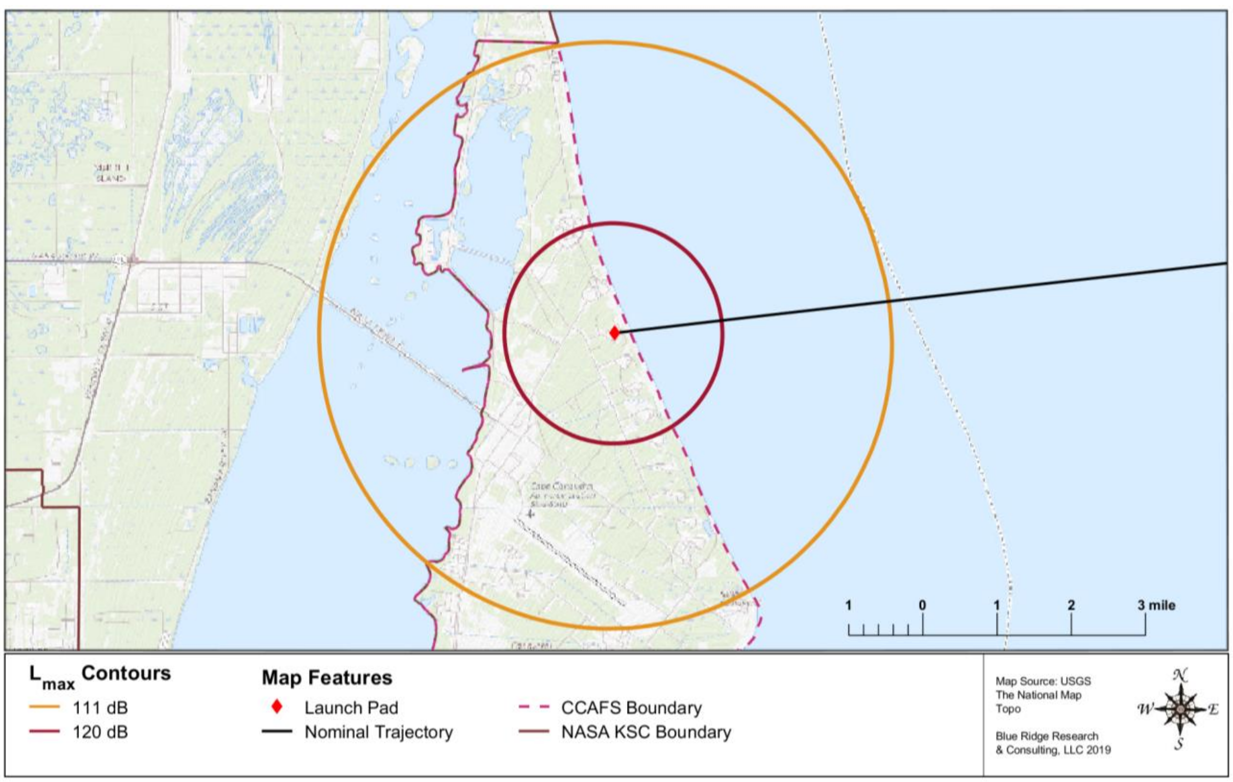

Figure 5-6. L_{max} contours for the Beta launch from Firefly's CCAFS SLC-20B

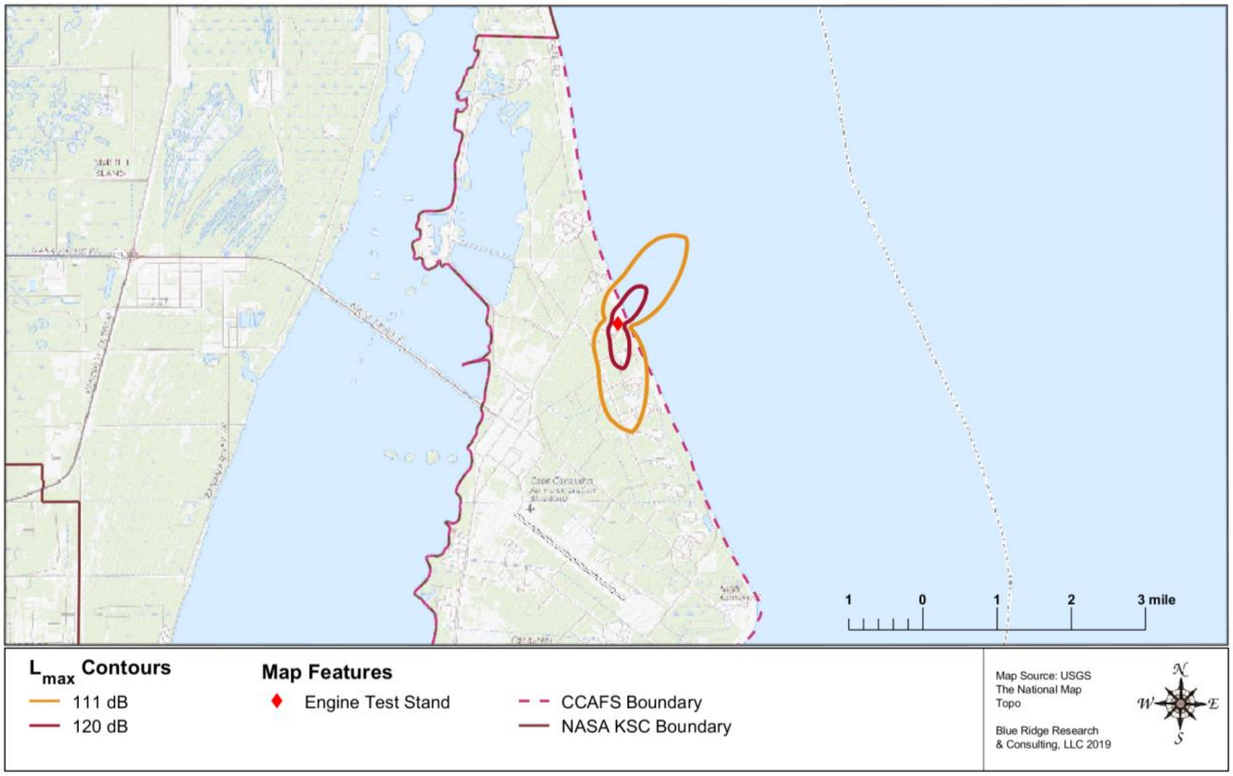

Figure 5-7. L_{max} contours for all Alpha static fire operations at Firefly's CCAFS SLC-20A

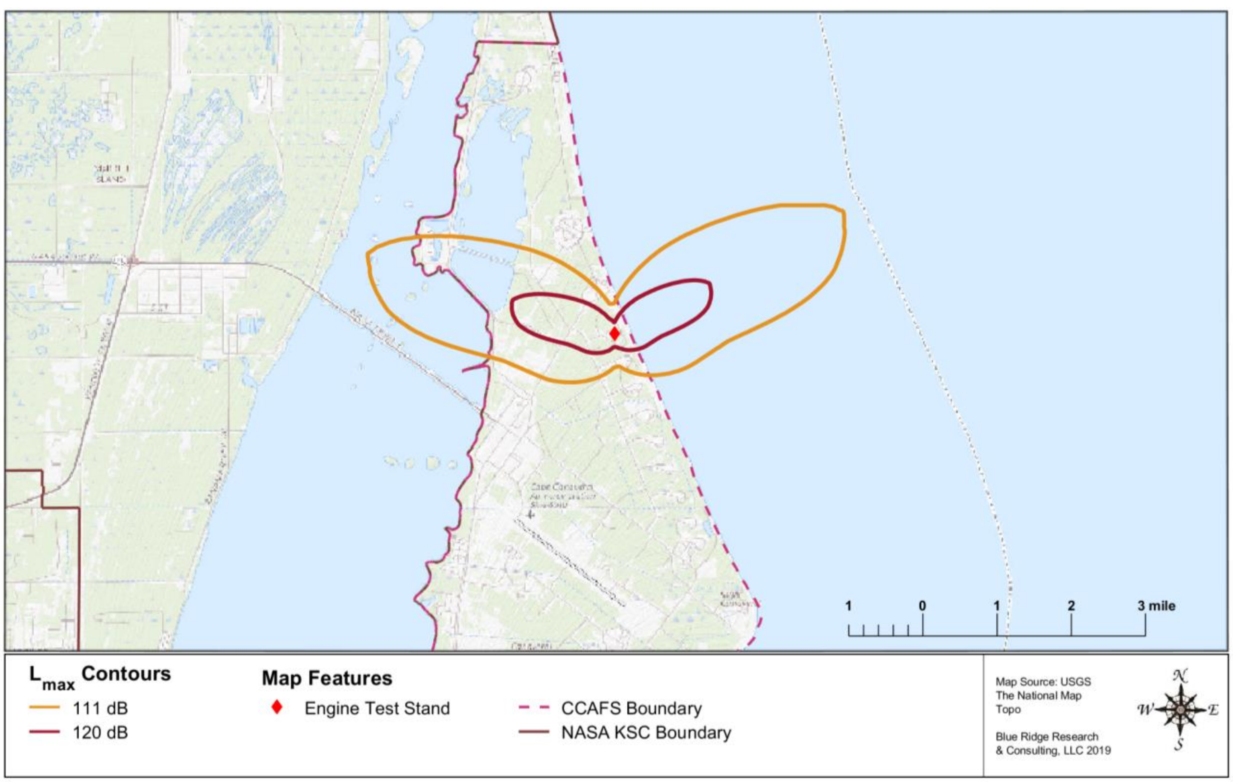

Figure 5-8. L_{max} contours for all Beta static fire operations at Firefly's CCAFS SLC-20A

5.1.2 Sonic Booms

Individual launch site operations are evaluated using maximum peak overpressure for sonic booms.

Maximum Peak Overpressure (psf)

The modeled sonic boom peak overpressure contours for typical Alpha and Beta launch operations are presented in Figure 5-9 and Figure 5-10, respectively. The sonic booms were modeled based on Alpha and Beta launch trajectories at a nominal azimuth of 85° relative to true north. The sonic booms produced by the Alpha and Beta launch vehicles have long, narrow, forward-facing, crescent-shaped focus boom regions 37 and 44 miles downrange of the launch site, respectively. These focus boom regions are generated because the rocket continuously accelerates and pitches downward as it ascends. The maximum peak overpressures along the focus boom regions for the Alpha and Beta launch vehicles are predicted to be approximately 6.1 psf and 7.4 psf, respectively. However, these levels would only occur in extremely small areas along the focus boom regions. As the rocket gains altitude, the sonic boom peak overpressure gradually decreases, and the crescent-shaped contours become slightly wider.

To determine the sonic boom peak overpressure contours over the range of proposed launch azimuths, the 85° nominal trajectory was rotated to create composite contours. To facilitate visualization of the effect of rotation, an intermediate illustration of the 44°, 85°, and 110° trajectories is shown for Alpha and Beta launches in Figure 5-11 and Figure 5-12, respectively. A bounding line is shown in gray to demonstrate the overall extents of the contours obtained from the rotated trajectories.

The composite contours shown in Figure 5-13 and Figure 5-14 for the Alpha and Beta launch operations, respectively, represent the maximum peak overpressure that may occur due to Alpha and Beta launch operations at any azimuth between 44° and 110°. The banding of contour levels shown in Figure 5-13 is a result of the narrow focal zones. Note, sonic booms produced by a single launch event will not be audible over the entire contour areas shown in Figure 5-13 and Figure 5-14, but they will impact somewhere within these contour areas, with the specific locations determined by the launch azimuth. As discussed previously, the potential remains for elevated levels within small focal regions.

The locations of the sonic boom footprints produced by Alpha and Beta launch operations will be highly dependent on the vehicle configuration, trajectory, and atmospheric conditions at the time of flight. However, the sonic booms resulting from Alpha and Beta launch operations are predicted to occur over the Atlantic Ocean for all proposed launch azimuths between 44° and 110°. Thus, no noise impacts with respect to human annoyance, health and safety, or structural damage are expected due to the sonic booms produced by Alpha and Beta launch operations.

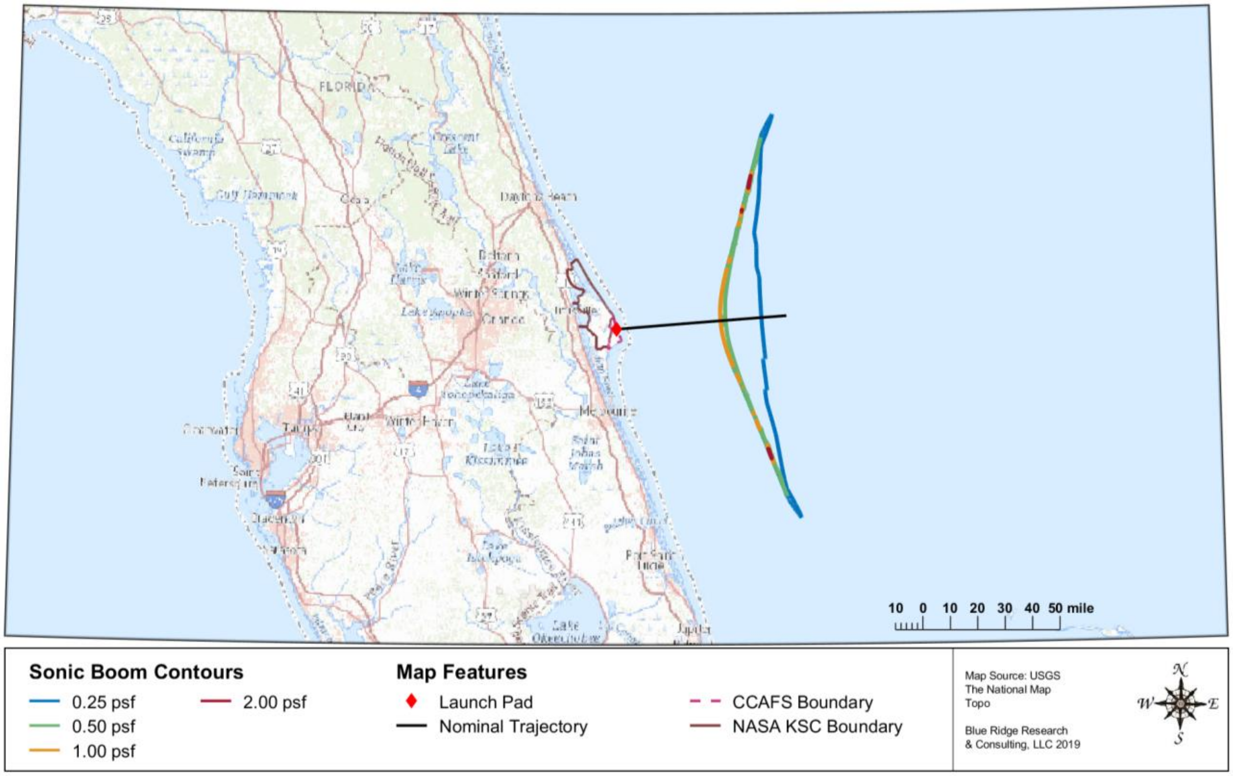

Figure 5-9. Sonic boom peak overpressure contours for a nominal Alpha launch from SLC-20A

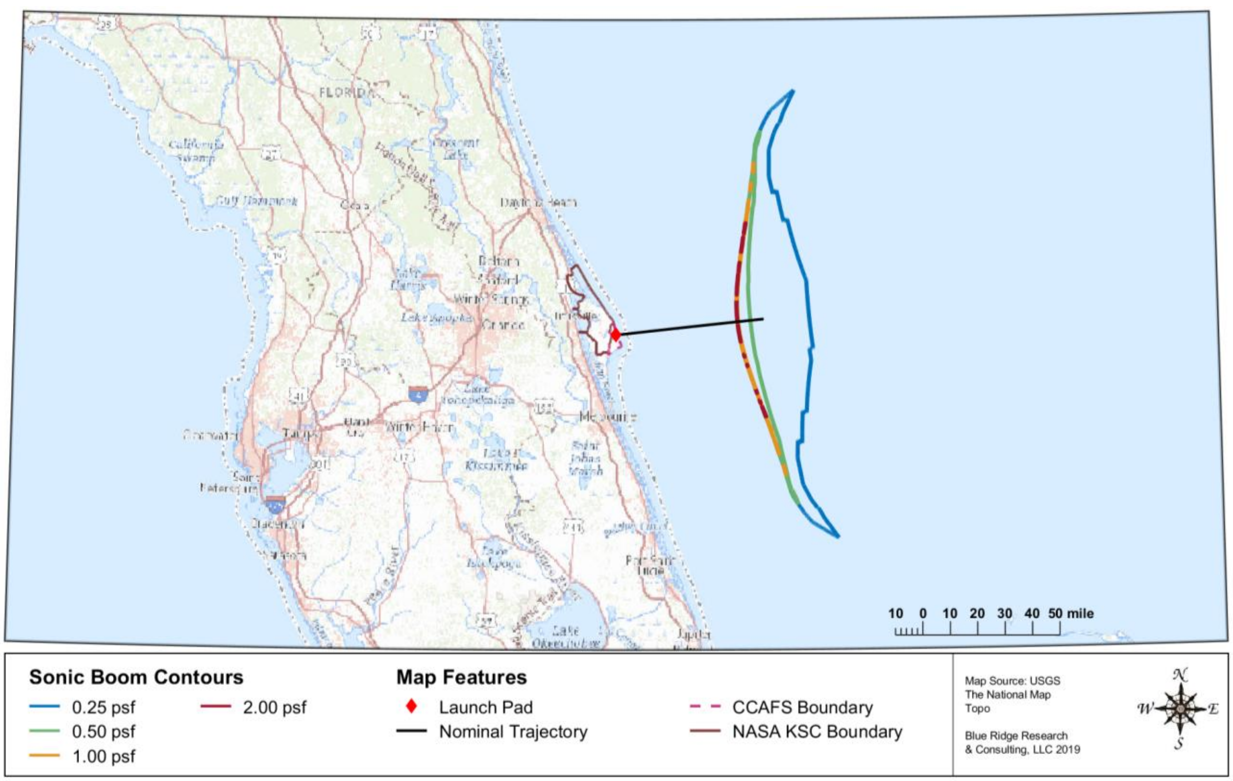

Figure 5-10. Sonic boom peak overpressure contours for a nominal Beta launch from SLC-20B

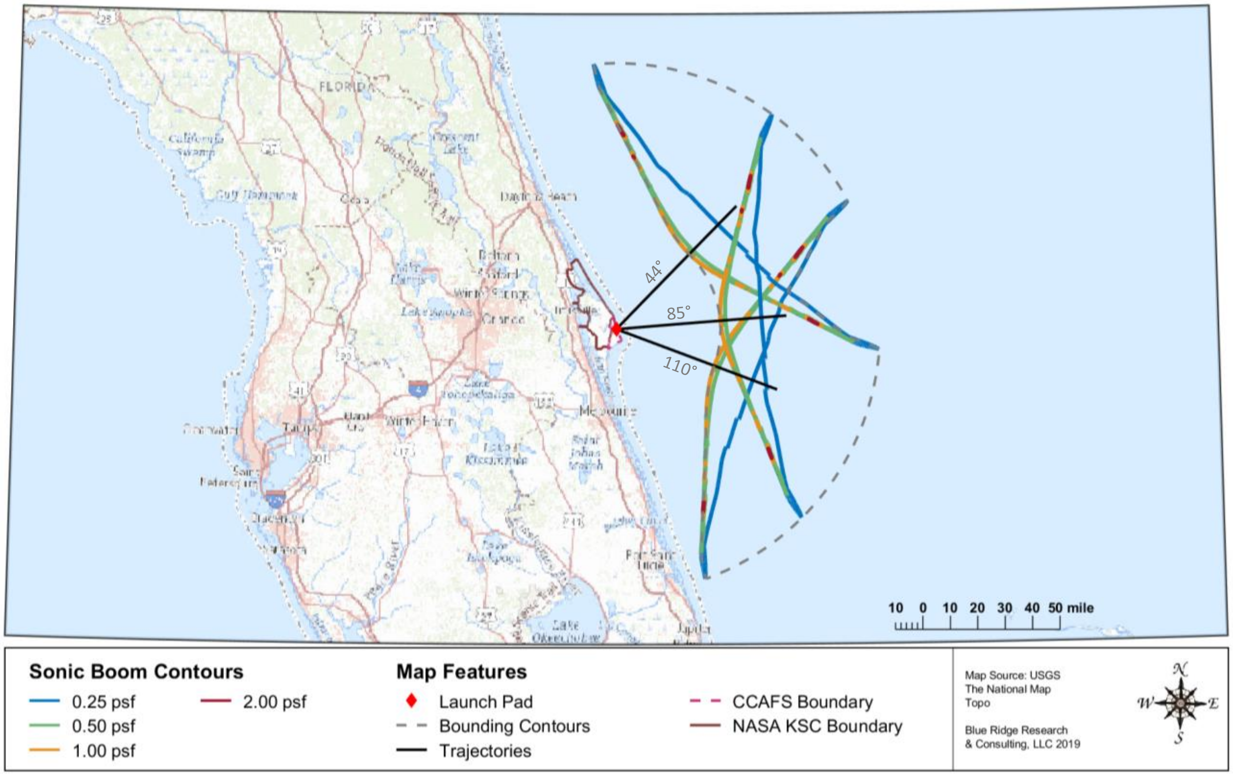

Figure 5-11. Sonic boom peak overpressure contours for 44°, 85°, and 110° Alpha launches from SLC-20A

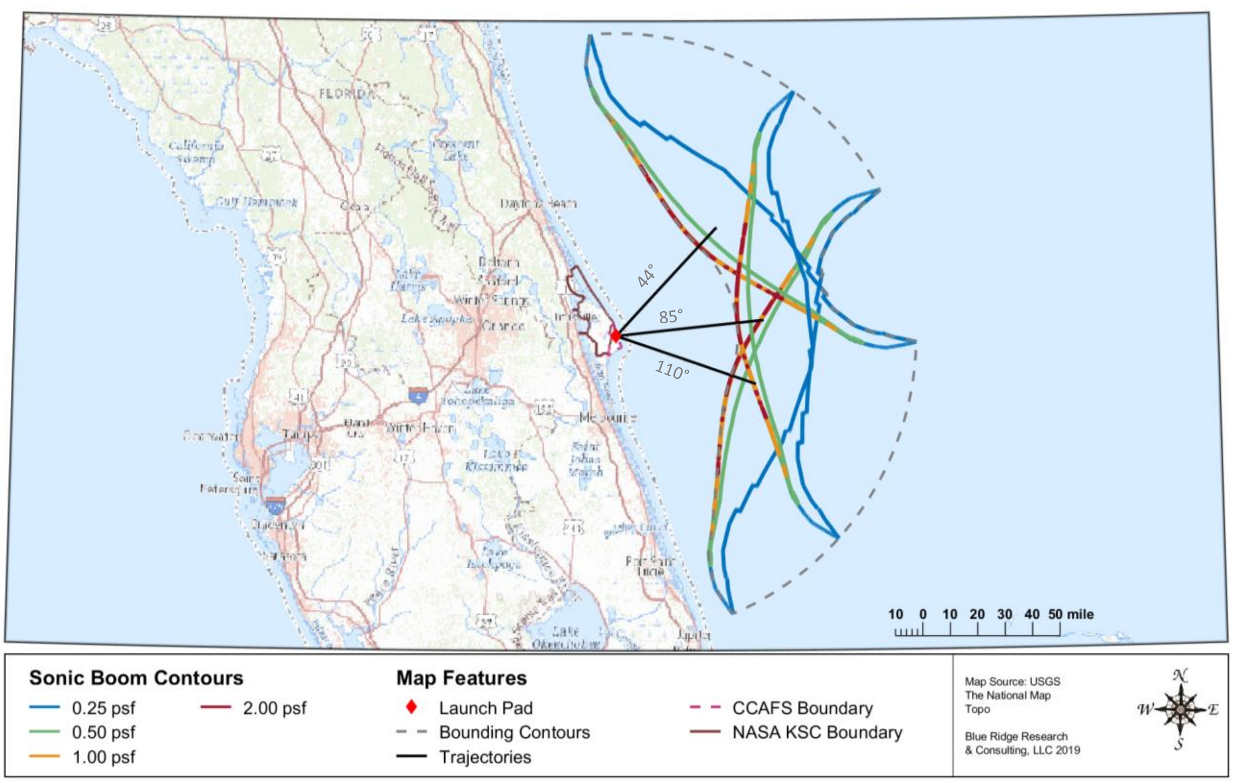

Figure 5-12. Sonic boom peak overpressure contours for 44°, 85°, and 110° Beta launches from SLC-20B

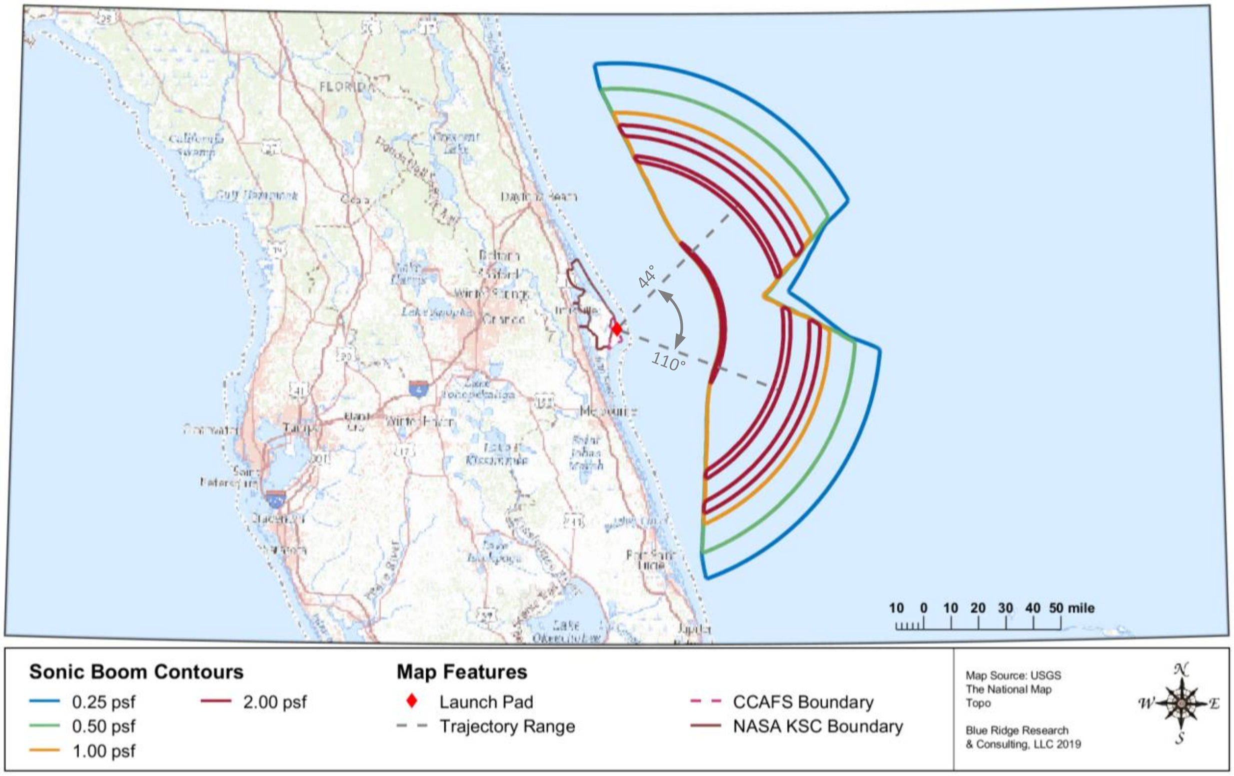

Figure 5-13. Maximum sonic boom peak overpressure contours for Alpha launches from SLC-20A

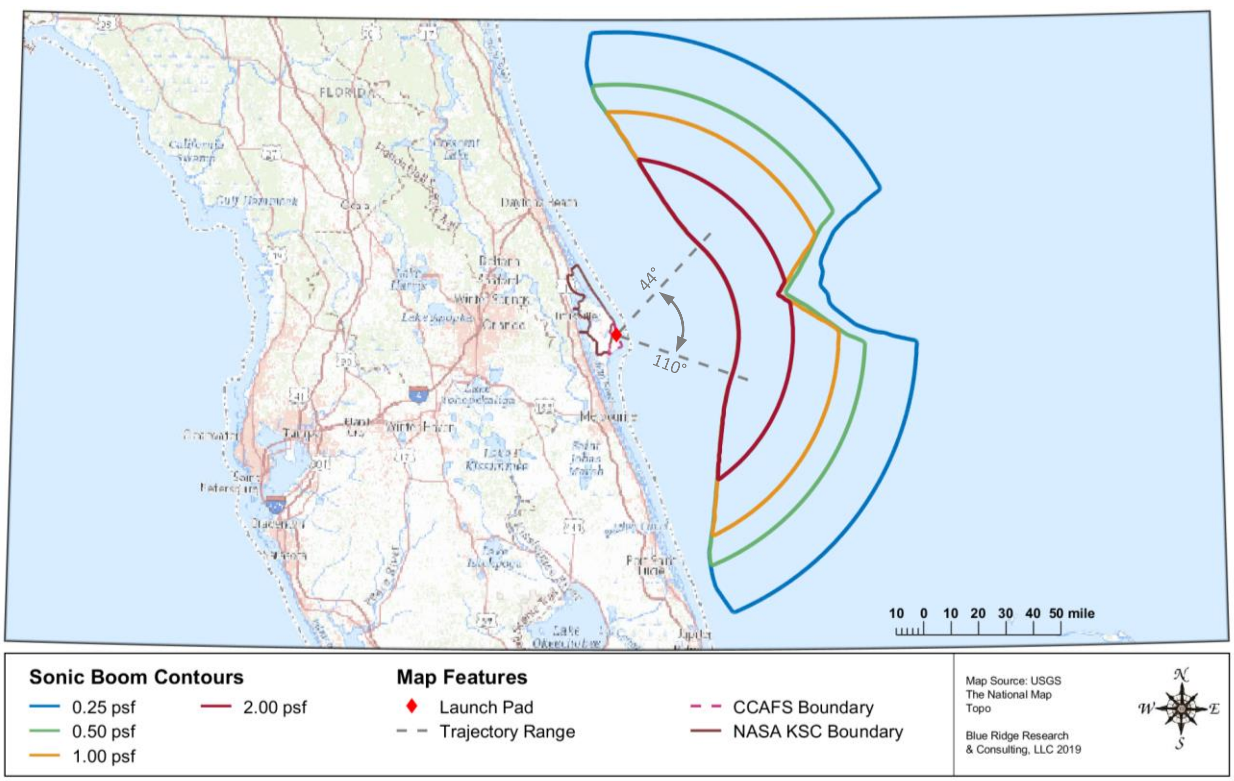

Figure 5-14. Maximum sonic boom peak overpressure contours for Beta launches from SLC-20B

5.2 Cumulative Noise

The potential for long-term community annoyance is assessed using A-weighted DNL for launch vehicle noise and C-weighted DNL for sonic booms. Alpha and Beta launch operations are considered over a range of launch azimuths between 44° and 110°.

<u>Launch Site Operations</u>

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" [11]. The DNL contours from 60 dBA to 75 dBA are presented in Figure 5-15. 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.

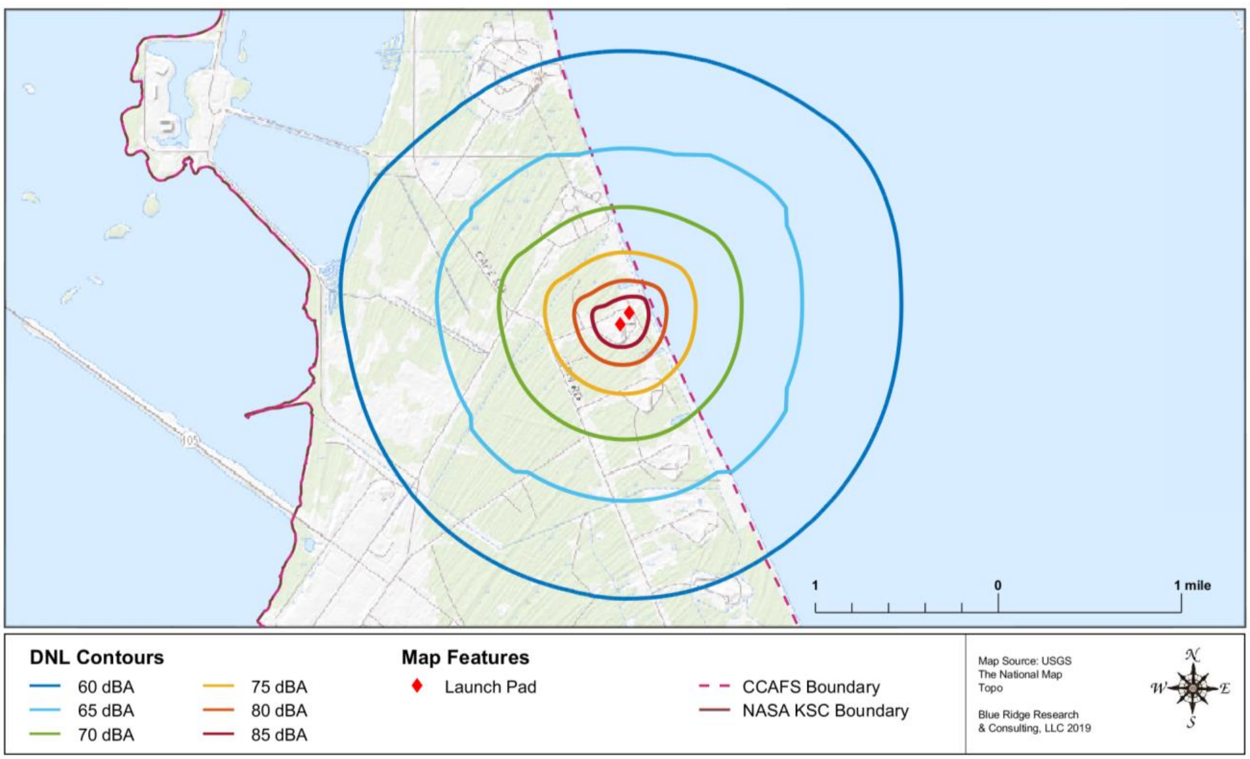

Figure 5-15. DNL contours for launch and static fire operations for both Alpha and Beta vehicles at Firefly's CCAFS SLC-20

The presence and/or location of sonic booms from Firefly 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 range of proposed launch trajectories 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.

6 Summary

This report documents the noise study performed as part of the EA for Firefly's CCAFS SLC-20 Facility. Firefly plans to conduct Alpha operations for up to 10 pre-launch static fire engine tests, 24 acceptance static fire engine tests, and 10 vertical launches per year. Beta operations are planned for up to 18 pre-launch static fire engine tests, 24 acceptance static fire engine tests, and 18 vertical launches per year. Both the static fire and launch events will occur at Firefly's CCAFS SLC-20 Facility. The potential impacts from propulsion noise and sonic boom are evaluated on a single-event and cumulative basis in relation to hearing conservation, structural damage, and human annoyance.

Single Event Noise Results with respect to Hearing Conservation

An upper limit noise level of $L_{A,max}$ 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 NIHL. The 115 dBA contours associated with the launch and static fire events are entirely within the boundaries of CCAFS.

For impulsive noise events such as sonic booms, noise impacts to human annoyance and health and safety are not expected. Thus, the potential for impacts to people in the community with regards to hearing conservation is negligible

Single Event Noise Results with respect to Structural Damage

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 [21]. The entire land area encompassed by the 111 dB noise contours resulting from the Alpha and Beta launch or static fire events lies within CCAFS/KSC boundaries.

For impulsive events such as sonic booms, there is potential for structural damage (to glass, plaster, roofs, and ceilings) for well-maintained structures for overpressure levels greater than 2 psf. Modeled sonic boom overpressure levels between 2 and 4 psf are directed easterly out over the Atlantic Ocean in the direction of the launch azimuth, making them inaudible on the mainland. Thus, the potential for impacts with regards to structural damage is negligible

Cumulative Noise Results

The DNL 60 dBA contour is used to conservatively identify the potential for significant noise impacts. The area identified within the 60 dBA contour for cumulative noise does not encompass land outside of the boundaries of CCAFS and NASA KSC, and, thus, no residences are impacted.

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APPENDIX C

USFWS Biological Opinion

United States Department of the Interior

FISH AND WILDLIFE SERVICE
North Florida Ecological Services
7915 BAYMEADOWS WAY, SUITE 200
JACKSONVILLE, FLORIDA 32256-7517

FWS Log No. 04EF1000-2020-F-0288

April 23, 2020

Mr. Michael Blaylock, Chief, Environmental Conservation
Department of the Air Force, 45th Space Wing
45 CES/CEIE
1224 Jupiter Street
Patrick AFB, Florida 32925
(Attn: Angy Chambers)

Subject: Space Florida LC-20

Dear Mr. Blaylock:

This letter acknowledges the U.S. Fish and Wildlife Service (Service) has reviewed the consultation request and the supporting Biological Assessment (EA) for Space Florida's Launch Complex-20 (SLC-20) Construction and Operations at Cape Canaveral Air Force Station (CCAFS), Brevard County, FL. The 45th Space Wing (SW) has prepared a BA pursuant to section 7 of the Endangered Species Act of 1973 (Act) (16 U.S.C. 1531 *et seq*.) and is requesting our concurrence and formal consultation for the proposed modifications at SLC-20.

Some of the information needed to initiate consultation was included with your request received on October 18, 2019, or was supplied in a supplemental BA provided on March 5, 2020. The 45th SW has revised the effects determination for eastern indigo snake (*Drymarchon corais couperi*) and Florida Scrub-Jay *(Aphelocoma coerulescens*).

Section 7 allows the Service up to 90 calendar days to conclude formal consultation with your agency and an additional 45 days to prepare our biological opinion (unless we mutually agree to an extension). Under the revised regulations 50 CFR §402.16, reinitiating criteria is clarified to include informal consultations.

The 45th SW has determined that the Action may affect, and is likely to adversely affect southeastern beach mice (*Peromyscus polionotus niveiventris)*. The Service has received the information for the formal consultation request in the amended BA. In the amended BA, the Service was provided an updated map for the proposed southeastern beach mouse habitat enhancement area for the pending biological opinion and an updated effects analysis for the following species.

Florida Scrub-Jay

The 45th SW is revising its approach with current and future users to ensure burn windows occur annually to prioritize prescribed fire management goals. The 45th SW is working with senior CCAFS environmental staff to develop operational controls. These operational controls will block out a set number of days annually within which launches or other activities affected by prescribed burns cannot occur. Designated burn windows will allow SW to meet its habitat management goals agreed to with the resource agencies. Space Florida will incorporate language into their tenant lease agreements that reference the prescribed burn goal, listed species management responsibilities, and resulting annual restrictions (1-2 weeks) during a 45th SW predefined period. As part of the lease agreement with Space Florida, the tenants will have a contractual obligation to comply with the specified prescribed burn days schedule by providing adequate protection for their equipment (via containment or filtration systems) or moving sensitive equipment to another location while the prescribed burn days are in force.

In summary, the Service concurs with the revised determination based on the following revisions in the BA:

1) Schedule operational controls that will provide assurances that 45th SW can meet the land management responsibilities;
2) Space Florida's lease agreements that the proposed processing facility shall accommodate smoke or move sensitive equipment to another location; and
3) the loss of 0.3 acres marginal coastal scrub habitat will have a discountable impact overall to the species management.

Eastern Indigo Snake

The 45th SW has agreed to implement the *Standard Protection Measures for Eastern Indigo Snakes* (SPM) to minimize any potential effects on the species. The eastern indigo snake has been observed on Cape Canaveral but has not been documented in the LC-20 project area. Scoping of burrows before collapsing will ensure that the species is not entombed during the collapse of refugia. Although eastern indigo snakes are vulnerable during construction activities, the SPM will educate construction personnel. If any indigo snakes are encountered during clearing activities, they will be allowed to move out of the project area safely and the 45th SW will contact the Service per the SPM.

Thank you for the request for formal consultation and revised BA, we expect to provide you with our biological opinion not later than July 16, 2020. For any questions about our concurrence letter, please contact Ms. Tera Baird by phone at 904-731-3196 or by email at tera_baird@fws.gov.

Sincerely,

Jay B. Herrington
Field Supervisor

United States Department of the Interior

FISH AND WILDLIFE SERVICE
North Florida Ecological Services
7915 BAYMEADOWS WAY, SUITE 200
JACKSONVILLE, FLORIDA 32256-7517

FWS Log No. 04EF1000-2020-F-0288

July 13, 2020

Mr. Michael Blaylock
Chief, Environmental Conservation
45 CES/CEIE-Cape

Subject: Space Florida Launch Complex 20

Dear Mr. Blaylock:

This letter transmits the U.S. Fish and Wildlife Service's (Service) biological opinion (BO) for Space Florida's Construction and Operations at Space Launch Complex-20 (SLC-20 or Action) at Cape Canaveral Air Force Station (CCAFS), Brevard County, FL. The 45th Space Wing (SW) prepared a Biological Assessment pursuant to section 7 of the Endangered Species Act of 1973 (Act) (16 U.S.C. 1531 *et seq*.) and requested formal consultation for the proposed modifications at SLC-20 and the anticipated effects of the Action on southeastern beach mice (*Peromyscus polionotus niveiventris*).

The transmitted BO considers the effects of the Action on southeastern beach mice. The Action does not affect designated critical habitat; therefore, this BO does not address critical habitat. The Service has determined that the proposed action will not jeopardize the continued existence of the southeastern beach mouse.

The SW determined that the Action may affect, but is not likely to adversely affect the West Indian manatee (*Trichechus manatus latirostris*), Wood stork (*Myteria americana*), Piping plover (*Charadrius melodus*), Red knot *(Calidris canutus*), eastern indigo snake (*Drymarchon corais couperi*) and Florida Scrub-Jay (*Aphelocoma coerulescens)*. The Service concurred with the determinations for the first four species in a letter dated February 10, 2020 and concurred on the remaining two species in a letter dated April 23, 2020.

The SW has determined that the Action may affect, and is likely to adversely affect the following nesting marine turtles: leatherback (*Dermocheuls coriacea*), green (*Chelona mydas*), loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempii*), and hawksbill (*Eretmochelys imbricata*). The Service has analyzed programmatically the effects of facility lighting adjacent to nesting marine turtle habitat and has exempted incidental take under the BO, FWS Log. 2009-F-0087.

The applicant and the SW have agreed to implement the measures outlined in the BO and the Service has determined programmatically that such actions that implement all the terms and conditions of the BO will not jeopardize the continued existence of nesting marine turtles.

Thank you for requesting consultation with the Service. If you have any questions about the BO, please contact Ms. Tera Baird by email at tera_baird@fws.gov or by phone at 904-731-3196.

Sincerely,

Acting for:
Jay B. Herrington
Field Supervisor

Biological Opinion

For Space Launch Complex -20
At Cape Canaveral Air Force Station

FWS Log #: 04EF1000-2020-F-0288

Prepared by:

U.S. Fish and Wildlife Service
North Florida Ecological Services
7915 Baymeadows Way, Suite 200
Jacksonville, FL 32256

Acting For ______________________________ ____________________

Jay B. Herrington - Field Supervisor Date

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CONSULTATION HISTORY

This section lists key events and correspondence during this consultation. A complete administrative record of this consultation is on file in the U.S. Fish and Wildlife North Florida Ecological Services' Office (Service).

2019-09-27 - 45th Space Wing (SW) sent a biological assessment (BA) requesting formal consultation for southeastern beach mouse (*Peromyscus polionotus niveiventris*), eastern indigo snake (*Drymarchon corais couperi*) and Florida Scrub-Jay (*Aphelocoma coerulescens*).

2020-12-06 - Air Force liaison and Service biologist had a call with the SW to discuss two projects, Space Florida Launch Complex-20, Space Florida Launch Complex-16, and the proposed compensation. AF Liaison discussed swapping the proposed compensation to support southeastern beach mice habitat restoration near the launch pads and an opportunity to collaborate with Florida Fish and Wildlife Commission to monitor the beach mice near the launch facilities.

2020-01-15 - SW sent a revised BA with changes to the project description and requested consultation on the following species: marine turtles: leatherback *(Dermocheuls coriacea*), green (*Chelona mydas*), loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempii*), and hawksbill *(Eretmochelys imbricata)*, southeastern beach mouse (*Peromyscus polionotus niveiventris*), Florida Scrub-Jay (*Aphelocoma coerulescen*s), eastern indigo snake (*Drymarchon corais couperi*), West Indian manatee (*Trichechus manatus latirostris*), Wood stork (*Mycteria americana*), Piping plover (*Charadrius melodus*), and Red knot (*Calidris canutus*). The BA also addressed the candidate species, gopher tortoise (*Gopherus polyphemus*).

2020-02-05 – SW sent an email with the proposed area for southeastern beach mouse habitat enhancement at land management unit 27.

2020-02-11- SW sent an email with the revised map for southeastern beach mouse habitat enhancement/restoration compensation. Habitat enhancement area is between Space Launch Complex-16 and Space Launch Complex-19.

2020-02-18 - The Service sent a concurrence letter dated February 10, 2020, for the following species: marine turtles (leatherback, green, Kemp's ridley, and hawksbill), West Indian manatee, Wood stork, Piping plover, and Red knot. The letter requested more information to support the effect determination for the Florida Scrub-Jay and eastern indigo snake.

2020-02-24- AF Liaison and Florida Scrub-Jay recovery biologists met with the SW and members of the space industry, including Space Florida, to discuss future compatibility of prescribed fire habitat management and operations of the launch facilities.

2020-03-05 – SW revised BA with an updated determination for Florida Scrub-Jay and eastern indigo snake. The BA has described that SW will establish an operational window for prescribed fire in the launch schedule to assist in prioritizing the habitat management.

2020-04-21 - The Service sent a letter dated April 6, 2020 to the SW stating that the consultation package is complete and expects formal consultation to be concluded on July 17, 2020. The Service concurred with the may affect, but is not likely to adversely affect determination for Florida Scrub-Jay and eastern indigo snake.

2020-04-24 - The Service sent a revised concurrence letter dated April 23, 2020, correcting the project proponent name in the subject line, header, and paragraph one. No changes to the consultation conclusion date of July 17, 2020.

2020-06-10 – The Service provided SW the complete draft to review.

2020-06-25 – The Service received preliminary track tube data from the Fish and Wildlife Commission and clarified the project description with the SW on the types of management that will occur outside the area of construction.

BIOLOGICAL OPINION

1. INTRODUCTION

A biological opinion (BO) is the document that states the opinion of the U.S. Fish and Wildlife Service (Service) under the Endangered Species Act of 1973, as amended (ESA), as to whether a Federal action is likely to:

- jeopardize the continued existence of species listed as endangered or threatened; or
- result in the destruction or adverse modification of designated critical habitat.

The Federal action addressed in this BO is the refurbishment of the Launch Complex 20, for Space Florida at Cape Canaveral Air Force Station (the Action). This BO considers the effects of the Action on the southeastern beach mice (*Peromyscus polionotus niveiventris*). The Action does not affect designated critical habitat; therefore, this BO does not address critical habitat.

The 45th Space Wing (SW) has determined that the Action may affect, but is not likely to adversely affect the West Indian manatee (*Trichechus manatus latirostris*), Wood stork (*Myteria americana*), Piping plover (*Charadrius melodus*), and Red knot *(Calidris canutus*). The Service concurs with the determinations for these species in a letter dated February 10, 2020.

The Service asked for more information to support the determination for the eastern indigo snake (*Drymarchon corais couperi*) and Florida Scrub-Jay (in the concurrence letter sent on February 10, 2020. SW revised BA and the effect determination to may affect, but is not likely to adversely affect the Florida Scrub-Jay and eastern indigo snake on March 05, 2020, and the Service concurred in a letter dated April 06, 2020. The Service sent a revised concurrence letter dated April 23, 2020.

The SW has determined that the Action may affect, and is likely to adversely affect nesting marine turtles: leatherback (*Dermocheuls coriacea*), green (*Chelona mydas*), loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempii*), and hawksbill (*Eretmochelys imbricata*). The Service has analyzed programmatically the effects of facility lighting adjacent to nesting marine turtle habitat and has exempted incidental take under the BO, FWS Log. 2009-F-0087. The applicant and the SW have agreed to implement the measures outlined in the opinion and the Service has determined programmatically that such actions that implement all the terms and conditions of the BO will not jeopardize the continued existence of nesting marine turtles.

This BO uses hierarchical numeric section headings. Primary (level-1) sections are labeled sequentially with a single digit (e.g., 1. PROPOSED ACTION). Secondary (level-2) sections within each primary section are labeled with two digits (e.g., 1.1. Action Area), and so on for level-3 sections.

BO Analytical Framework

A BO that concludes a proposed Federal action is *not* likely to *jeopardize the continued existence* of listed species and is *not* likely to result in the *destruction or adverse modification* of critical habitat fulfills the Federal agency's responsibilities under §7(a)(2) of the ESA.

> *"Jeopardize the continued existence* means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR §402.02).
> "*Destruction or adverse modification* means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR §402.02).

The Service determines in a BO whether we expect an action to satisfy these definitions using the best available relevant data in the following analytical framework (see 50 CFR §402.02 for the regulatory definitions of *action, action area, environmental baseline, effects of the action*, and *cumulative effects*).

a. *Proposed Action*. Review the proposed Federal action and describe the environmental changes its implementation would cause, which defines the action area.

b. *Status*. Review and describe the current range-wide status of the species or critical habitat.

c. *Environmental Baseline*. Describe the condition of the species or critical habitat in the action area, without the consequences to the listed species caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early consultation, and the impacts of State or private actions which are contemporaneous with the consultation.

d. *Effects of the Action*. Predict all consequences to species or critical habitat caused by the proposed action, including the consequences of other activities caused by the proposed action, which are reasonably certain to occur. Activities caused by the proposed action would not occur but for the proposed action. Effects of the action may occur later in time and may include consequences that occur outside the action area.

e. *Cumulative Effects*. Predict all consequences to listed species or critical habitat caused by future non-Federal activities that are reasonably certain to occur within the action area.

f. *Conclusion*. Add the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the species, formulate the Service's opinion as to whether the action is likely to jeopardize species or adversely modify critical habitat.

2. PROPOSED ACTION

The Proposed Action is the repurposing and operation of a commercial launch site at Space Launch Complex 20 (SLC-20) at CCAFS, Florida. Space Florida intends to refurbish, enhance, and use the existing SLC-20 support shop, Horizontal Integration Facility (HIF), and blockhouse. The proposed real property license area, 220-acres, includes SLC-20 facility area that will be rehabilitated and adjacent undeveloped lands.

The facility would contain infrastructure to test rocket engines, integrate launch vehicles, and conduct launches of liquid fueled, small and medium-lift class launch vehicles. The action includes construction of a Concept A and Concept B launch pads, horizontal integration facility, fuel storage tanks, lighting, stormwater retention ponds throughout the complex, and customer and operations support buildings.

SLC-20 is located centrally within the Air Force Station and south of Space Launch Complex 34 to the north, 19 to the south, and the Atlantic Ocean to the east within Sections 5-8, Township 23 South, Range 38 East, Brevard County, Florida (Figure 2-1). The following sections deconstruct the Action in three parts: Construction, Habitat Enhancement, and Operations.

2.1. Construction

The SLC-20 real property license area is 220 acres, but most of the area proposed for construction, 33 acres, is previously disturbed and developed in areas. The Action will reuse much of the existing impervious concrete for planned roads and structures. Construction activities, such as scraping, facility demolition, or refurbishment will be required to make the existing structures viable for launch activities.

Site development will take place over three phases of construction. The BA has a list of phases with the new construction mapped within the bounds of the Proposed Action Boundary, (pg. 4-2, 4-3). The new HIF/hazardous payload processing facility along the southwest region of the Proposed Action Boundary is the only new construction that requires clearing outside the legacy SLC-20 footprint. The new HIF will result in clearing of 0.3 acre of undisturbed live oak and saw palmetto upland habitat (Figure 2-1). Remaining areas are impervious or previously disturbed and now dominated some native and exotic plant species.

Within the area of construction there will be heavy machinery and staging areas for construction equipment. The limits within the area of construction will be cleared using heavy machinery. Cleared material will be placed in wheeled dump trucks for removal from that area. Once vegetation is removed from this area, much of the site will be graded using large, heavy tracked bulldozers. Material will either be transferred to a suitable off-site area or burned on location in accordance with SW regulations as schedule and burn conditions permit. It is anticipated that all excavated soil will remain onsite within the area of construction.

Existing roadways will be reused but may require resurfacing and potentially slight widening to support small and medium launch vehicle transporters and equipment.

2.2. Southeastern Beach Mouse Habitat Enhancement

The habitat enhancement for southeastern beach mouse (SEBM) will be done within a 9.5 acre plot (Figure 2-2).

The exact acreage and methodology will be outlined in the scope of work. Relativity Space has agreed to habitat enhancement within the same area. The SW, the Service, Relativity Space, and Space Florida will be collaborating on a scope of work for the proposed area that will focus on the following:

1. Improve the condition of the ecotone between the primary and secondary habitat, thus improving the condition of the seaward edge of the secondary habitat.

2. Provide corridors from the primary habitat into good and fair condition scrub and other landward habitats.

The scope of work may include track mechanical thinning or hand clearing of coastal scrub habitat and clearing to create corridors to landward scrub habitat. Vegetation will either be removed to a suitable off-site area or incinerated on location in accordance with SW regulations as schedule and conditions permit.

2.3. Operations

Space Florida expects up to 24 total Concept A/B launches. Seventy percent of the launches are expected to occur during daylight hours and 30 percent of the launches are expected to occur during night hours (after 10 p.m. and before 7 a.m.).

To prepare for launches, payload preparation activities would be conducted in parallel with most launch vehicle preparations. Payload activities include payload checkout, spacecraft propellant loading (if required), and payload encapsulation in the fairings. The encapsulated payload would then be transported to SLC-20.

Non-hazardous and hazardous payload processing and encapsulation would take place in the existing HIF for the Concept A launch vehicle. Following construction of the new HIF, hazardous payload processing would transition to the new facility.

SLC-20 will have maintained roads and grassed areas within the complex. The areas are expected to be maintained by mowing on a periodic basis using standard large-scale grass mowing equipment. Maintained roads outside the area of construction at the complex and the security fence will be maintained on a periodic basis. The mowing right-of-way near the fence line and roads will not exceed 30 feet.

2.4. Other Activities Caused by the Action

A BO evaluates all consequences to species or critical habitat caused by the proposed Federal action, including the consequences of other activities caused by the proposed action, that are reasonably certain to occur (see definition of "effects of the action" at 50 CFR §402.02). Additional regulations at 50 CFR §402.17(a) identify factors to consider when determining whether activities caused by the proposed action (but not part of the proposed action) are reasonably certain to occur. These factors include, but are not limited to:

(1) past experiences with activities that have resulted from actions that are similar in scope, nature, and magnitude to the proposed action;
(2) existing plans for the activity; and
(3) any remaining economic, administrative, and legal requirements necessary for the activity to go forward.

In its request for consultation, the SW did not describe, and the Service is not aware of, any additional activities caused by the Action that are not included in the previous description of the proposed Action. Therefore, this BO does not address further the topic of "other activities" caused by the Action.

2.5. Action Area

The action area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR §402.02). Delineating the action area is necessary for the Federal action agency to obtain a list of species and critical habitats that may occur in that area, which necessarily precedes any subsequent analyses of the effects of the action to the species or critical habitats.

It is practical to treat the action area for a proposed Federal action as the spatial extent of its direct and indirect "modifications to the land, water, or air" (a key phrase from the definition of "action" at 50 CFR §402.02). Indirect modifications include those caused by other activities that would not occur but for the action under consultation. The action area determines any overlap with critical habitat and the physical and biological features therein that we defined as essential to the species' conservation in the designation final rule. For species, the action area establishes the bounds for an analysis of individuals' exposure to action-caused changes, but the subsequent consequences of such exposure to those individuals are not necessarily limited to the action area.

Figures 2-1 and 2-2 shows the locations of all activities that the proposed Action that would cause changes to land, water, or air caused by these activities. The action area for this BO is the SLC- 20 real property lease area boundary, 220 acres, of which 33 acres is the proposed area of construction and re-development, and the proposed 9.5 acre habitat enhancement area for SEBM near SLC-19.

2.6. Tables and Figures

Figure 2-1. Real Property Lease Boundary of SLC-20 and Proposed Action Boundary. All construction activities will occur within the Proposed Action Boundary.

Figure 2-2. The proposed SEBM habitat enhancement area outlined yellow

3. SOURCES OF CUMULATIVE EFFECTS

A BO must predict the consequences to species caused by future non-Federal activities within the action area, *i.e.,* cumulative effects. "Cumulative effects are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation" (50 CFR §402.02). Additional regulations at 50 CFR §402.17(a) identify factors to consider when determining whether activities are reasonably certain to occur. These factors include, but are not limited to: existing plans for the activity; and any remaining economic, administrative, and legal requirements necessary for the activity to go forward.

In its request for consultation, the SW did not describe, and the Service is not aware of, any future non-Federal activities that are reasonably certain to occur within the action area. Therefore, we anticipate no cumulative effects that we must consider in formulating our opinion for the Action.

4. STATUS OF SOUTHEASTERN BEACH MOUSE

This section summarizes best available data about the biology and current condition of the throughout its range that are relevant to formulating an opinion about the Action. Most of this text is taken directly from the draft Status Species Assessment (SSA) that is currently under peer-review.

The Service published its decision to list the SEBM as threatened species under the Act in 1989 (54 FR 20598). Critical habitat is not designated for this subspecies, and therefore will not be analyzed in this opinion.

4.1. Species Description

The SEBM is one of 16 recognized subspecies of old field mice *Peromyscus polionotus* (Hall 1981); it is one of the eight of those subspecies that are called beach mice. The SEBM is a small mouse that reaches an average length of 136 mm with an average body mass of 14.5 g (Stout 1992). Southeastern beach mice have pale, buffy coloration from the back of their head to their tail, and their underparts are white.

4.2. Life History

SEBM are generally nocturnal, semifossorial, and monogamous. The subspecies occupies foredunes (i.e., frontal, primary, and secondary), transitional (i.e., coastal grasslands and coastal strand) dunes, coastal scrub dunes. SEBM also occur in interior scrub and other landward habitats, though the extent to which these areas utilized is unclear. Below is a summary of the various elements of the SEBM life history, including reproduction, survival and mortality, foraging, home range, burrowing behavior, and habitat.

4.2.1. Survival and Mortality

The average life span of beach mice in the wild is 9 months to one year (Bird et al. 2016, Oddy 2000, Swilling 2000), although a few individuals have been known to live longer than two years. Studies at CCAFS found the mean longevity of SEBM on across study grids was 113 days with no significant differences between sexes (Oddy 2000). Maximum longevity in this study was 596 days. Swilling and Wooten (2002) found longer persistence times associated with mice dispersing further away from their natal home range, perhaps a result of reduced predation rates.

4.2.2. Foraging

Beach mice are food generalists and feed on a variety of seeds of dune and scrub plants and insects (Moyers 1996, Sneckenberger 2001, Keserauskis 2007).

Studies show that the diet of the SEBM varies seasonally and among and within habitats, and fruits, seeds and arthropods that feed on them comprise most of their diet (Keserauskis 2007).

In most cases, fruits and seeds that are consumed by beach mice are produced by low growing, prostrate plants, on supple stems easily manipulated by mice, or as the fruits and seeds become available as fallen seeds (Moyers 1996). Beach mice also consume invertebrates, especially during late winter or early spring when seeds are scarce (Ehrhart 1978).

4.2.3. Home Range

Beach mouse home range size varies among subspecies (USFWS 2010) and may vary seasonally and in relation to density as well as habitat and food resources. Beach mouse home ranges average approximately 1.2 acres (Bird 2016). Swilling and Wooten (2002) found the mean home range for Anastasia beach mice (ABM) (both sexes) was approximately 0.89 acres, whereas using radio telemetry data, Lynn (2000) found home ranges of 1.68 acres and 1.73 acres for males and females respectively; neither study noted significant differences in home range size between males and females.

Blair (1951) found home ranges of beach mice living in the comparatively dense cover of the beach dunes averaged significantly larger in the spring than in the fall. Beach mice tend to inhabit a single home range throughout their lifetime and will often maintain several burrows within their home range (Blair 1951). Extine and Stout (1987, USFWS 1999) reported movements of the SEBM between the primary dunes and interior scrub on Kennedy Space Center (KSC) and Merritt Island National Wildlife Refuge (MINWR) and concluded that home ranges can overlap and reach high densities within preferred habitats.

4.2.4. Burrows

While multiple species of *Peromyscus* will excavate burrows, *P. polionotus* is the only member of the genus that excavates its own burrow, which is extensive (Ehrhart 1978, USFWS 1999). Beach mice are semifossorial, and may utilize as many as 20 burrows within their home range (USFWS 1999). Beach mice will use burrows as a place to rest during the day and between nightly foraging bouts. Burrows are also used for escape from predators, birthing and caring for young.

Burrows generally consist of an entrance tunnel, nest chamber, and escape tunnel (Weber et al. 2013). High predation risk and the harsh coastal environment make selection of quality burrow sites critical for survival of beach mice (Swilling and Wooten 2002). Beach mice have been found to select burrow sites based on a suite of biotic and abiotic features. (Lynn 2000; Sneckenberger 2001).

Bird et al. (2004) in a study exploring the effects of artificial illumination on the behaviors of beach mice found that patch use was affected by the presence of illumination, light type, and distance from light source. In this study, foraging frequency was significantly higher in dark arrays and that more seeds were removed from resource patches as distance from illumination increased. This is consistent with the observation that beach mice activity decreases in response to increased levels of moonlight due to elevated risk perceptions (Stoddard et al. 2018).

4.2.5. Habitat

Beach mouse habitat includes a heterogeneous mix of interconnected coastal communities on barrier islands. Holler (1992) described beach mouse habitat at the time as including primary and secondary dunes vegetated by sea oats, beach grass (*Panicum amarum*), and blue stem (*Andropogon maritimus*). Contemporary understandings of the geographic distribution of beach mouse habitat is that beach mice inhabit coastal dune, strand, and scrub habitats (where available) that range from being comprised mostly of grasses to mostly shrubs (Sneckenberger 2001, Suazo et al. 2009, Stout et al 2012, Wilkinson et al. 2012, Breininger et al. 2018). Additionally, the coastal strand and scrub plant communities (e.g. Cape Canaveral area) likely serve as refugia for and sources of individuals that disperse into dune systems after storm events (Stout et al. 2012).

Coastal communities of Florida can be classified into three general zones. These zones, as described by Johnson and Barbour (1990) and used in the draft Species Status Assessment include ***foredunes*** (frontal, primary, and secondary), ***transitional dunes*** (coastal grasslands and strands), and ***coastal scrub dunes***. Additionally, beach mice are known to utilize adjacent or connected landward habitats including ***interior scrub*** (particularly within the Cape Canaveral), ruderal or old-field environments, and mowed roadside edges and rights-of-way.

Foredunes occur in the zone nearest the shoreline, but beyond the limits of the forces of annual wave action (Johnson and Barbour 1990) and include dunes frequently referred to as frontal, primary, and secondary. There is considerable uncertainty regarding optimal ranges of habitat conditions for SEBM in foredune areas. Given the differences in beach mouse habitats between the Gulf and Atlantic coasts, additional research is needed to accurately define optimal habitat conditions within foredune areas specific to SEBM.

Transitional dunes are in the zone situated between the foredunes and more distinct natural communities such as coastal scrub or maritime hammock (FNAI 2010). Transitional dunes may include herbaceous natural communities such as coastal grasslands as well as areas with a higher prevalence of woody plants such as coastal strand.

Coastal scrub dunes are typically located behind the foredunes. In addition to the shrubbier form of live oak, plant assemblages in this community include myrtle oak (*Q. myrtifolia*), saw palmetto, and yaupon holly (*Ilex vomitoria) (*Kurz 1942, Johnson and Barbour 1990) within a matrix of open sand areas. The low stature of coastal scrub is maintained via the effects of salt spray to terminal buds of plants (Johnson and Barbour 1990). Similarly, to inland scrub habitats (described below), periodic fires are integral to the maintenance of coastal scrub systems. In the absence of fire or in combination with fire, mechanical treatments may be used to manipulate the structure of vegetation within scrub communities.

While the predominance of SEBM occurrence within scrub type habitats is in the coastal scrub dunes, SEBM are known to occur in more interior scrub environments within the Cape Canaveral Complex. The cape feature at Cape Canaveral is unique among SEBM habitats as it includes a broad expanse of upland habitats between the Atlantic coast and the Banana and Indian Rivers. Beyond the Cape Canaveral, SEBM habitat generally occurs in narrow stretches along the shoreline.

While seasonally abundant, the availability of food resources in the foredunes fluctuates (Sneckenberger 2001). In contrast, the scrub habitat provides a more stable level of food resources, which becomes crucial when food is scarce or nonexistent in the primary and secondary dunes. Furthermore, the coastal scrub dunes appear to serve as refugia for beach mice during and after tropical storm events (Holliman 1983, Swilling et al. 1998), from which recolonization of the foredunes takes place (Swilling et al. 1998, Sneckenberger 2001). This suggests that access to primary, secondary, and coastal scrub habitat is essential to beach mice at the individual and population levels and to some extent at the range wide level. Additionally, studies have found no detectable differences between scrub and frontal dunes in beach mouse body mass, home range size, dispersal, reproduction, survival, food quality, and burrow site availability (Swilling et al. 1998, Swilling 2000, Sneckenberger 2001). It should be noted that the presence of "scrub" habitat with or without storm events as a driving factor for SEBM is known only for the Cape Canaveral area and portions of the panhandle; the entire dune system of the CNS and other areas of SEBM habitat mostly lack this feature.

Beyond the foredunes, transitional areas and coastal scrub, barrier islands often grade into stabilized dunes where shrubby plant communities give way to canopied forests. Stable dune areas may include maritime hammocks and forests that are not considered suitable beach mouse habitat. SEBM rarely, if ever, occur in areas where woody vegetation >2m is dominant (Stout 1992). Additionally, while Toombs' (2001) captured SEBM in the primary dunes and none were captured in dense areas of saw palmetto where it may be more difficult to burrow, this does not appear to be representative of occupancy of SEBM within the Cape Canaveral Complex in more dense and unmanaged coastal habitats (Oddy personal communication, 2019). There is research that provides evidence of long-term occupancy of interior scrub habitats by SEBM within the CCAFS (Stout 1979, Suazo et al. 2009, Simmons 2008).

The three general zones can be classified into two habitat classes for SEMB. **Primary habitat** identifies the characteristic dune habitats typically occupied by SEBM (foredunes, transitional dunes, and coastal scrub dunes). **Secondary habitats** include interior scrub and other natural and human-altered landscapes landward of the dunes that provide critical refugia habitat and may support SEBM resource needs, may provide movement corridors, or may support an extension of a population.

4.3. Numbers, Reproduction, and Distribution

4.3.1. Numbers and Distribution

SEBM are found in coastal habitats of Florida's east coast. The 1989 Final Listing Rule states that the subspecies was known to occur on Canaveral National Seashore (CNS), MINWR, CCAFS, the north and south ends of Orchid Island at Sebastian Inlet area and Fort Pierce Inlet State Park (also known as north Hutchinson Island) on the north side of Ft. Pierce Inlet.

The Recovery Plan for the Anastasia Island Beach Mouse and the Southeastern Beach Mouse (USFWS 1993) described the limits of occurrence of SEBM from Volusia County at Canaveral National Seashore south to 7 miles north of the Brevard County line and including scattered localities in Indian River County, and St. Lucie County. At the time of listing, in areas south of St. Lucie Inlet, nearly all dune habitat was developed and unsuitable for beach mice (USFWS 1988). Some potentially suitable habitat remains within public conservation lands on Jupiter Island, St. Lucie Inlet Preserve State Park, Hobe Sound National Wildlife Refuge and in Palm Beach County at John D. MacArthur Beach State Park.

In the draft SSA, the Service reviewed the extant and historic distribution of the species range wide and grouped the populations into geographic segments: Canaveral North, Canaveral South, Orchid Island/ Hutchinson Island North, Hutchinson Island, Jupiter Island, Jupiter South, Palm Beach, Boynton, and Hillsboro. The geographic segments are illustrated in Figure 4-1. and includes inlet locations associated with limits of historic range (light grey box), limits of range at the time of federal listing (1989; medium grey box), current range where two extant populations are known to occur (dark grey box), and areas of uncertain occupancy (red dashed lines).

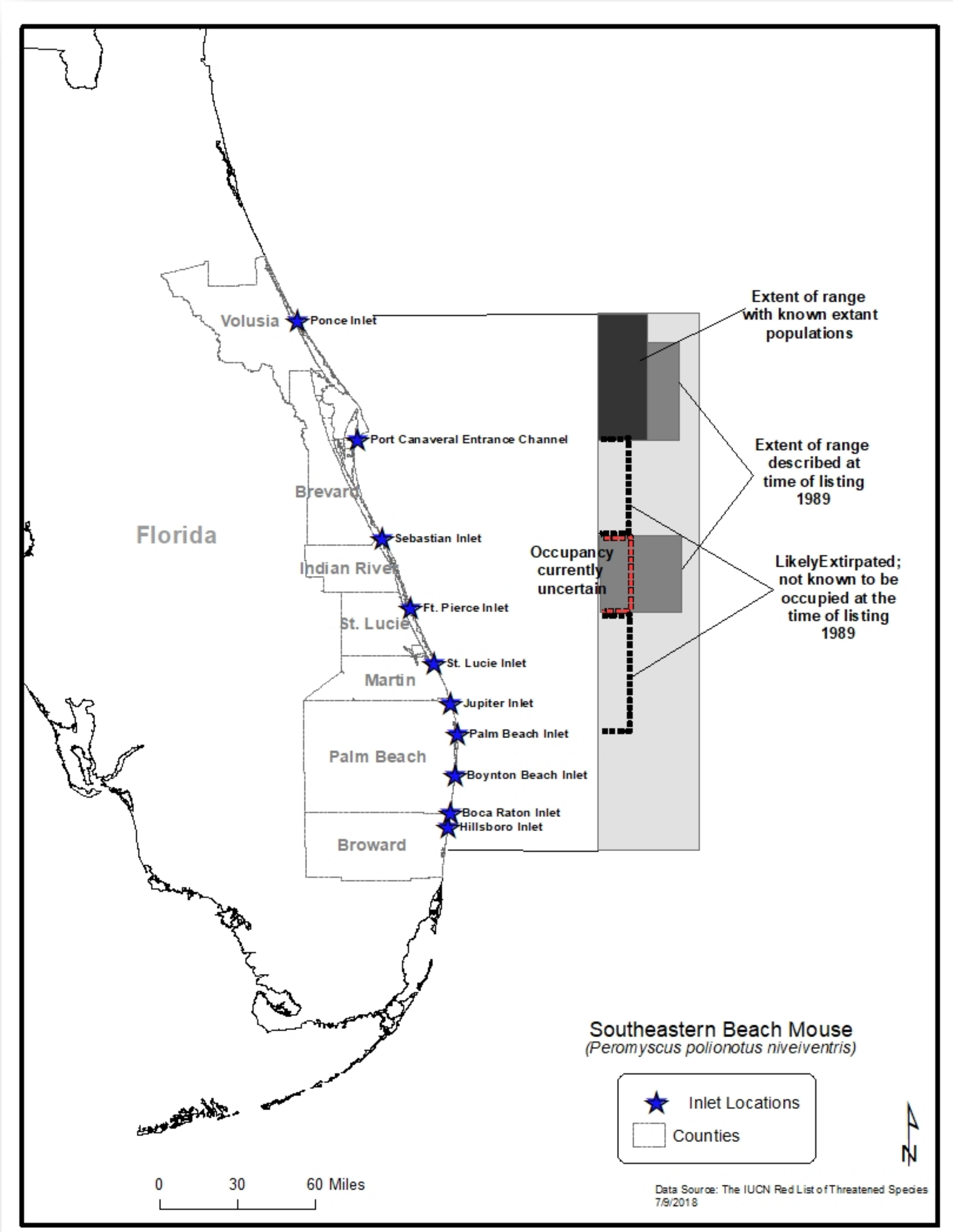

FIGURE 4.1 SEBM RANGE MAP – Extant and Likely Extirpated.

To assess current condition of the species, the draft SSA characterizes the amount of primary and secondary habitat within the geographic segments across the range of species. The geographic segments are parsed in eight different resilience units. The Canaveral Complex resilience unit is the most important for the recovery of the species.

The Canaveral Complex Unit is a metapopulation and has the most habitat to support the species. The Canaveral Complex has 89% of the total protected habitat, with the most acres of primary habitat, 3,377 acres, and 11,897 secondary habitats. Within the secondary habitat, the natural communities within occur at a fine-scale mosaic of conditions that may or may not be suitable for SEBM.

4.3.2. Reproduction

Beach mice have a monogamous mating system (Blair, 1951, Smith 1966, Lynn 2000). Mated pairs tend to remain associated in acquiring food and sharing burrows (Blair 1951). Beach mice reach sexual maturity at 55 days of age; however, some mice are capable of breeding earlier (Ehrhart 1978).

Peak breeding season for beach mice appears to occur between November and early January (Blair 1951) and appears to coincide with increased availability of food from the previous growing season (Rave and Holler 1992); although pregnant and lactating SEBM have been observed in all seasons (Stout 1979, Oddy et al*.* 1999, Oddy 2000, Bard personal communication, 2019).

While the reproductive potential of beach mice is generally high, Blair (1951) reported only 19.5 percent of beach mice within his study survived from January to May in the same year indicating that mortality of adult beach mice is also quite high.

4.4. Conservation Needs and Threats

4.4.1. Conservation Needs

There is considerable uncertainty regarding beach mouse use of the scrub and more stable, interior habitats, particularly within the CCAFS. Future research is needed to better define optimal habitat conditions for SEBM in coastal scrub and interior scrub habitats. Habitat conditions within the interior scrub areas that benefit the threatened Florida Scrub-jay (*Aphelocoma coerulescens*) may also benefit SEBM (Suazo et al. 2009). While ranges of habitat conditions occur as a result of management regimes and techniques, optimal habitat conditions for Florida Scrub-Jays within the interior scrub within the Canaveral Complex includes a more open habitat structure (Breininger 1992, Breininger et al. 2003, USFWS 2007) that is ideally maintained with use of periodic prescribed fire. Optimal fire-return intervals may be shorter in coastal scrub habitats than in more interior locations (Schmalzer and Hinkle 1992), which may result in less desirable SEBM conditions in the more interior areas. Depending on the matrix of vegetation within the coastal scrub and adjacent habitats, fire return frequencies vary from 3 to

10 years (USFWS 2007). In the absence of fire, the cover and stature of woody vegetation increases, often resulting in the loss of open areas.

4.4.2. Threats

Habitat loss and fragmentation due to destruction associated with residential and commercial development has created disjunct and isolated populations of SEBM along the east coast of Florida. South of the Port Canaveral Entrance Chanel, five inlets between Indian River and Broward Counties create additional barriers to dispersal. Most remaining SEBM habitat occurs on public conservation lands, though some private lands also support areas of natural dune vegetation that could be occupied by beach mice (e.g. St. Lucie Nuclear Power Plant, undeveloped lots, and undeveloped portions of residential and commercial lots). As a result, extant populations of SEBM are geographically and thus genetically, isolated. Within the current landscape configuration, natural dispersal between existing populations is highly unlikely.

Other threats to the species include shoreline armoring to protect coastal to protect coastal properties from erosion, coastal lighting at facilities or residential development, vehicular or foot traffic near developments, and climate change.

5. ENVIRONMENTAL BASELINE FOR SOUTHEASTERN BEACH MICE

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the southeastern beach mice its habitat, and ecosystem within the action area. The environmental baseline is a “snapshot” of the species’ health in the action area at the time of the consultation and does not include the effects of the Action under review.

5.1. Action Area Numbers, Reproduction, and Distribution

The SEBM is found along the entire reach of immediate coastline and within coastal strand on CCAFS in addition to the KSC and Cape Canaveral National Seashore. The known distribution is a result of cursory surveys, intermittent trapping involving different construction projects, two demography studies conducted in 2007, 2011-2012, and annual occupancy studies conducted 2010-2015, and 2018. In addition, several captures of have occurred in the existing blockhouse in 2001.

In 2020, Florida Fish and Wildlife Conservation Commission (FWC), set up tube tracking cameras to monitor SEBM use near the SLC pads that are proposed for rehabilitation or construction and the near the pad proposed for the habitat enhancement. Track tubes at SLC 16 and 19 have been deployed since late January 2020 and have been checked a total of 9 times. Track tubes at SLC 20 have been in place since late April 2020 and have been checked 3 times. Track tubes at LMU 18 and 22 have been out since late April and have been checked 4 times. All track tubes are checked every 2 weeks. Figure 5-1, is a map of the preliminary data sent to the Service on June 25, 2020, and the map has the detection rates displayed as percentage of total surveys at a site with positive beach mouse detections.

Using the GIS layer created for the draft SSA, we reviewed distribution the primary and secondary habitat within the real property lease area (Figure 5.2). The lease area is 220 acres with 25 acres of primary habitat (landward foredunes), and 90 acres secondary habitat (human altered habitat of the dune). The area of construction within the lease area has about 4 acres of primary habitat and 5 acres of secondary habitat.

To estimate the number of individuals that the lease area may support, we reviewed home range data and compared it to the acres of primary habitat within the action area. Beach mouse home ranges average approximately 1.2 acres (Bird 2016), .89 acres for both male and female (Swilling and Wooten 2000), and 1.68 acres and 1.73 acres for males and females respectively (Lynn 2000). Using the 25 acres of primary habitat, we estimate the lease area has enough primary habitat to support between 15 – 28 individuals. However, the habitat within the action area has not been managed to support the species, and the transitional dune systems is degraded from previous development. The maintained grasses in the lease area portion of the action area have a mixture of native and exotic species, making the foraging habitat less than ideal. Based on the habitat condition there is likely a small fraction of the estimated individuals within the lease area portion of the action area. We expect a smaller number of those individuals are utilizing the primary (4 ac) and secondary habitat (5 ac) within the proposed construction area (33 ac) for foraging, burrows, and travel corridors.

5.2. Action Area Conservation Needs

The proposed construction area for SLC-20 is situated west of the beach dune area. Figure 5-1 shows the habitat types within the construction portion of the action area and the entire lease portion of the action area.

To support SEBM, the coastal scrub and grasses should be managed, particularly areas that connect to the seaward edge of the secondary habitat. Restoration and management of the primary and secondary habitat may provide increased connectivity, allow for storm refugia, and diverse forage.

SEBM are at increased risk to predation and modify their foraging behavior when exposed to artificial lighting. Lighting should be managed to protect coastal species, including SEBM which are vulnerable to excessive coastal lighting.

5.3. Tables and Figures

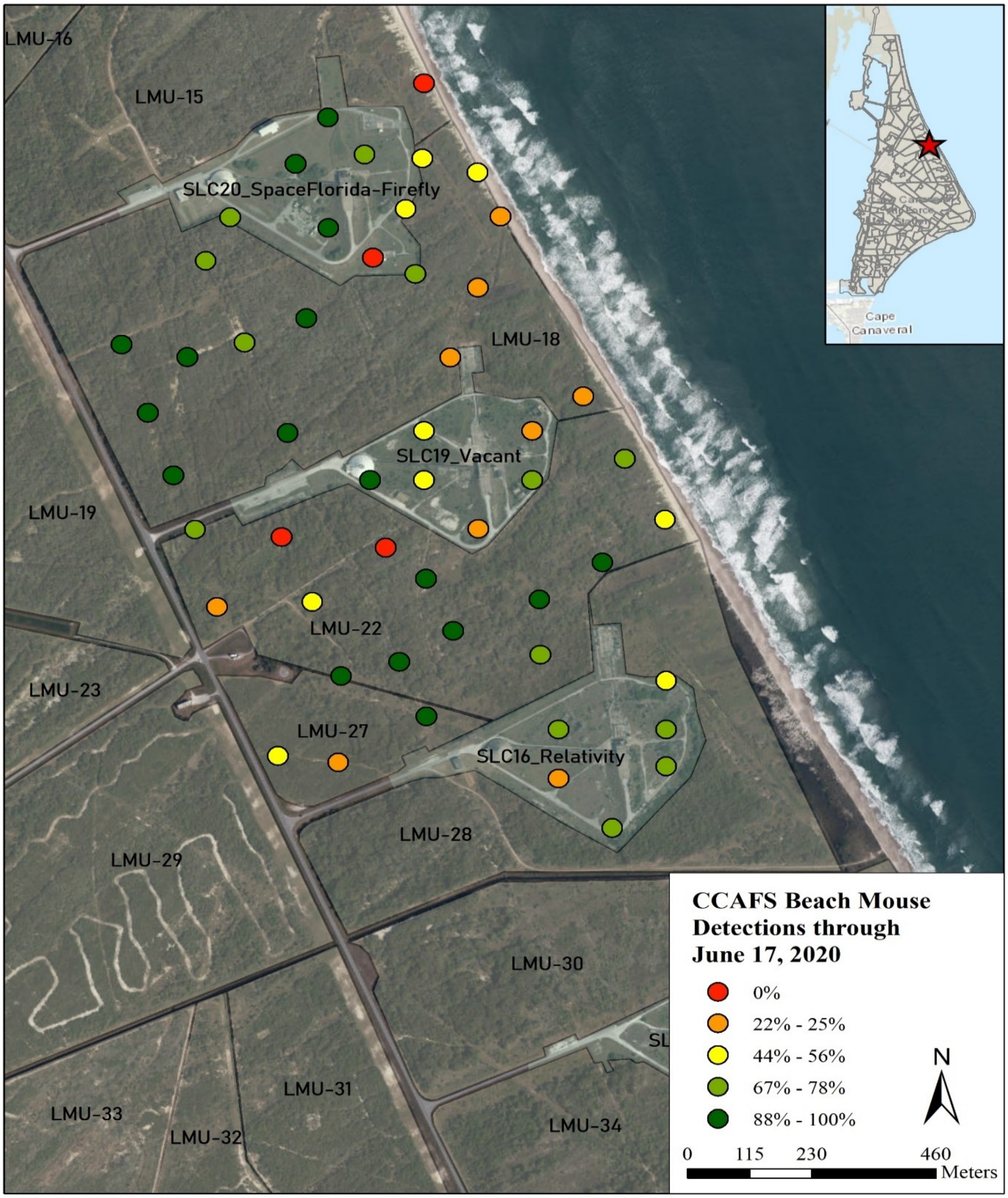

Figure 5-1. CCAFS Track Tube SEBM Detections through June 17, 2020. Preliminary data provided by FWC.

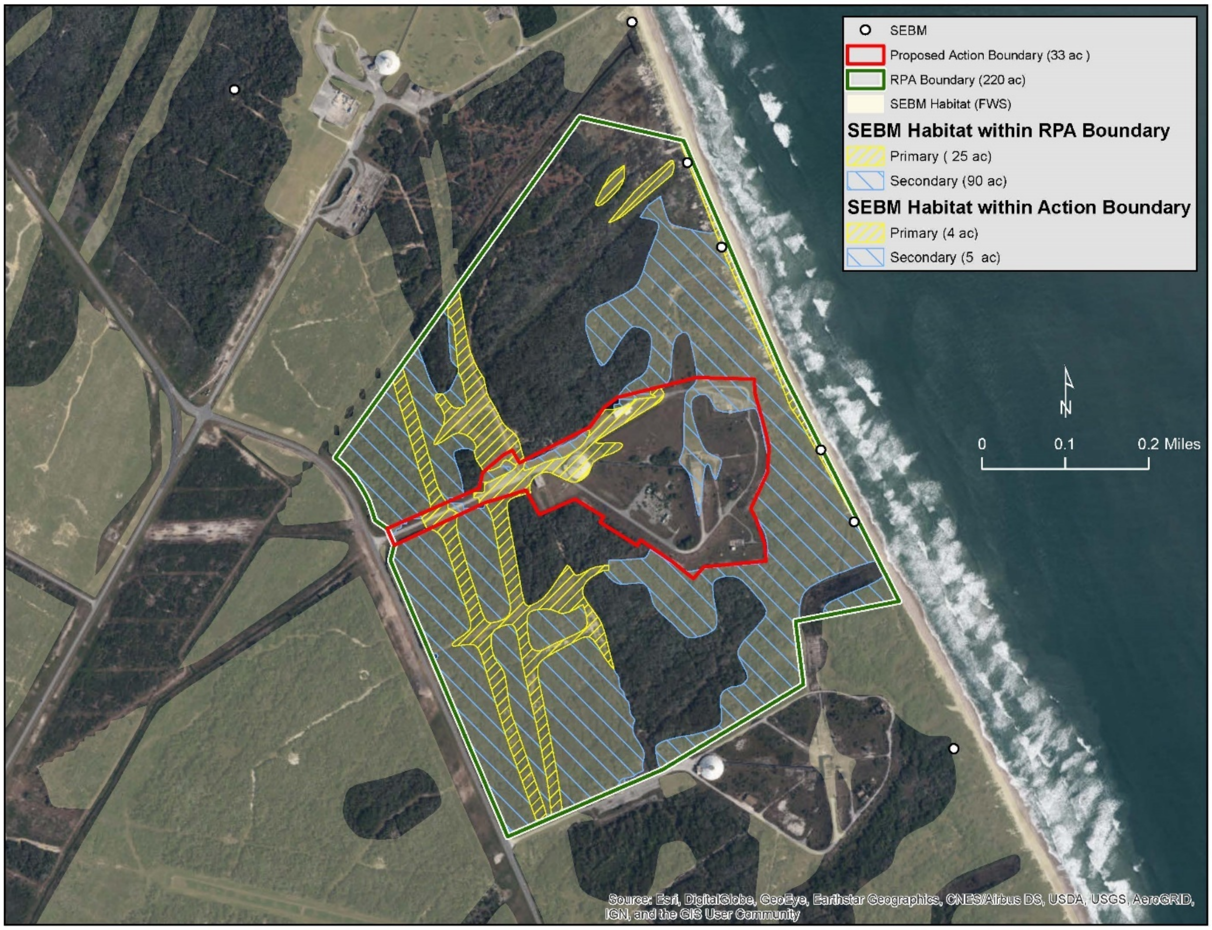

Figure 5-2. Habitat types (primary and secondary) within the Real Property Lease Area of SLC- 20.

6. EFFECTS OF THE ACTION ON SOUTHEASTERN BEACH MICE

In a BO for a listed species, the effects of the proposed action are all reasonably certain consequences to the species caused by the action, including the consequences of other activities caused by the action. Activities caused by the action would not occur but for the action. Consequences to species may occur later in time and may occur outside the action area.

We identified and described the activities included in the proposed Action in sections 2.1–2.3. Our analyses of the consequences caused by each of these activities follows.

6.1. Facility Construction and Refurbishment

Construction activities will include heavy equipment to remove live oak and saw palmetto in inland areas and refurbishment of the launch complex. The refurbishment will consist of heavy equipment for the demolition and new construction of a customer support building, operation support building, and development of generators at the historical site near facility 18800 and the Blockhouse. The habitat is degraded but has habitat for SEMB. The species has been recorded in the Blockhouse and recorded via track tubes this year. Preliminary data indicates that the species is utilizing the area, however density cannot be derived from these data. There will be several facilities constructed within the existing launch pad, including a non-hazardous payload processing facility and Concept A within SEBM habitat. The consequences of the action, construction activities and modifying areas where the species is known to be present, will result in the loss of habitat that supports resource needs such as foraging and a movement corridor.

Based on plans for construction, the Service expects harm to any individuals via the destruction of burrows during clearing activity or during the refurbishment of facilities or new construction in primary habitat, secondary habitat or possibly in the construction area of the launch facility. Individuals may also be harmed if they are utilizing the primary or secondary habitat for burrows or within the construction area. Using action area baseline estimates outlined in section 5.1, we expect several SEBM and/or nestlings will be exposed to the consequences of habitat destruction and new construction associated with re-development of the launch facility. There is also some risk that construction activities within the 33 acres of the project area may adversely affect the SEBM that may be using the area as a movement corridor or foraging area.

Preliminary track tube data (Figure 5-1) indicates that during the period tubes were monitored, that SEBM are frequently utilizing the area for foraging. Track tube detections were outside the primary and secondary habitat within the pad area. However, most, if not all, of the construction will occur within the daytime periods when mice are typically inside burrowing habitat and not out moving within the habitat. Most of the soils within the construction area are compacted from past use and development, but some of the soils could still support burrows. Construction activities could collapse undetected burrows within the 33 acres of the construction area, and we anticipate there is a risk that SEBM may not be able to excavate or escape from a collapsed burrow.

The scale of the action area is a small fraction of the geographic segment of the Canaveral Complex Unit. The loss of a several individuals will not result is adverse population effects or reduce appreciably the species' likelihood of survival and recovery. Additionally, the refurbishment of the launch facility will not place barriers for species movement, a threat to the species described in section 4.4. After construction activities, we expect the species will have access and can use the primary and secondary habitat within the lease area as a corridor for movement, refugia, or forage opportunities.

To set a standard for determining when the level of anticipated take has been exceeded, the Service can establish a causal link to construction activities within primary and secondary habitats, see Figure 5.1 showing habitat types within the construction area, to the harm or "taking" of the species. The linking habitat within the construction boundary of the action area will allow the Service to have a clear standard for determining when the level of anticipated take has been exceeded.

6.2. Southeastern Beach Mouse Habitat Enhancement

The purpose of the SEBM habitat enhancement plan is to address the conservation needs of the species within the action area. The habitat enhancement plan and monitoring shall be developed with the Service, FWC, and SW with support of Space Florida. The plan will include an FWC monitoring component to monitor how the species is using the coastal scrub habitat between the space launch facilities.

The removal dense woody vegetation and coastal scrub management will allow for species movement and increase forage quality in the secondary habitat. If project timing allows, the Service is recommending that the habitat enhancement area serve as a recipient site for mice found within the construction area (described in Section 8, Conservation Recommendations). The recommendation includes saturation trapping of SEBM in areas that are slated for construction, roadways or anywhere habitat modification shall occur. To minimize adverse effects to the species, saturation trapping should be completed by a qualified biologist and follow the 2020 Beach Mouse Protocol for trapping, thus reducing the likelihood that the species is harmed via trapping or relocating activities. Because we anticipate that individuals would be harmed during construction, the salvaging of all individuals via trapping and moving the newly restored area would be a net benefit to the species.

If salvage activities cannot occur due to project timelines or the timeline of the habitat restoration component, the restoration and enhancement of coastal scrub will still provide a net benefit to the species and addresses the conservation needs of the species range-wide and within the action area.

6.3. Operations

SEBM have been documented inside facilities throughout CCAFS, the SW has a Programmatic BO that covers pest management activities within and around such facilities. Per the Programmatic BO, Space Florida will be required to live trap and release mice within and around its facilities on SLC-20.

During facility operations, rocket launches may startle SEBM, and noise associated with landing, though not as loud, may do the same. Noise impact to wildlife is expected to be minimal and discountable. Current and past launch programs at CCAFS, the Atlas, Titan, and Delta launches did not document any animal mortality associated with noise.

Operational lighting at the facility may have adverse effects to the species by disrupting foraging behavior. Nighttime launches and the lighting needed to support these events will have some adverse effects, but it is anticipated not to last more than a few days to support the launch activity. We expect that the lighting will be managed to standards outlined in the Programmatic Sea Turtle Biological Opinion, 2009-F-0087, and conform to the SW Instruction 32-7001. This will minimize lighting and restrict lighting visible to the beaches during sea turtle nesting season (1 May through 31 October). Beach mice will likely benefit from these restrictions, but the period does not cover the wintertime, a peak period for SEBM.

SLC-20 will have maintained roads and grassed areas within the complex. The maintained roads and grass areas within the complex are expected to be maintained by mowing on a periodic basis using standard large-scale grass mowing equipment. Mowing or habitat modification within the real property lease area is not proposed except for the 30 feet right-of-way around the perimeter of the fence line and adjacent to the roads that lead to the launch complex. The Service expects minimal disturbance to the species via noise, vibration, and temporal loss of forage associated with periodic maintenance.

7. CONCLUSION

"*Jeopardize the continued existence*" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02). After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action and the cumulative effects, it is the Service's BO that the Action is not likely to jeopardize the continued existence of the southeastern beach mouse.

The Service has come to this conclusion based on the following:

- The loss of several individuals within the action area will not result in adverse population effects or reduce appreciably the species' likelihood of survival and recovery.
- The refurbishment of the launch facility will not place a barrier for species movement that will preclude or delay recovery goals.
- After construction activities, we expect the species will access and use the primary and secondary habitat within the lease area as a corridor for movement, refugia, or forage opportunities.
- Restoration of coastal scrub at SLC-19 addresses conservation needs of the species within the action area and recovery needs for the species range-wide.

8. INCIDENTAL TAKE STATEMENT

ESA §9(a)(1) and regulations issued under §4(d) prohibit the take of endangered and threatened fish and wildlife species without a special exemption. The term "take" in the ESA means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (ESA §3(19)). In regulations, the Service further defines:

- "harm" as "an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering;" (50 CFR §17.3) and
- "incidental take" as "takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant" (50 CFR §402.02).

Under the terms of ESA §7(b)(4) and §7(o)(2), taking that is incidental to a Federal agency action that would not violate ESA §7(a)(2) is not considered prohibited, provided that such taking is in compliance with the terms and conditions of an incidental take statement (ITS).

The Action considered in this BO includes the refurbishment of the SLC-20, Space Florida Launch Complex at Cape Canaveral and the SEBM habitat enhancement area. This BO considers the effects of the Action on southeastern beach mice (*Peromyscus polionotus niveiventris*). The Action does not affect designated critical habitat; therefore, this BO does not address critical habitat.

For the exemption in ESA §7(o)(2) to apply to the Action considered in this BO, the SW and the Space Florida must undertake the non-discretionary measures described in this ITS, and these measures must become binding conditions of any permit, contract, or grant issued for implementing the Action. Consistent with ESA section 7(b)(4)(C)(iv), the SW has a continuing duty to regulate the Action activities covered by this ITS that are under its jurisdiction. The Space Florida is responsible for the Action activities covered by this ITS that are under its control and are not under SW jurisdiction. The protective coverage of §7(o)(2) may lapse if the SW or Space Florida fails to:

- assume and implement the terms and conditions; or
- require a permittee, contractor, or grantee to adhere to the terms and conditions of the ITS through enforceable terms that are added to the permit, contract, or grant document.

In order to monitor the impact of incidental take, the SW and Space Florida must report the progress of the Action and its impact on the species to the Service as specified in this ITS.

8.1. Amount or Extent of Take

This section specifies the amount or extent of take of listed wildlife species that the Action is reasonably certain to cause, which we estimated in the "Effects of the Action" section of this BO. Table 8-1 identifies the species, life stage(s), estimated number of individuals, the form of take anticipated, and the section of the BO that contains the supporting analysis.

Table 8-1. Estimates of the amount of take (# of individuals) caused by the Action, by species, life stage, and form of take, collated from the cited BO effects analyses.

Common Name	Life Stage	# of Individuals	Form of Take	BO Effects Analysis Section
Southeastern Beach Mice	ALL	Several	Harm	6.1
Southeastern Beach Mice	Adult or Juvenile	ALL*	Capture	6.2

* Capture is exempted if the Conservation Recommendations are undertaken by the SW, SW authorized agents, FWS personnel or SEBM recovery permit holders. Salvage activities via capture of SEBM within the action area under this BO must follow the Service's South Eastern Beach Mouse Trapping Protocols 2020 or most recent version. Please contact the Service for these protocols.

It is difficult to estimate number of species within the action area, section 5.1 estimates use home ranges, but the actual number of individuals is likely a fraction of this estimate because the habitat quality. Additionally, salvage success will likely to be less within the areas where the construction actions are slated to occur.

Surrogate Measures for Monitoring

For the SEBM, detecting take that occurs incidental to the Action is not practical. SEBM are semi-fossorial during the day so locating all individuals within the area slated for construction is impractical. However, we do know that 4 acres of primary habitat and 5 acres of secondary habitat is within the 33 acres of construction area. The Service will monitor take using the temporary modification of the habitat as the surrogate.

When it is not practical to monitor take in terms of individuals of the listed species, the regulations at 50 CFR §402.14(i)(1)(i) indicate that an ITS may express the amount or extent of take using a surrogate (*e.g.,* a similarly affected species, habitat, or ecological conditions), provided that the Service also:

- describes the causal link between the surrogate and take of the listed species; and
- sets a clear standard for determining when the level of anticipated take has been exceeded.

We have identified surrogate measures in our analyses of effects that satisfy these criteria for monitoring take of the species named above during Action implementation. Table 8-2 lists the species, life stage, surrogate measure, and the section of the BO that explains the causal link between the surrogate and the anticipated taking. We describe procedures for this monitoring in section 8.4.

Table 8-2. Surrogate measures for monitoring take of listed wildlife species caused by the Action, based on the cited BO effects analyses.

Common Name	Life Stage	Surrogate (units)	Quantity	BO Effects Analysis Section
Southeastern Beach Mice	All	Primary/secondary habitat acres within the proposed construction limits	9	6.1

8.2. Reasonable and Prudent Measures

The Service believes that no reasonable and prudent measures are necessary or appropriate to minimize the impact, *i.e.,* the amount or extent, of incidental take of southeastern beach mice caused by the Action. Minor changes that do not alter the basic design, location, scope, duration, or timing of the Action would not reduce incidental take below the amount or extent anticipated for the Action as proposed. Therefore, this ITS does not provide RPMs for these species.

8.3. Terms and Conditions

No reasonable and prudent measures to minimize the impacts of incidental take caused by the Action are provided in this ITS; therefore, no terms and conditions for carrying out such measures are necessary.

8.4. Monitoring and Reporting Requirements

In order to monitor the impacts of incidental take, the SW must report the progress of the Action and its impact on the species to the Service as specified in the incidental take statement (50 CFR §402.14(i)(3)). This section provides the specific instructions for such monitoring and reporting. As necessary and appropriate to fulfill this responsibility, the SW must require any permittee, contractor, or grantee to accomplish the monitoring and reporting through enforceable terms that are added to the permit, contract, or grant document. Such enforceable terms must include a requirement to immediately notify the SW and the Service if the amount or extent of incidental take specified in this ITS is exceeded during Action implementation.

M&R 1. Reporting After construction is completed, report to the Service the sum (in acres) that was modified or cleared within the area of construction. The sum shall not exceed 33 acres which includes 4 acres of Primary habitat within the area of construction.

M&R 2. Disposition of Dead or Injured Upon locating a dead, injured, or sick threatened or endangered species, notification must be made to the North Florida Ecological Services Field Office at 904-731-3336 and by email to Jaxregs@FWS.gov within 24 hours. If an injured or sick specimen is found and North Florida Ecological Services Field Office staff is unable to be reached, contact the Florida Fish and Wildlife Conservation Commission Wildlife Alert Hotline at 1-888-404-3922.

Care should be taken in handling dead specimens to ensure biological material is preserved in the best possible state for later analysis as to the cause of death. If a dead specimen is found in the project area, the specimen should be thoroughly soaked in water and frozen for later analysis of cause of death. In conjunction with the preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

9. CONSERVATION RECOMMENDATIONS

§7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by conducting conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary activities that an action agency may undertake to avoid or minimize the adverse effects of a proposed action, implement recovery plans, or develop information that is useful for the conservation of listed species.

1. Salvage any SEBM that would otherwise be harmed by the action.
   If project timing allows, complete the habitat enhancement before the construction activities at SLC-20. The habitat enhancement area could serve as a recipient site for SEBM residing within the construction area of the launch complex. Saturation trapping of SEBM (conducted by a qualified biologist) should be completed within the area of construction before construction activities commence. Mice found within the area of construction may be relocated to the habitat enhancement areas between SLC-16 and SLC-19. If the habitat enhancement area/restoration activities are not completed, SEBM may be moved to nearby low to non-occupied suitable habitat.
2. Collaborate with FWC to monitor SEBM within the habitat enhancement area between SLC-16 and SLC-19 and other areas of interest at Cape Canaveral Complex.

10. REINITIATION NOTICE

Formal consultation for the Action considered in this BO is concluded. Reinitiating consultation is required if the SW retains discretionary involvement or control over the Action (or is authorized by law) when:

a. the amount or extent of incidental take is exceeded;
b. new information reveals that the Action may affect listed species or designated critical habitat in a manner or to an extent not considered in this BO;
c. the Action is modified in a manner that causes effects to listed species or designated critical habitat not considered in this BO; or
d. a new species is listed or critical habitat designated that the Action may affect.

In instances where the amount or extent of incidental take is exceeded, SW is required to immediately request a reinitiation of formal consultation.

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APPENDIX D

Biological Assessment

BIOLOGICAL ASSESSMENT FOR THE RECONSTITUTION AND ENHANCEMENT OF SPACE LAUNCH COMPLEX 20 MULTI-USER LAUNCH OPERATIONS AT CAPE CANAVERAL AIR FORCE STATION, FLORIDA

REVISION A

Prepared for:

Space Florida

In Cooperation With:

45th Space Wing, Patrick Air Force Base, Florida

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1 SUMMARY

Space Florida was created pursuant to Chapter 331, Part II, Florida Statutes as an independent special district and subdivision of the State of Florida. The purpose of Space Florida is to foster the growth and development of a sustainable and world-leading aerospace industry in Florida. Space Florida leverages Florida's highly skilled workforce and existing infrastructure to attract and expand the next generation of space industry businesses. The Cape Canaveral Spaceport (CCS), where Space Florida has an operational spaceport authority role, is the premiere transportation hub for global space commerce. Space Florida oversees management and operation of key elements of Florida's existing space transportation capability.

Space Florida is pursuing a Real Property Agreement (RPA) with the US Air Force (USAF) 45th Space Wing of approximately 220 acres (88 hectares [ha]) of land, to include Space Launch Complex 20 (SLC-20) and all facilities contained within, at Cape Canaveral Air Force Station (CCAFS). Space Florida will develop and sublicense the approximately 220 acres to meet current and future commercial, national, and state space transportation requirements through the expansion and modernization of space transportation facilities.

Space Florida, in cooperation with USAF as the Lead Agency, and the Federal Aviation Administration (FAA) and National Aeronautics and Space Administration (NASA) as Cooperating Agencies, is preparing an Environmental Assessment (EA) to comply with National Environmental Policy Act (NEPA) requirements to support obtaining the Real Property transfer. This EA will evaluate the potential environmental impacts resulting from the refurbishment and enhancement of SLC-20 facilities, operation of small- and medium-lift launch vehicles on 33 acres (13.2 ha) of the 220 acres, activities associated with redeveloping SLC-20 into a vehicle processing area, an engine test area, and a space vehicle launch facility for Firefly Aerospace, Inc. The EA process has identified certain actions associated with the Proposed Action that may affect federally listed threatened and/or endangered species. In accordance with the Endangered Species Act, Formal Section 7 Consultation is required for any action that may affect listed species. This Biological Assessment (BA) provides the necessary information required to initiate Formal Section 7 Consultation.

2 PURPOSE AND NEED

The purpose of the Proposed Action is to provide multiple launch pads for commercial users to support Space Florida's CCS Master Plan in accordance with Florida Statutes Section 331 (Space Florida, 2017). Specifically, Space Florida must meet current and future commercial, national, and state space transportation requirements through expansion and modernization of space transportation facilities within its Spaceport territories. The territory includes, but is not limited to, areas within CCAFS. The Proposed Action would allow commercial launch providers such as Firefly to assemble, process, test, and launch vehicles to meet the demand for lower-cost access to space in the legacy SLC-20 disturbed area. The Proposed Action would provide the continued capability of space exploration by commercial users and improve the return on taxpayer investment of CCAFS facilities through expanded use and improved utilization. The Proposed Action would also continue to provide economic and technical benefits to the government and the private sector following the retirement of the Space Shuttle Program in 2011. On November 27, 2018, the Space Florida Board of Directors approved the request to proceed with negotiations and agreements for the redevelopment of SLC-20 to meet Florida's commercial space transportation industry needs.

The Proposed Action is needed to test and launch vehicles efficiently in the United States for use by commercial space launch enterprises. The Proposed Action would contribute to meeting the goals of the CCS Master Plan consistent with the National Space Transportation Policy, NASA's Space Act Agreement, and the Department of Defense (DoD) policy pursuant to DoD Directive 3230.3.

3 INTRODUCTION AND DESCRIPTION OF THE PROPOSED ACTION

The Proposed Action is to twofold: (1) to transfer by RPA approximately 220 acres of land to include SLC-20 and all facilities contained within at CCAFS by the USAF to Space Florida and (2) to sub-license 33 acres of the 220 acres to include the existing launch site infrastructure to Firefly on a dedicated basis. Following execution of a sub-license, Firefly will refurbish and enhance existing SLC-20 facilities, test and operate small- and medium-lift launch vehicles, and transport vehicle stages from Exploration Park to SLC-20.

3.1 PROJECT LOCATION

The project location consists of 220 acres, referred to as the RPA Boundary, that contain the SLC-20 within CCAFS in Sections 5-8 Township 23 South, Range 38 East, Brevard County, Florida (Figures 3-1 and 3-2). The SLC-20 developed launch site consists of 14 facilities (Table 3-1 and Figure 3-3) and is within the northeast portion of CCAFS off ICBM Road between SLC-19 and SLC-34. The remainder of the RPA Boundary area is primarily oak/palmetto.

Figure 3-1 Location Map

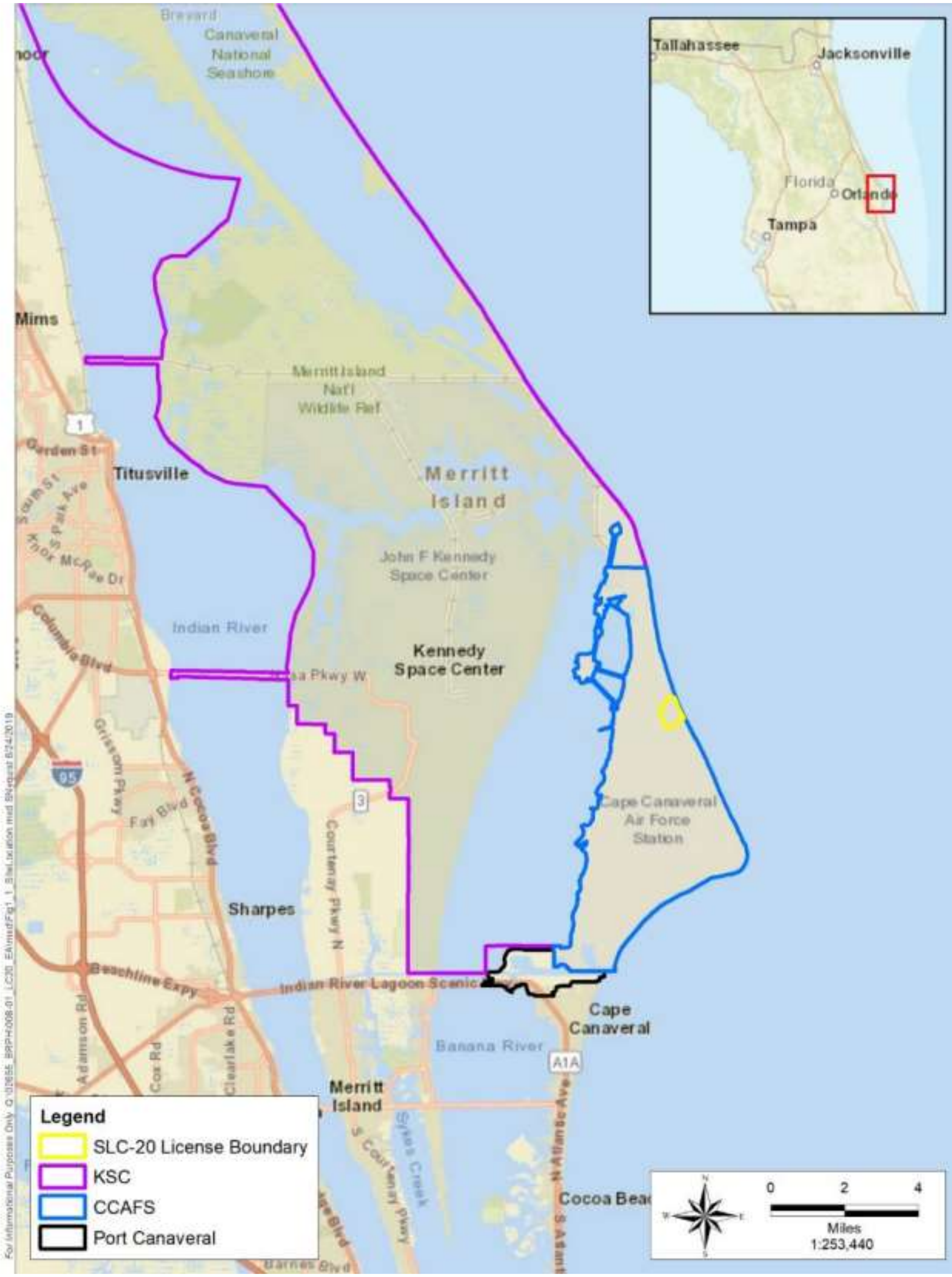
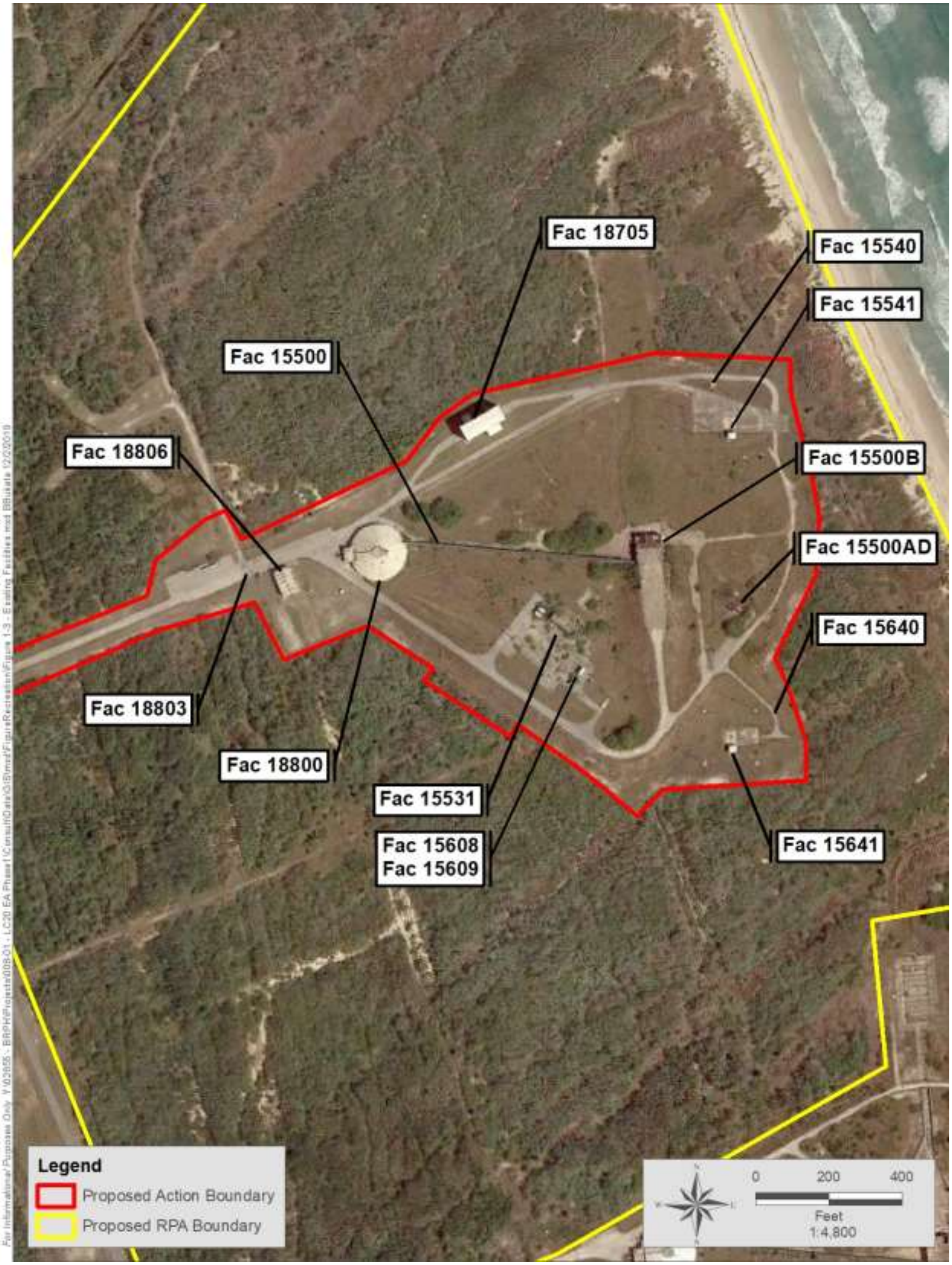


Figure 3-2 Aerial Map

Table 3-1 Existing SLC-20 Facilities

Original Site Facility Name	Current Name	Year Built	Status
15500, Control Cableway	15500, Control Cableway	1959	The structure's setting and design remains intact.
15500AD, Fuel Holding Area	15500AD, Liquid Hydrogen Holding Area	1963	All that remains today is the earthen berm, concrete walls, above-ground storage tank holding area, and truck parking area.
15500AF, Oxidizer Holding Area	15531, Retaining Wall	1962	All that remains of the original facility is the earthen berms and concrete retaining walls.
15500B, Launch Stand and Ramp	15500B, Launch Stand and Ramp	1959	Very little of the original components remain.
15540, Launch Pad A – Ballistic Missile Development Office	15540, Launch Pad A – Ballistic Missile Development Office	1989	The facility is now abandoned in-place and essentially unchanged. The launch rail has been removed and only the mounting ring remains.
15541, Equipment Building Pad	15541, Equipment Building	1989	The facility remains abandoned in-place and essentially unchanged.
15608, Power Center	15603, Power Center	2003	The facility served as an instrumentation facility until it was abandoned in-place in 2010.
15609, Control Center	15609, Control Center	2003	The facility served as an instrumentation facility until it was abandoned in-place in 2010.
15640, Launch Pad B – Ballistic Missile Development Office	15640, Launch Pad B – Ballistic Missile Development Office	1989	The facility remains abandoned in-place and essentially unchanged. The launch rail has been removed and only the mounting ring remains.
15641, Equipment Building Pad A	15641, Equipment Building	1989	The facility remains intact.
18705, Warehouse	18705, Warehouse	1999	The building remains intact.
15500A, Blockhouse	18800, Blockhouse	1959	Although abandoned in-place in 2012, the building remains intact.
18803, Guard House	18803, Guard House	1999	This structure is in a ruinous state of condition.
15500C, Ready Building	18806, Payload Assembly Building	1959	The building is abandoned and in a state of disrepair.

Figure 3-3 Existing Facilities Map



3.2 LAUNCH VEHICLES

Space Florida proposes to establish a multi-user launch capability at SLC-20. Firefly, one of the potential launch providers, proposes to launch Alpha, a small-lift class launch vehicle, and future Beta, a small- to medium-lift class launch vehicle from SLC-20. Firefly's Alpha and Beta launch vehicles will be used as representative vehicles for the Proposed Action and will be subsequently referred to as Concept A and Concept B, respectively. Both representative launch vehicles are expendable and provide satellite delivery services with the future opportunity for lunar surface delivery services. The following describes each vehicle. Table 3-2 summarizes general specifications for both launch vehicles.

Table 3-2 Launch Vehicle Specifications

Specification	Concept A	Concept B (Future)
Length	95 ft (29 m)	140 ft (43 m)
Diameter	6 ft (2 m)	10 ft (3.1 m)
Stages	2	2
Recoverable First Stage	No	No
Parachute Required?	No	No
First Stage Propellant	LO_X/RP-1	LO_X/RP-1/LCH_4
Total Wet Mass	120,000 lb (54,000 kg)	470,000 lb (214,000 kg)
First Stage Thrust	730 kN (163,888 lbf)	2,760 kN (620,000 lbf)

Notes: ft = feet; kg = kilogram; kN = kilonewtons; lbf = pound-force; lb = pounds; LCH_4 = liquid methane; LO_X = liquid oxygen; m = meter; RP-1 = Rocket propellant -1.

3.2.1 CONCEPT A LAUNCH VEHICLE

The Concept A launch vehicle is a small, unmanned, light-lift, two-stage, liquid-fueled launch vehicle with a gross lift-off weight of approximately 120,000 lb (81,647 kg) that can carry payloads between 1,323 lb (600 kg) and 2,205 lb (1,000 kg), depending on the orbit. The first and second stages use only liquid oxygen (LO_X) and rocket propellant-1 (RP-1), which is highly refined kerosene.

The first stage consists of a cylindrical structure containing LO_X and RP-1 tanks separated by an intertank. This first stage is powered by four 182-kN (40,972-lbf) thrust LO_X/RP-1 engines. Roll control and thrust vector control use hydraulic actuators and the on-board RP-1 for its fuel. The engine is a 70-kN (15,714-lbf) thrust engine with hot helium attitude control and hydraulic actuators for thrust vector control.

Concept A may carry small payloads of up to 2,205 lb (1,000 kg) consisting mostly of non-hazardous materials. Some payloads may use small amounts of hazardous propellants for on-orbit maneuvering. These propellants for payloads may include hypergolic fuels such as hydrazine, pressurized gases including helium and nitrogen, and some solid propellants. Hazardous material quantities would vary. In addition, a small amount of ordnance such as small explosive bolts and on-board batteries are typical. Payload propellants will be stored before use in a certified facility near the payload processing facility where the loading will occur. Residual propellants for payloads will be returned to the storage facilities.

Two potential paths for flight termination exist. If the Concept A launch vehicle varies from its planned trajectory, the launch vehicle will be equipped with a destructive flight termination system. Preliminary flight safety analysis will determine the flight termination system type. The expected destructive termination system includes two linear-shaped charges that are intended to rupture the vehicle tanks when commanded to destruct, thereby dispersing propellants and breaking up the vehicle to minimize the impact to ground assets.

A second option if approved would be thrust termination. A thrust termination system commands the shutdown of the vehicle engines. Upon activation of the thrust termination system, the Concept A launch vehicle would fall to the ocean possibly intact and, depending on the circumstances and time in the flight of the termination, may explode upon impact. If later in flight, the Concept A launch vehicle would likely break up from aerodynamic loading of the airframe dispersing propellants similar to a destruct termination system.

The Proposed Action includes a non-destructive software and telemetry testing of the flight termination systems. No ascent abort testing of the launch vehicle is proposed nor is the destructive testing of the ordnance flight termination system or thrust termination system.

3.2.2 CONCEPT B LAUNCH VEHICLE

The Concept B launch vehicle shares the same basic design as the Concept A launch vehicle with higher thrust, providing a higher payload capacity that can carry between 7,275 lb (3,300 kg) and 12,787 lb (5,800 kg) depending on orbit. Concept B will also use liquid propellants LO_x and RP-1.

4 SITE DEVELOPMENT

Site development will occur on 33 acres (13.2 ha) of the approximately 220-acre (88-ha) RPA Boundary, and the majority of site development/refurbishment will occur within the existing disturbed legacy SLC-20 footprint (Figure 3-2).

The Proposed Action's Launch Vehicle Program is designed for minimal vehicle assembly or processing on the launch pad, and most of the vehicle assembly will occur at Exploration Park. Launch vehicle stages and payloads will arrive at SLC-20 from Exploration Park via heavy truck (tractor-trailer). Development of Exploration Park was previously addressed by an Environmental Assessment (NASA, 2008).

Space Florida intends to refurbish, enhance, and use the existing SLC-20 support shop, Horizontal Integration Facility (HIF), and blockhouse. The Proposed Action will reuse and likely resurface and/or improve existing impervious surface areas for planned roads and structures. Proposed new facilities and supporting infrastructure are summarized in Table 4-1 and are depicted on Figure 4-1. Site development will take place over three phases of construction.

The new HIF/hazardous payload processing facility along the southwest region of the Proposed Action Boundary is the only new construction that requires clearing outside the legacy SLC-20 footprint. The new HIF will result in clearing of 0.3 acre of undisturbed upland habitat (Figure 4-1). Remaining areas are impervious or previously disturbed and now dominated by ruderal and exotic plant species. These areas are expected to be maintained by mowing on a periodic basis using standard large-scale grass mowing equipment.

4.1 Launch-Related Operations

Payload preparation activities would be conducted in parallel with most launch vehicle preparations. Payload activities include payload checkout, spacecraft propellant loading (if required), and payload encapsulation in the fairings. The encapsulated payload would then be transported to SLC-20. Non-hazardous and hazardous payload processing and encapsulation would take place in the existing HIF for the Concept A launch vehicle. However, following construction of the new HIF, hazardous payload processing would transition to the new facility.

4.2 Launch Events

Space Florida expects up to 24 total Concept A/B launches. To be conservative in determining noise-related impacts, all 24 annual launches are assumed to be from Concept B launch vehicles. Seventy percent of the launches are expected to occur during daylight hours and 30 percent of the launches are expected to occur during night hours. Night is defined as any event occurring after 10 p.m. and before 7 a.m.

Table 4-1 Proposed New Construction

Phase	New Facility	Historical Site
Phase 1	Concept A Pad	Fac 15540, Launch Pad A
	Concept A Launch Equipment	Fac 15541, Equipment Building Pad A
	Deluge Containment	New Construction Near Former Facilities 15540 and 15541
	Concept A ECS	New Construction
	Rocket Propellant 1 and Gaseous Nitrogen Storage	Facility 15500AD, Fuel Holding Area
	Ordnance Storage	New Construction Near Former Facility 15640, Launch Pad B
	Liquid Oxygen, Liquid Nitrogen, and Gaseous Helium	Facilities 15608, Power Center; 15609, Control Center; and 15531, Retaining Wall (Former Oxidizer Holding Area)
	Generators	New Construction Near Facility 18800, Blockhouse
	Launch Communication Equipment and Pad Office	New Construction Near Facility 18800, Blockhouse
	Support Shop	Facility 18806, Payload Assembly Building
	Pad Security	Facility 18803, Guard House
	Non-hazardous Payload Process Facility Horizontal Integration Facility	Facility 18705, Warehouse
Phase 2	Complex Support Building/Office	New Construction
	Deluge Containment Concept A/B Pad Concept B ECS Concept B Launch Equipment	Facility 15500B, Launch Stand and Ramp
	New Horizontal Integration Facility/Hazardous Payload Processing Facility	New Construction
	Water Pump House	New Construction
Phase 3	Customer Support Building/Office	New Construction

Figure 4-1 Proposed Facilities Map

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5 DESCRIPTION OF THE AREA IMPACTED BY THE PROPOSED ACTION

The Proposed Action will repurpose the existing SLC-20 complex within the historical fence-line and require development of a 0.3-acre undisturbed area along the southwest boundary for the construction of a new HIF. In July 2019, a pedestrian survey was completed of the proposed RPA Boundary to map vegetation communities, determine the presence of jurisdictional wetlands and surface waters, and document the presence/absence of, or habitat that could support, listed wildlife species.

5.1 LAND COVER

The land cover within the Proposed Action Boundary and RPA Boundary were categorized using the CCAFS 45th Space Wing habitat designations. The project area is composed of three upland communities, two wetland communities, and one surface water community (Figure 5-1). Table 5-1 summarizes the habitat designations and acreages, and describes each unique habitat.

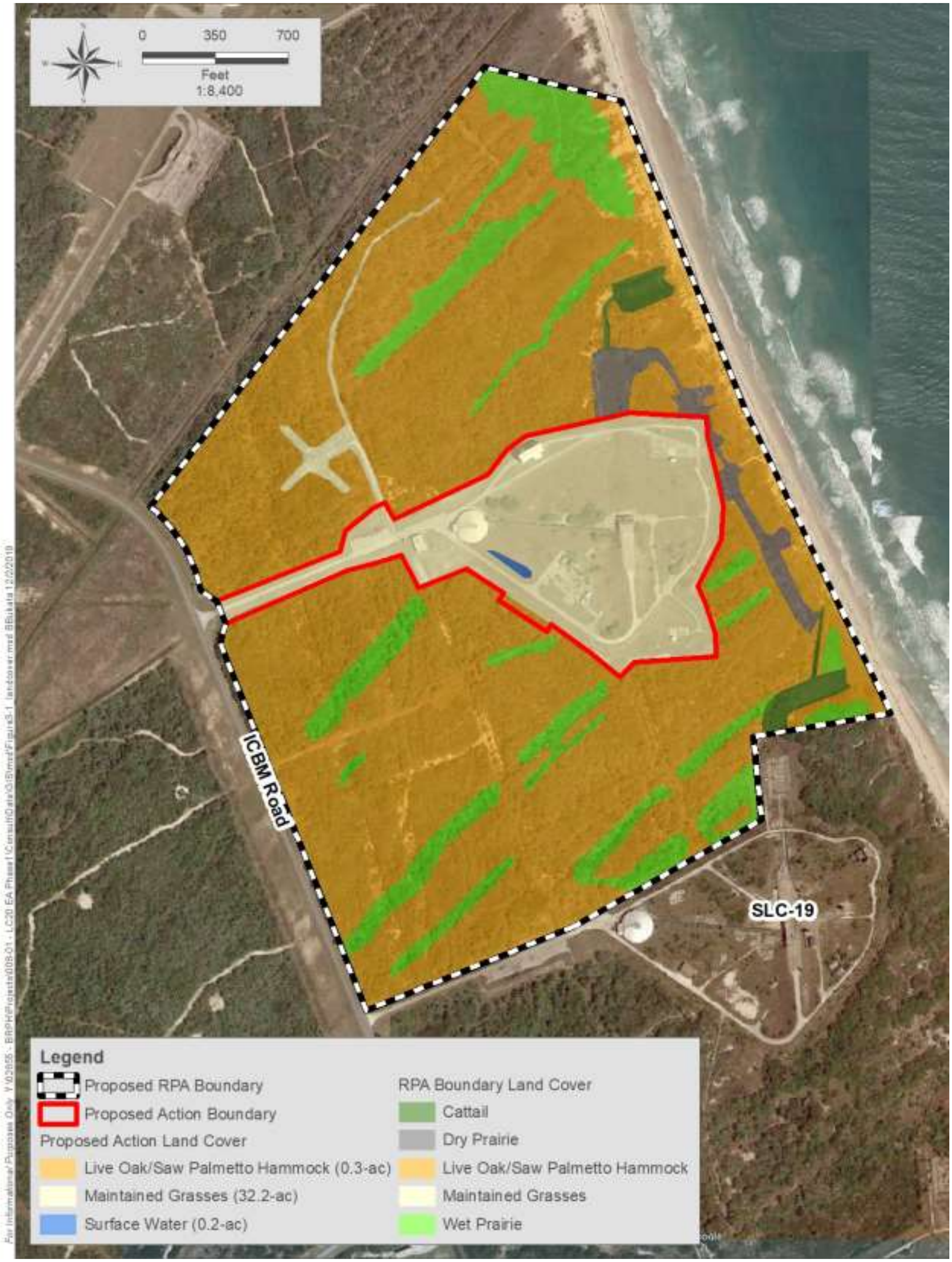
5.1.1 UPLANDS

The following three upland habitats are found within the SLC-20 RPA and Proposed Action Boundary: (1) Maintained Grasses, (2) Dry Prairie, and (3) Live Oak/Saw Palmetto Hammock (Figure 5-1).

Maintained Grasses comprises 32.2 acres (13.0 ha) within the Proposed Action Boundary and refers to areas of impervious surface such as roads, buildings, and disturbed vegetated areas within legacy SLC-20 area that have been maintained inconsistently. Vegetated areas within the Proposed Action area is dominated by a diversity of native and exotic species such as ragweed (*Ambrosia artemisiifolia*), beggars tick (*Bidens pilosa*), frogfruit (*Phyla nodiflora*), muhly grass (*Muhlenbergia capillaris*), Bermuda grass (*Cynodon dactylon*), bahia grass (*Paspalum notatum*), alamo vine (*Merremia dissecta*), mother of thousands (*Kalanchoe daigremontiana*), sunflower (*Helianthus debilis*), lantana (*Lantana* sp.), century plant (*Agave americana*), prickly pear cactus (*Opuntia humifusa*), morning glory (*Ipomea* sp.), partridge pea (*Chamaecrista fasciculata*), and winged loosestrife (*Lythrum alatum*) (Photograph 5-1). Several large clumps of Brazilian pepper (*Schinus terebinthifolius*) are also found in the central and south region with a few scattered live oak (*Quercus virginiana*) and hog plum (*Ximenia americana*). In addition, several large areas of St. Augustine grass (*Stenotaphrum secundatum*) exist throughout the site as well as a large monoculture of guinea grass (*Megathyrsus maximus*) (Photograph 5-2).

The second upland community, Dry Prairie, is found in the east region of the RPA Boundary and is dominated by various upland herbaceous and shrub species such as Brazilian pepper, St. Augustine grass, bahia grass, ragweed, beggars tick, frogfruit, muhly grass, partridge pea, and winged loosestrife. These areas were also likely previously cleared and disturbed for historical launch operation activities.

Figure 5-1 Existing Land Cover



Photograph 5-1 South Side of SLC-20

Photograph 5-2 North Portion of SLC-20 Looking North Toward Existing HIF

Table 5-1 Summary of Land Cover Types

Site	Land Cover Description	Acreage*
Proposed Action	Maintained Grasses	32.2 (13.0)
	Oak/Palmetto	0.3 (0.1)
	Wet Prairie	0.19 (0.08)
		33.0 (13.2)
RPA Boundary	Maintained Grasses	2.2 (0.9)
	Dry Prairie	4.2 (1.7)
	Oak/Palmetto	155.1 (62.0)
	Marsh - Freshwater	2.5 (1.0)
	Wet Prairie	23.0 (9.2)
		187.0 (74.8)
	Total=	**220.0 (88)**

*Hectares in parenthesis.

The third upland community, Oak/Palmetto, is found in the southwest region of the Proposed Action area and comprises approximately 0.3 acre (Figure 5-1) (Photograph 5-3). This community is dominated by live oak (*Quercus virginiana*), sabal palm (*Sabal palmetto*), saw palmetto (*Serenoa repens*), grape vine (*Vitis* sp.), and greenbriar (*Smilax* sp.).

Photograph 5-3 Coastal scrub Facing South from Launch Pad Access Road

5.1.2 WETLANDS

The two wetland communities found within the RPA are Wet Prairie and Marsh – Freshwater (Figure 5-1). The Wet Prairie community found throughout the RPA Boundary is dominated by Brazilian pepper, sand cordgrass (*Spartina bakerii*), lateflowering thoroughwort (*Eupatorium serotinum*), winged loosestrife, broomsedge (*Andropogon glomeratus*), sawgrass (*Cladium jaimacense*), frogfruit, and foxtail (*Seteria* sp.). Surface water was not present, soils were extremely dry, and hydric soil indicators consisted of sandy redox (S5). Due to the lack of an organic horizon at the surface, these wetlands are not expected to experience prolonged inundation during the wet seasons; rather, the water table is found at or below grade. The second wetland community, Marsh – Freshwater, is in the northeast and southeast corners of the RPA Boundary (Figure 5-1). This community is dominated by dense cattail.

5.1.3 SURFACE WATERS

This community comprises 0.2 acre and is in the southwest region of the Proposed Action Boundary. It is an upland cut roadside drainage swale that is dominated by frog-fruit, St. Augustine grass, pennywort (*Hydrocotyle umbellata*), and sedges (*Cyperus* sp.).

Figure 5-2 presents a light detecting and ranging-derived digital elevation model (DEM) topographic map for the Proposed Action.

Figure 5-2 Topographic Map

For Informational Purposes Only Y:\02655 - BRPH\Projects\008-01 - LC20 EA Phase1\Consult\Data\GIS\mxd\FigureRecreation\Figure 3-2 - DEM Map.mxd BBukata 12/2/2019

6 LISTED WILDLIFE SPECIES

Table 6-1 summarizes the listed wildlife species that may be potentially impacted as a result of the Proposed Action based on field investigations, existing data, and habitats found within the Proposed Action or RPA Boundary area.

6.1 FLORIDA SCRUB-JAY

The Florida scrub-jay is a federally threatened bird endemic to open, oak-dominated scrub habitats of Florida. Widespread loss and degradation of scrub habitat over the last century have resulted in dramatic declines in the distribution and abundance of this species. Populations of this species that remain are small, demographically isolated, and likely to decline. One of three core populations that contains over half of the State's remaining scrub-jays is found at Kennedy Space Center (KSC)/CCAFS (USAF, 2018a). The 45th Civil Engineering Squadron, Environmental Conservation Element (45 CES/CEIE-C) is the organization within the 45th Space Wing with primary responsibility for overseeing Florida scrub-jay management and handling Section 7 consultations with the US Fish and Wildlife Service (USFWS) as required under the Endangered Species Act.

The SLC-20 RPA Boundary is in Land Management Units (LMU) 15 and 18. The Proposed Action site contains 0.3 acre (0.1 ha) of coastal scrub habitat that is considered poor quality (Figure 6-1) (USAF, 2018a). However, in the future the 45th Space Wing may conduct controlled burns and mechanical vegetation management to improve the coastal scrub habitat within the RPA Boundary up to the Proposed Action Boundary.

USAF conducts a yearly census of the Cape Canaveral population of scrub-jays in all suitable accessible jay habitat. In 2018, 136 Florida scrub-jay groups were identified, which has varied from 104 groups in 2000 to 157 groups in 1996 and 1997 (Figures 6-1 and 6-2). Data from the 2018 census indicate the presence of a single group within the RPA Boundary area just east of ICBM Road but over 1,100 feet west of the Proposed Action Boundary (Figure 6-3).

As previously stated, the Proposed Action will impact 0.3 acre (0.1 ha) of low-quality Florida scrub-jay habitat dominated by sand live oak and saw palmetto (Figure 6-3). The remaining disturbed areas do not support the Florida scrub-jay.

Table 6-1 Potential Impacts, Section 7 Finding, and Compensation to Federal and State Protected Wildlife Species that Occur or Have Potential to Occur within the Proposed Action Area (Area defined as direct or indirect impact by construction or operations)

Common Name *Scientific Name*	Status[1] USFWS	Status[1] FFWCC	Occurrence	Potential Impacts	Section 7 Finding	Compensation
Florida Scrub-Jay *Aphelocoma coerulescens*	T	T	Potential	Reduced restoration of suitable habitat.	May Affect, But Not Likely To Adversely Affect	Habitat restoration near SLC-19, change in 45 SW operational controls to ensure burn days, and continued habitat restoration on CCFAS.
Gopher Tortoise *Gopherus polyphemus*	C	T	Documented	Crushing by equipment. Loss of habitat.	NA	Affected individuals to be relocated.
Eastern Indigo Snake *Drymarchon corais couperi*	T	T	Potential	Crushing by equipment.	May Affect, But Not Likely To Adversely Affect	Continued habitat restoration on CCAFS.
Southeastern Beach Mouse *Peromyscus polionotus niveiventris*	T	T	Documented	Crushing by equipment. Disruption due to noise.	May Affect and Is Likely To Adversely Affect	Continued habitat restoration on CCAFS.
Marine Turtle: Leatherback (*Dermocheyls coriacea*) Green (*Chelona mydas)* Loggerhead (*Caretta caretta*) Kemps Ridley (*Lepidochelys kempii*) Hawksbill (*Eretmochelys imbricata*)	 E T T E E	 E T T E E	Documented	Disruption and disorientation due to light.	May Affect and Is Likely To Adversely Affect	Implement exterior lighting compliant management plans.
West Indian Manatee *Trichechus mantus*	T	T	No habitat	No impacts	No Affect	NA
American Alligator *Alligator mississippiensis*	S/A		No habitat	No impacts	No Affect	NA
American Wood Stork *Mycteria americana*	T	T	Potential	Disruption of foraging habitat. Disruption due to noise.	May Affect But Not Adversely Affect	Impacts to wetlands will be mitigated in accordance with state and federal wetland regulations.
Piping Plover *Charadrius melodus*	T	T	Potential	Disruption due to noise.	May Affect But Not Adversely Affect	None provided.
Red Knot *Calidris canutus*	T		Potential	Disruption due to noise.	May Affect But Not Adversely Affect	None provided.

Note [1]: Legend: (C) Candidate; (T) Threatened; (E) Endangered; (S/A) Similarity of Appearance.
FFWCC = Florida Fish and Wildlife Conservation Commission.

Figure 6-1 2018 Florida Scrub-Jay Census Map

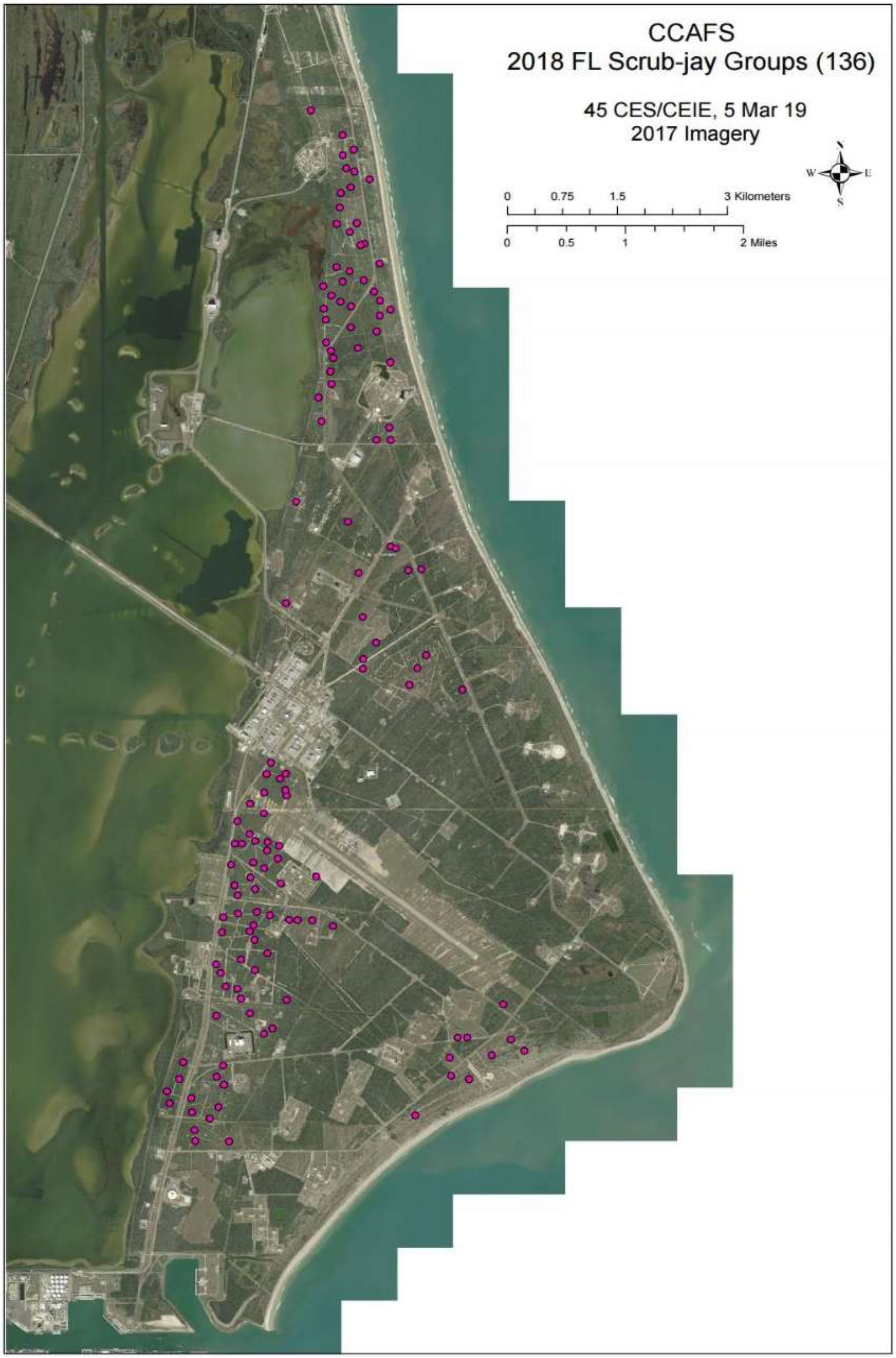


Figure 6-2 CCAFS Florida Scrub-Jay Annual Census Totals (USAF, 2019)

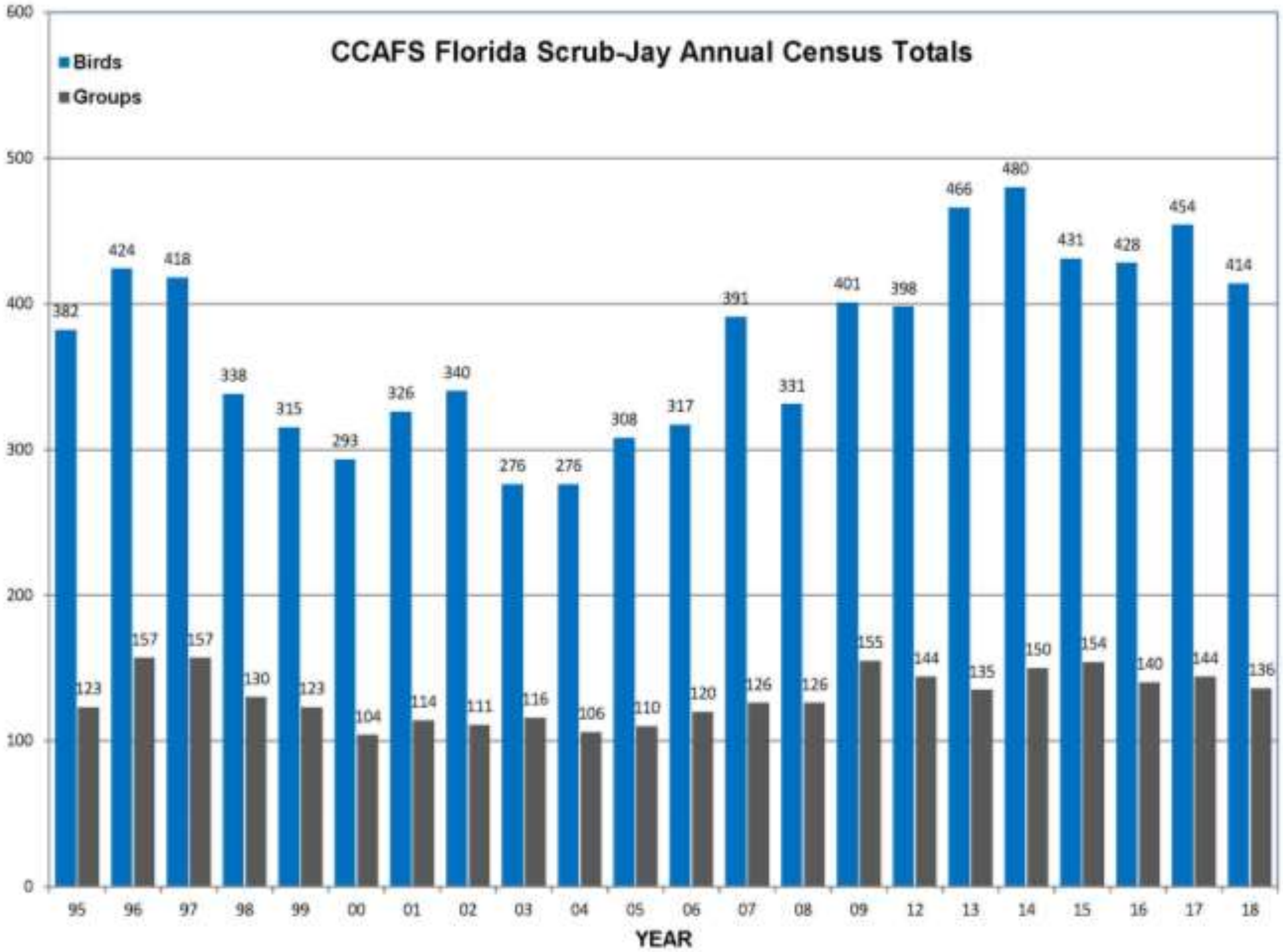


Figure 6-3 Proposed Florida Scrub-Jay Habitat Impacts and Census Data

6.2 GOPHER TORTOISE

The gopher tortoise is a State-Listed *Threatened* species by FFWCC and is protected by State law, Chapter 68A-27, Florida Administrative Code (FAC). The gopher tortoise is also currently classified as a *Category 2 Candidate Species* by USFWS under the Endangered Species Act. The basis of the *Threatened* classification by FFWCC for the gopher tortoise is due to habitat loss and destruction of burrows. The gopher tortoise can live up to 80 years in the wild and occurs in upland habitats such as sandhills, pine flatwoods, scrub, scrubby flatwoods, dry prairies, xeric hammock, pine-mixed hardwoods, and coastal dunes. Gopher tortoises will dig and use several burrows during the warm months and burrows can range from 3 to 52 feet long. These burrows provide refuge for more than 350 other commensal species such as small mammals, frogs, mice, snakes, and insects.

In July 2019, a pedestrian gopher tortoise survey was completed for approximately 90 percent of the Proposed Action area and approximately 60 percent of high probability habitat in the RPA Boundary. Within the Proposed Action area, a diversity of burrow sizes was observed, from juveniles to large adults (Photographs 6-1 and 6-2), with over 160 potentially occupied (PO) burrows observed within the boundary and 35 observed outside the boundary (Figures 6-4 and 6-5).

Photograph 6-1 Hatchling Gopher Tortoise Burrow Adjacent to Road to Launch Pad

Photograph 6-2 Adult Gopher Tortoise Burrow

Figure 6-4 Proposed Action Boundary PO Gopher Tortoise Burrow Location Map

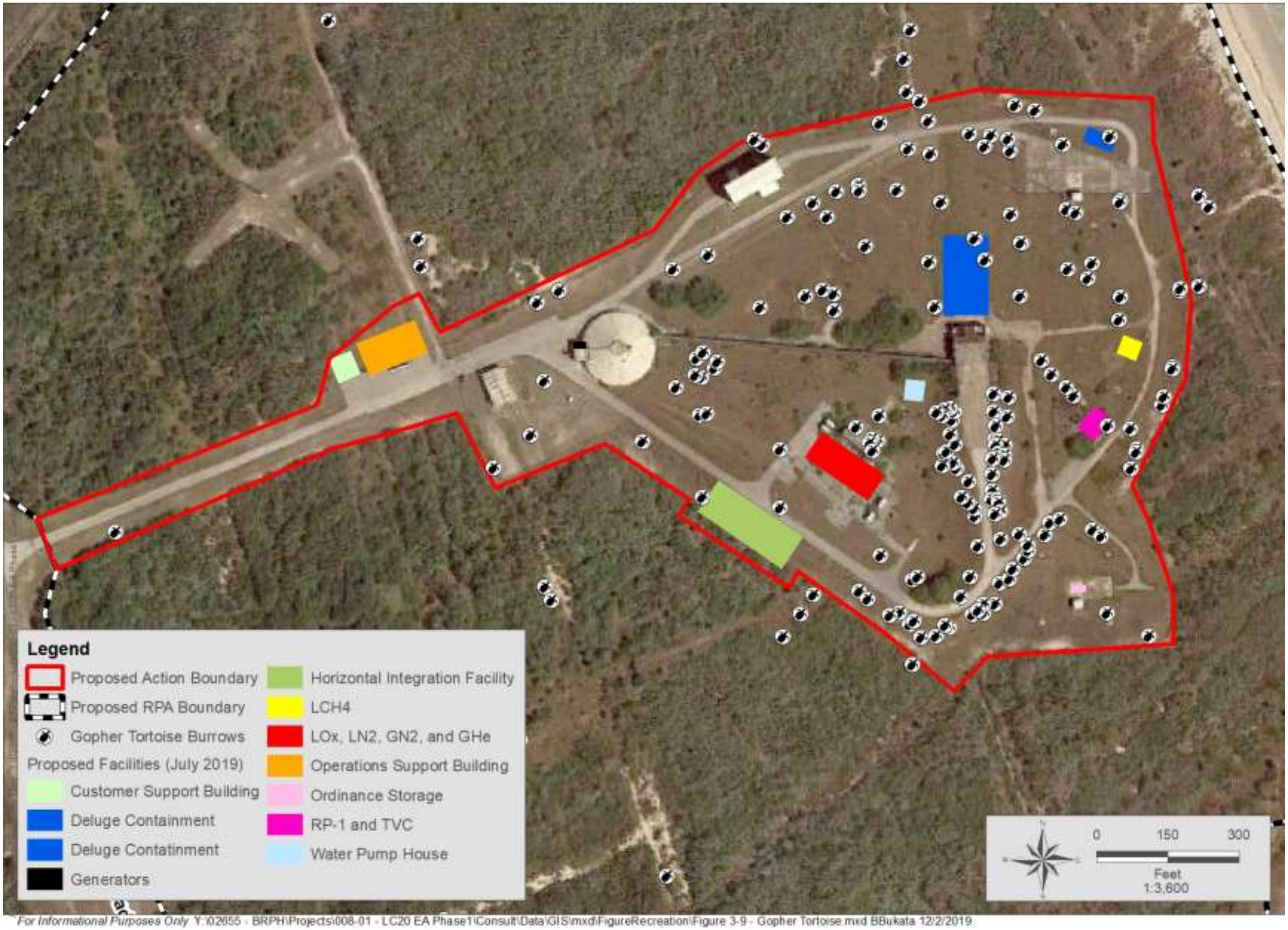


Figure 6-5 Proposed RPA Boundary Area PO Gopher Tortoise Burrow Location Map

6.3 Eastern Indigo Snake

The eastern indigo snake is a federally *Threatened* species that may attain a length of up to 8 feet. It is found in a diversity of habitats and is closely associated with gopher tortoise burrows, which it uses for shelter during cold weather and extremely dry periods. The eastern indigo snake feeds on other snakes, frogs, salamanders, toads, small mammals, and birds and can have a home range of over 200 acres (USAF, 2018a). The eastern indigo snake has been observed on CCAFS and likely occurs throughout the installation; however, exact numbers are not known. The breeding season occurs between November and April with egg-laying occurring May through June with hatchlings emerging in late July through October. Major threats to the indigo snake on CCAFS are habitat loss and vehicle traffic. An installation-wide census for the eastern indigo snake has not been completed. This species is likely to occur within the Proposed Action Boundary based on the abundance of gopher tortoise burrows. This species is also likely to occur within the RPA Boundary area due to the habitat type and presence of gopher tortoise burrows.

6.4 Southeastern Beach Mouse

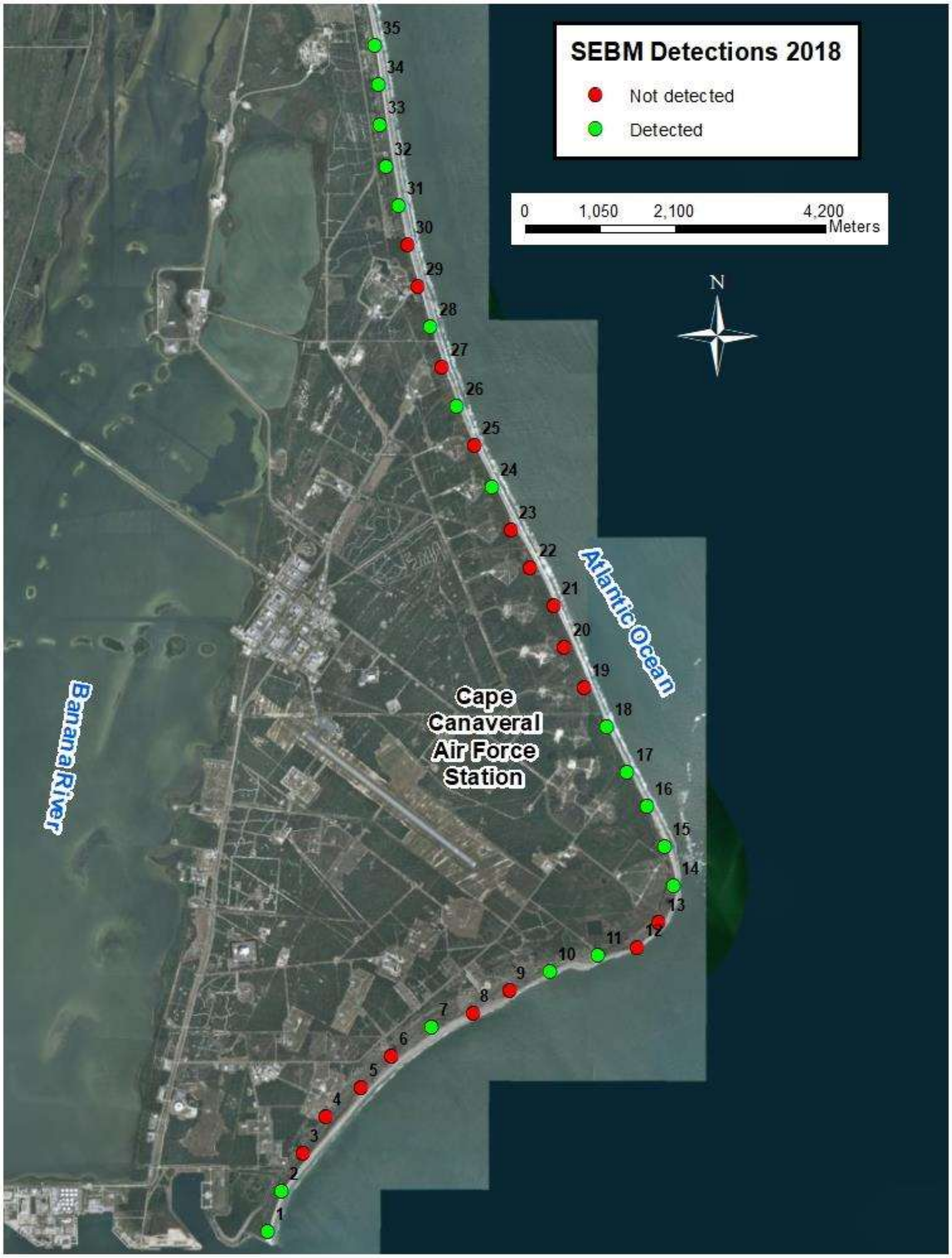
The southeastern beach mouse is a federally *Threatened* subspecies that historically existed on coastal dunes and coastal strand communities from Ponce Inlet south (Volusia County) to Hollywood, Florida (Broward County) (Humphrey et al., 1987). Currently, the southeastern beach mouse is restricted to predominantly federal lands encompassing and adjacent to CCAFS, KSC, Canaveral National Seashore (CNS), the Merritt Island National Wildlife Refuge (MINWR), and a few locations on Pelican Island National Wildlife Refuge and Sebastian Inlet State Park (Oddy et al., 2012). This species is a high priority for management on federal lands encompassing the Cape Canaveral Barrier Island Complex (CCBIC), which includes KSC/MINWR, CCAFS, and CNS.

Reasons for decline in southeastern beach mouse populations include habitat loss due to development and erosion, habitat fragmentation, isolation, competition from the house mouse, and predation from domesticated cats (Stout, 1992). The beach mouse is a monogamous species for which breeding typically occurs November through January with females producing two or more litters per year with an average of three to four offspring per litter.

Biologists have been studying the demographics of this species since the late 1970s with a baseline study of KSC and CCAFS conducted by Stout (1979). Since 2008, biologists have monitored habitat occupancy of the southeastern beach mouse on the CCBIC, with the goal of sampling habitat occupancy annually each fall/winter throughout the entire area of suitable coastal habitat.

A long-term sampling grid (BG3) is north of the Proposed Action area but within the RPA Boundary as well as a 2011 to 2012 random coastal point referred to as 18 (Figure 6-6). Southeastern beach mice were captured at these locations during the 2011 to 2012 sampling period (Oddy et al., 2012). Sampling conducted in 2018 did not detect the presence of this species (Oddy and Stolen, 2018) (Figure 6-7), and results of the sampling determined a habitat occupancy rate of 0.72 percent of CCBIC coastal habitat was occupied. More importantly, several southeastern beach mice were captured inside the SLC-20

Figure 6-6 Locations at which Southeastern Beach Mice were Detected During the Occupancy Survey on CCAFS, February to March 2018



(Green circles indicate that beach mice were detected at a site, and red circles indicate no detection at a site. Numbers indicate site locations.)
(Oddy and Stolen, 2018)

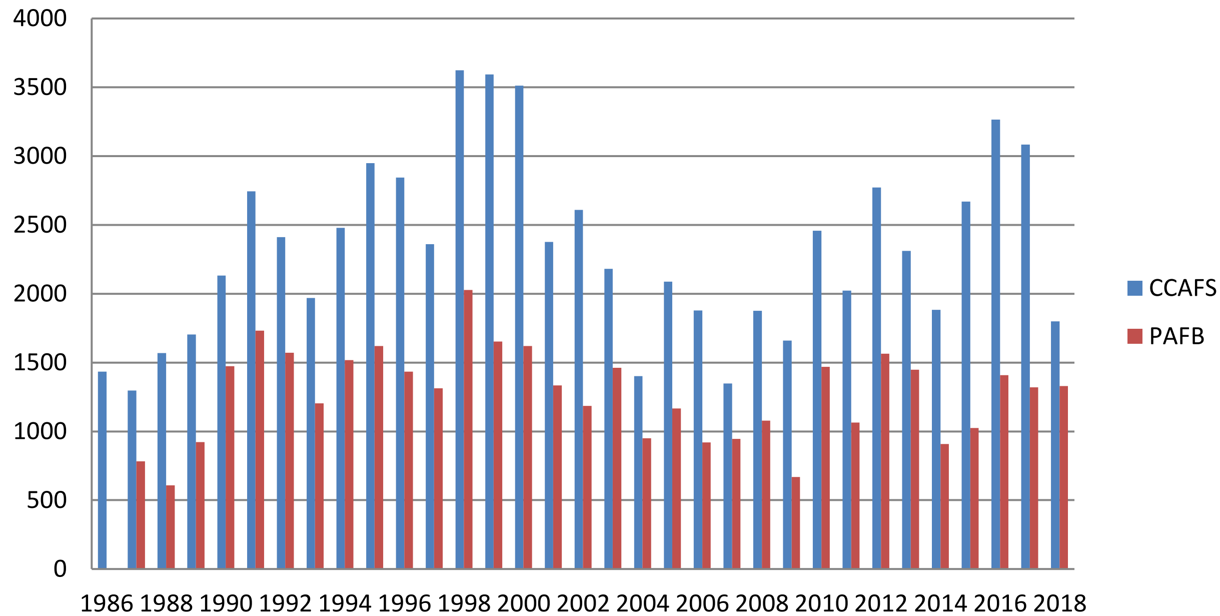
blockhouse (Facility 18800) in 2001 (ESC, 2002). As a result, the presence of this species has been confirmed within the Proposed Action Boundary as well as within the RPA Boundary area.

Figure 6-7 Land Management Units (Blue), Long-Term Grids (Green), and Random Coastal Points (Red) on CCAFS Where Small Mammal Trapping Occurred in Fall 2011 and Spring 2012

6.5 MARINE TURTLES

The loggerhead, green, leatherback, and Kemp's ridley sea turtles nest on the beaches of CCAFS and Patrick Air Force Base (PAFB). In 1986, the 45th Space Wing began sea turtle monitoring at CCAFS and PAFB. Nests are deposited on CCAFS and PAFB each year between April and September. Each year, between 1,400 to 3,600 sea turtle nests are deposited on the 13 miles of beach at CCAFS based on nest surveys at CCAFS from 1986 through 2018 (Figure 6-8) (USAF, 2018b).

Figure 6-8 All Sea Turtle Nests Deposited at CCAFS and PAFB



Although sea turtles spend much of their lives in the ocean, females come ashore each year to nest. Preliminary research indicates that lights adjacent to sea turtle nesting beaches may hinder the beach nest site selection of nesting females. Regarding sea turtle hatchlings, extensive research has demonstrated that the principal component of the emergent sea turtle hatchlings' orientation behavior is visual (Carr and Ogren, 1960; Dickerson and Nelson, 1989; Witherington and Bjorndal, 1991). Artificial beachfront lighting has been documented to cause disorientation (loss of bearings) and misorientation (incorrect bearing) of hatchling turtles. As hatchlings head toward artificial lights, their exposure to predators and the likelihood of dehydration are greatly increased. Misoriented hatchlings can become entrapped in vegetation or debris, and some hatchlings have been found dead on nearby roadways and in parking lots after being struck by vehicles. Intense artificial lighting can even draw hatchlings back out of the surf (USAF, 2018b).

In 1988, in compliance with Section 7 of the Endangered Species Act, USAF developed Light Management Plans (LMPs) for various areas and facilities on CCAFS to protect sea turtles. A Biological Opinion (BO) issued by USFWS in April 1991, with several subsequent revisions, requires LMPs for any new facilities that are close to the beach, are not constructed in accordance with 45th Space Wing Instruction (SWI) 32-7001, have lighting directly visible from the beach, and/or may cause significant sky glow. The BO was modified again in 2008 and authorized a 3-percent take of nesting females and up to 3 percent of all hatchlings disoriented/misoriented from a representative sample of all surveyed marked nests. The BO also requires at least five night light surveys at CCAFS and PAFB during the peak of nesting season (May 1 through October 31). Currently, no exterior lighting operates at SLC-20 and no disorientation has been documented on the beach in this area for several years.

6.6 West Indian Manatee

The West Indian manatee is listed as *Endangered* by USFWS. Manatees are protected under the Marine Mammal Protection Act, which prohibits the take (i.e., harass, hunt, capture, or kill) of all marine mammals. Manatees are found in marine, estuarine, and freshwater water bodies. The West Indian manatee includes two distinct subspecies; the Florida manatee *(Trichechus manatus latirostris)* and the Antillean manatee *(Trichechus manatus manatus)*. Although morphologically distinctive, both subspecies have many common features such as large, seal-shaped bodies with paired flippers and a round, paddle-shaped tail. They are typically grey (color can range from black to light brown) and occasionally spotted with barnacles or colored by patches of green or red algae. The muzzle is heavily whiskered and coarse, single hairs are sparsely distributed throughout the body. On average, adult manatees are approximately 9 feet long (3 meters) and on average weigh 1,000 lb (200 kg). At birth, calves are between 3 and 4 feet long (1 meter) and weigh between 40 and 60 lb (30 kg).

No surface waters exist for the West Indian manatee within the Proposed Action or RPA Boundary areas. However, this species could use coastal waters of the Atlantic Ocean to the east.

6.7 American Alligator

The American alligator is federally listed as *Threatened* due to its similarity in appearance to other endangered species such as the American crocodile (*Crocodylus acutus*). The American alligator has made a strong recovery in Florida and inhabits and reproduces in nearly all CCAFS waters. Alligators are apex predators and consume fish, amphibians, reptiles, birds, and mammals. They play an important role as ecosystem engineers in wetlands through the creation of alligator holes, which provide wet and dry habitats for numerous other organisms.

The Proposed Action area does not contain wetland or surface water habitat that could support this species. However, the RPA Boundary area does contain two cattail-dominated ponds that could support the American alligator (Figure 5-1).

6.8 American Wood Stork

The American wood stork is a federally listed *Threatened* species and is the only stork species found in North America. It is a large, white and black wading bird, with a long 'ibis-shaped' beak. Wood storks forage in small pools and wetland areas that support small fish. The species breeds in late winter once fish populations in small vernal pools have dried up sufficiently to support the raising of young.

The Proposed Action area does not contain wetland or surface waters that would be used by the American wood stork. However, the proposed RPA Boundary area does contain two cattail-dominated ponds and several depressional wetlands that could provide marginal foraging habitat for use by the American wood stork.

6.9 Piping Plover

The piping plover, a federally listed *Threatened* species, is a small sand-colored, sparrow-sized shorebird that nests and feeds along coastal sand and gravel beaches in North America. The adult has yellow-orange legs, a black band across the forehead from eye to eye, and a black ring around the neck. Their breeding habitat includes beaches or sand flats on the Atlantic coast, Great Lakes, and the mid-west. They forage for food on beaches moving across in short bursts around the high-tide wrack zone eating insects, marine worms, and crustaceans.

The piping plover is not known to breed in Brevard County; however, it does have the potential to occur on Brevard beaches during the non-breeding season (July to March) and has been previously observed on CCAFS beaches in small numbers.

6.10 Red Knot

The red knot is a federally listed *Threatened* species and is a medium-sized shorebird that breeds in tundra and the Arctic Cordillera in the far north of Canada, Europe, and Russia. The red knot has one of the longest migrations of any bird. The red knot is an occasional visitor along the Florida seashore during its annual migration. This species is not known to breed or nest in Brevard County; however, it has been previously observed on CCAFS beaches in small numbers.

7 EFFECTS OF ACTION ON LISTED SPECIES

The following sections discuss specific effects from the Proposed Action. Effects are caused by construction and operations activities. Envisioned impacts include construction and operation activities associated with the launch of the Concept A and B launch vehicles. Potential impacts to listed species have been significantly minimized by siting facilities/ structures in cleared and disturbed areas associated with the legacy SLC-20. The only proposed impacts to undisturbed areas are in association with the new HIF in Phase 2, which will require the clearing of 0.3 acre (0.1 ha) of coastal scrub. Construction in this area is unavoidable due to HIF orientation requirements to move the assembled launch vehicle to the launch pad.

7.1 FLORIDA SCRUB-JAY

7.1.1 DIRECT IMPACTS

The clearing for the new HIF of the Proposed Action will result in the loss of approximately 0.3 acre (0.1 ha) of poor-quality unoccupied scrub-jay habitat. Figure 6-3 shows that the 2018 Florida Scrub-Jay census did not reveal the presence of any scrub-jay groups or individuals within the Proposed Action area. However, the 2018 census did observe this species within the proposed RPA Boundary area (just west of ICBM Road) but not within areas where the proposed construction would occur. As a result, direct impacts to this species are not expected. The proposed operations at SLC-20 would increase traffic in the vicinity of the scrub-jay habitat and thus create the opportunity for a take due to road-kill mortality.

7.1.2 INDIRECT IMPACTS

Potential effects to the Florida scrub-jay, if present, during construction activities would include disruption of normal activities due to noise and ground disturbances. These impacts would be short-term and would elicit a startle response to avoid the noise. This would help the birds to avoid the threat and therefore would not cause a negative impact to populations near the Proposed Action and RPA Boundary areas. Launch-related noise may startle many species within the CCAFS area. However, actual noise impact to wildlife, including the Florida scrub-jay is expected to be minimal. Current and past launch programs on CCAFS, i.e., Atlas, Titan, and Delta launches, have been documented as not causing any animal mortality or significant impact to wildlife on CCAFS (USAF, 1998).

The 45th Space Wing has a CCAFS habitat management goal of burning 500-acres annually to manage habitat for the Florida scrub-jay and other threatened and endangered species. This goal has been established through consultation with federal resource agencies pursuant to Section 7 of the Endangered Species Act. In order to achieve this goal, the 45th Space Wing typically needs 6-8 days of prescribed burning per year. Burn window opportunities for the 45th Space Wing have been periodically reduced due to numerous factors such as weather, payload transport, payload processing, payload storage at a launch pad, launches, wet dress, and static test fires, among others. Historically, the 45th Space Wing has been relatively successful at meeting this objective. However, due to the current military project needs and increasing number of commercial aerospace customers, prescribed burning has and will become more difficult.

As a result, the presence of new launch operations at SLC-20 has the potential to reduce burn windows for LMUs 15 and 18 and other LMUs due to launches, payload processing, and other operation activities. As a result, this could have negative indirect impacts on the Florida scrub-jay because of the reduced restoration of suitable habitat for this species.

Historically, the 45th Space Wing has maintained a launch table from which burn windows are identified. The increase in aerospace activities has reduced the availability of these windows due to reasons listed above as well as secondary impacts such as launch delays or improper weather conditions when a prescribed burn window arises. As a result, the 45th Space Wing plans to revise its approach with current and future users and Space Florida to ensure adequate burn windows occur annually in an effort to prioritize this listed species management activity rather than it being secondary to launch operations. The SW is currently working with senior CCAFS staff to develop operational controls that will block out a set number of days annually within which launches or other activities affected by prescribed burns cannot occur in order to allow SW to meet its habitat management goals agreed to with the resource agencies. Operational controls will be implemented that will provide more assurance that CCAFS will meet its burning goals as part of its land management unit responsibilities. In addition, Space Florida will incorporate language into their tenant lease agreements that references the 45th Space Wing prescribed burn goal, listed species management responsibilities, and resulting annual restrictions (1-2 weeks) during a 45th Space Wing predefined period. As part of the lease agreement with Space Florida, the tenants will have a contractual obligation to comply with the specified prescribed burn days schedule by providing adequate protection for their equipment (via containment or filtration systems) or moving sensitive equipment to another location while the prescribed burn days are in force. In addition, Space Florida will work closely with 45th Space Wing and attend the CCAFS Controlled Burn Working Group meetings to stay abreast of prescribed fire schedules.

Because of the potential for an indirect take of scrub-jays as noted above, the 45th Space Wing has determined that the proposed project *may affect, but not likely to adversely affect* the Florida scrub-jay.

7.2 Gopher Tortoise

PO gopher tortoise burrows are throughout the Proposed Action area, adjacent to proposed facilities, and very dense along the shoulders of the road that serves the SLC-20 launch pads (Figure 6-4). As such, the Proposed Action will result in the loss of occupied gopher tortoise habitat and require the relocation of numerous tortoises. Relocation activities on military bases are exempt from FFWCC permitting and fees in accordance with the FFWCC Gopher Tortoise Management Plan. Additionally, USAF is required to provide an annual report that includes relocation activities taking place on its property in accordance with the Gopher Tortoise Candidate Conservation Agreement.

All tortoises that may be impacted will be safely excavated by FFWCC-authorized gopher tortoise agents and relocated to an approved gopher tortoise recipient site on CCAFS property in accordance with FFWCC rules. The Proposed Action could result in a direct take due to mortality or injuries sustained by heavy equipment.

Reptiles and amphibians are sensitive to vibrations, which provide information about approaching predators and prey. Vibration and noise associated with construction activities would potentially cause short-term disturbance to gopher tortoises. These impacts would be considered short-term and would not cause a significant impact to populations within the vicinity of the project area. Noise associated with rocket launches may startle many species within the CCAFS area. However, actual noise impact to wildlife is expected to be minimal. As previously stated, studies on current and past launch programs on CCAFS have not been documented to cause animal mortality or significant impact to wildlife on CCAFS (USAF, 1998).

7.3 Eastern Indigo Snake

The Proposed Action will result in the loss of approximately 0.3 acre (0.1 ha) of potential eastern indigo snake habitat (undisturbed coastal scrub) and approximately 32 acres (13 ha) of disturbed habitat having a high density of gopher tortoise burrows that could be used by this species as refugia. As a result, it is unlikely a take may occur as the result of habitat loss and vast acreages of adjacent suitable habitat are present. A direct take would also not occur for this species that may be utilizing gopher tortoise burrows as all burrows will be excavated and any eastern indigo snakes will be safely moved or allowed to move outside the Proposed Action boundary. Eastern indigo snakes could be vulnerable to mortality as a result of injuries sustained during construction activities.

Reptiles and amphibians are sensitive to vibrations, which provide information about approaching predators and prey. Vibration and noise associated with construction activities would elicit a *startle response* to avoid the noise. These impacts would be considered short-term and would not cause a negative impact to the eastern indigo snake within the vicinity of the project area (USAF, Environ). Noise associated with rocket launches may startle this species within the CCAFS area. However, actual noise impact to this species is expected to be minimal. As previously stated, studies on current and past launch programs on CCAFS have not been documented to cause animal mortality or significant impact to wildlife on CCAFS (USAF, 1998).

Due to the potential for indirect take of the eastern indigo snake as noted above, the 45th Space Wing has determined that the proposed project *may affect, but not likely to adversely affect* the eastern indigo snake.

7.4 Southeastern Beach Mouse

Construction and operations will occur approximately 100 feet west of the beach dune area, typical habitat of the beach mouse. However, the Proposed Action will not result in the clearing of beach dune habitat and is limited to clearing 0.3 acre (0.1 ha) of coastal scrub approximately 850 feet west of the toe-of-slope of coastal dune habitat. All other impacts will be to previously disturbed and maintained low-quality ruderal habitat associated with the legacy SLC-20 area.

This species has been documented in the blockhouse, which will be renovated under the Proposed Action. As such, a take of beach mice is not expected to occur due to a loss of potential habitat. Rather, a take may occur as a result of the renovation of abandoned facilities that this species is known to use as refugia. However, the SLC-20 tenant will request and perform live trapping in accordance with the USFWS August 2002 BO on rodent trapping.

Potential noise-related effects to the southeastern beach mouse during construction activities would include disruption of normal activities due to noise and ground disturbances. These impacts would be short-term and would elicit a startle response to avoid the noise. This would help the mice avoid the threat and therefore would not cause an impact to this species within the vicinity of the project area. Noise associated with rocket launches may startle this species within the CCAFS area. However, actual noise impact to this species is expected to be minimal. As previously stated, studies on current and past launch programs on CCAFS have not documented animal mortality or significant impact to wildlife on CCAFS (USAF, 1998).

The proposed operations at SLC-20 would increase traffic in the vicinity of the southeastern beach mouse habitat and thus create the opportunity for a take due to road-kill mortality.

Due to the potential for direct and indirect take of the southeastern beach mouse as noted above, the 45th Space Wing has determined that the proposed project *may affect and is likely to adversely affect* the southeastern beach mouse.

7.5 Marine Turtles

The proposed clearing and construction of new facilities would not directly impact the nesting beach. Exterior lighting proposed for the new facilities and lighting required for night launches has the potential to be visible from the beach and could result in adult and/or hatchling disorientation adjacent to SLC-20. However, proposed lighting and its use will be outlined in a CCAFS-approved LMP.

Sea turtles are not expected to be affected by vibration and noise associated with construction activities since the project area will be beyond the beach and dune area. However, noise associated with rocket launches may startle many species within the CCAFS area, but the noise impact to wildlife is expected to be minimal. Sonic boom noise in the area is minimal, and large sonic boom may only occur offshore and would also have no effect.

Due to the potential that night launches may result in the disorientation of hatchlings, the 45th Space Wing has determined that the proposed project *may affect and is likely to adversely affect* the five species of marine turtles occurring at CCAS.

7.6 West Indian Manatee

The Proposed Action contains no habitat for this species and their presence is limited to Atlantic Ocean coastal waters to the east. Manatees are not expected to be affected by vibration and noise associated with construction activities since they are not in the area.

Noise associated with rocket launches may startle many species within the CCAFS area; however, its impact to wildlife is expected to be minimal. Sonic boom noise impacts to this species is expected to be negligible since it will occur many miles offshore.

Due to the lack of habitat, the 45th Space Wing has determined that the proposed project will have *no effect* on the West Indian manatee.

7.7 American Alligator

The Proposed Action will not impact the American alligator or its habitat as the small man-made swale totaling 0.19 acre (0.08 ha) would not be considered alligator habitat. Therefore, the Proposed Action is not likely to impact alligators. The RPA Boundary area does contain two cattail ponds that could provide habitat for this species. However, the Proposed Action proposes no impacts to this habitat.

Reptiles and amphibians are sensitive to vibrations, which provide information about approaching predators and prey. Vibration and noise associated with construction activities could cause short-term disturbance to an alligator. These impacts would be considered short-term and would not affect alligators within the vicinity of the project area. Noise associated with rocket launches may startle the American alligator and other species within the CCAFS area. However, actual noise impact to wildlife is expected to be minimal. As previously stated, studies on current and past launch programs on CCAFS have not been documented to cause animal mortality or significant impact to wildlife on CCAFS (USAF, 1998).

Because of the lack of potential impact to this species, the 45th Space Wing has determined that the proposed project will have *no effect* on the American alligator.

7.8 American Wood Stork

The Proposed Action area does not contain wetland or surface waters that would be used by the American wood stork. However, the proposed RPA Boundary area does contain two cattail dominated ponds comprising 2.5 acres (1.0 ha) that could provide marginal foraging habitat. The dense vegetation limits the value of this habitat for the wood stork. Approximately 15.5 acres (6.3 ha) of shallow depressional wetlands exist characterized as wet prairies throughout the RPA Boundary area. However, as previously mentioned, these wetlands do not experience prolonged inundation and they are not connected to other wetlands or surface waters to support fish species that wood storks rely on. As such, these wetlands likely provide little to no foraging habitat for use by the American wood stork.

Noise associated with rocket launches may startle many species within the CCAFS area. Actual noise impact to wildlife is expected to be minimal. As previously stated, studies on current and past launch programs on CCAFS have not been documented to cause animal mortality or significant impact to wildlife on CCAFS (USAF, 1998). Sonic boom noise may only occur well offshore and its impact on this species is expected to be minimal.

Due to the lack of potential impact to this species, the 45th Space Wing has determined that the proposed project *may affect but is not likely to adversely affect* the American wood stork.

7.9 Piping Plover

The piping plover forages along the shoreline and nesting has been documented in Brevard County. As a result, the Proposed Action and future activities within the RPA Boundary area will not impact Piping Plover habitat.

Potential noise-related effects from construction or launches is not expected to impact the piping plover.

Due to the lack of potential impact to this species, the 45th Space Wing has determined that the proposed project *may affect but is not likely to adversely affect* the piping plover.

7.10 RED KNOT

The red knot is recognized as an occasional visitor that forages along the shoreline during its migration. The Proposed Action or future activities within the RPA Boundary area will not impact shoreline habitat used by the red knot.

Potential noise-related effects from construction or launches is not expected to impact the red knot.

Due to the lack of potential impact to this species, the 45th Space Wing has determined that the proposed project *may affect but is not likely to adversely affect* the red knot.

8 COMPENSATION FOR AFFECTED SPECIES

8.1 FLORIDA SCRUB-JAY

USFWS and USAF have agreed to a mitigation formula for scrub-jay habitat impacts that mitigate loss of scrub or potential scrub habitat acreage by restoring degraded scrub habitat at a 2:1 ratio. The objective of CCAFS scrub habitat restoration is to restore, using fire and mechanical methods, the over-mature scrub to a condition suitable to support the Florida scrub-jay. The 45th Space Wing proposes to enhance coastal scrub habitat on the southeast corner of SLC-19 as compensation for effects on the southeastern beach mouse (Figure 8-1). This habitat enhancement will provide suitable habitat for the Florida scrub-jay to mitigate the proposed 0.3 acre of habitat impacts. Space Florida will be the agency responsible for the completion and subsequent monitoring of the habitat enhancement mitigation area.

Although the Proposed Action area is not suitable habitat nor currently occupied, scrub-jay surveying would be conducted before clearing to ensure that no jays are nesting within 300 feet of clearing activities. All suitable scrub-jay habitat would be surveyed for nesting jays. Any nests encountered would be flagged and no clearing would be allowed within 300 feet until all birds have fledged.

8.2 GOPHER TORTOISE

Substantial impacts to gopher tortoises could occur due to the high density of this species within the Proposed Action area. A high density of gopher tortoise burrows occurs on the shoulders of the launch pad access roads as well as the north/south road spur that ends at the launch pad (Figure 6-4). These roads are very old and need repairing and at a minimum resurfacing. Currently, the extent of road renovations or expansion under the Proposed Action have not been determined; therefore, the resulting impacts to the gopher tortoise is not known.

To minimize impacts to gopher tortoises, gopher tortoise burrows will not be disturbed if a minimum of a 25-foot (7.6-m) buffer can remain as well as maintaining connectivity of this buffer to foraging areas in accordance with FFWCC guidelines. No more than 90 days before and no fewer than 72 hours before any clearing or construction, a 100-percent pedestrian survey in accordance with FFWCC guidelines will be conducted to locate and flag/stake all burrows. Gopher tortoise burrows that occur within areas to be cleared, areas for new construction, or burrows found on the shoulder of roads to be rebuilt will be excavated, and captured tortoises will be relocated by an FFWCC-authorized agent in accordance with FFWCC guidelines to the 45th Space Wing-approved recipient site on CCAFS. A map showing the locations of the burrow and their occupancy status if a tortoise was captured will be provided to the construction contractor by the commercial space entity under lease agreement with Space Florida for SLC-20. Educational posters will be provided to construction personnel and future tenant personnel so that they are observant for any tortoises that may enter the construction site or during site operations. Any live or dead tortoises observed will be reported to the 45th Space Wing immediately.

Figure 8-1 Proposed Habitat Enhancement Location Map

8.3 Eastern Indigo Snake

The 45th Space Wing Indigo Snake Protection/Education Plan will be presented to the commercial space user project manager, their construction manager, and construction personnel. Educational signs will be displayed at the site to inform personnel of the snake's appearance, its protected status, and who to contact if any are spotted in the area. If any indigo snakes are encountered during clearing activities, they will be allowed to safely move out of the project area. Any observations of live or dead indigo snakes will be reported to the 45th Space Wing immediately, who will then report it to USFWS if appropriate.

8.4 Southeastern Beach Mouse

The Proposed Action would not significantly impact the southeastern beach mouse population at CCAFS since no clearing or construction of suitable habitat will occur. However, there could be a take of a southeastern beach mouse due to their use of the block house and disturbed habitats between this structure and the coast dunes. USAF has an USFWS Programmatic Biological Opinion that addresses impacts to beach mice associated with certain activities including launch site restoration actions (USFWS, 2002). Based on past studies completed for CCAFS, beach mice are benefitting from the same land management activities being conducted for scrub-jays, and the population is expanding into inland locations. However, as compensation for the potential take of this species as a result of the Proposed Action, Space Florida is proposing to enhance dune and coastal scrub habitat within an area on the southeast corner of SLC-19 (Figure 8-1). This habitat enhancement will help to provide high quality habitat and a corridor to additional suitable interior habitat. Space Florida will be the agency responsible for the completion and subsequent monitoring of the habitat enhancement mitigation area.

8.5 Marine Turtles

To minimize potential impacts to sea turtles from new or temporary facility lighting, the majority of exterior lighting proposed for this project would be in accordance with the 2018 45th SWI 32-7001, *Exterior Lighting Management*. Some *non-turtle friendly* lighting may be required during the day of launch and if any launches were occurring at night. An LMP will be completed by the SLC-20 tenant and submitted to the 45th Space Wing and USFWS for approval before new or temporary lighting construction. Clearing of vegetation at the SLC-20 area will not have an impact to nesting or hatchling sea turtles; therefore, no mitigation is required for those activities.

8.6 West Indian Manatee

Since the area where the West Indian manatee may be present is offshore well to the east of the Proposed Action area, negligible impacts are expected; therefore, mitigation measures are not proposed or needed.

8.7 American Alligator

Since the only potential water bodies where alligators may reside are not part of the Proposed Action construction area, impacts to this species are not expected; therefore, no mitigation measures are needed. However, construction and operations personnel will be advised of the potential presence of alligators in the off-site cattail ponds and disturbance to nests is not authorized. Additionally, Space Florida and its lessee will be responsible for ensuring all personnel understand the laws regarding the feeding of alligators. Any personnel observed feeding alligators will be reported to the appropriate authorities.

8.8 American Wood Stork

This species or its nests have not been observed on-site. In addition, no suitable foraging habitat exists within the Proposed Action Boundary. Therefore, no mitigation measures are required or proposed. During launch operations, wood storks in surrounding areas could be startled but this is expected to be a short-term impact.

8.9 Piping Plover

Since no clearing or disturbance to the beach is proposed, impacts to piping plover habitat will not occur. However, during launch operations, any plovers on the beach adjacent to SLC-20 could be startled; this would be expected to be a short-term impact.

8.10 Red Knot

Since no clearing or disturbance to the beach is proposed, impacts to red knot habitat will not occur. However, during launch operations, red knots on the beach adjacent to SLC-20 could be startled; this would be expected to be a short-term impact.

9 CUMULATIVE IMPACTS

Potential cumulative adverse impacts would occur for the Florida scrub-jay and eastern indigo snake when evaluated with other projects occurring or proposed on CCAFS and the potential for additional coastal scrub impacts in the future within the RPA Boundary area. These potential cumulative impacts arise due to the removal of coastal scrub habitat that could support the eastern indigo snake and coastal scrub habitat that could be restored in the future to support additional Florida scrub-jays. Potential cumulative impacts could also occur as a result of additional launches by future tenants, which could negatively affect the CCAFS controlled burn program, thereby slowing Florida scrub-jay habitat restoration efforts.

Cumulative impacts on the gopher tortoise are not expected within the Proposed Action area or the RPA Boundary area. Gopher tortoises observed within any area to be impacted by ground disturbance would be excavated and relocated by an FFWCC-Authorized Agent to an onsite recipient area approved and managed by USAF.

Cumulative impacts on sea turtles have the potential to occur. The new facilities will result in more exterior lighting than is currently present at LC-20. Adherence to the LMP and USAF lighting policies will minimize these impacts. CCAFS- and FFWCC-compliant lighting will be used to minimize potential adverse impacts on nesting turtles and/or their young.

Cumulative impacts on the West Indian manatee, American alligator, American wood stork, piping plover, and red knot are not expected to occur with the Proposed Action as there is no habitat that supports these species in the Proposed Action Boundary area. In addition, cumulative impacts on these species is not expected in the RPA Boundary area due to the lack of habitat to support these species.

10 LIST OF PREPARERS

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APPENDIX E

NMFS Consultation

UNITED STATES DEPARTMENT OF COMMERCE
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AUG 08 2016

Daniel Czelusniak
Environmental Specialist
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Dear Mr. Dankert and Mr. Czelusniak:

This letter responds to your request for consultation with us, the National Marine Fisheries Service (NMFS), pursuant to Section 7 of the Endangered Species Act (ESA) for the following action.

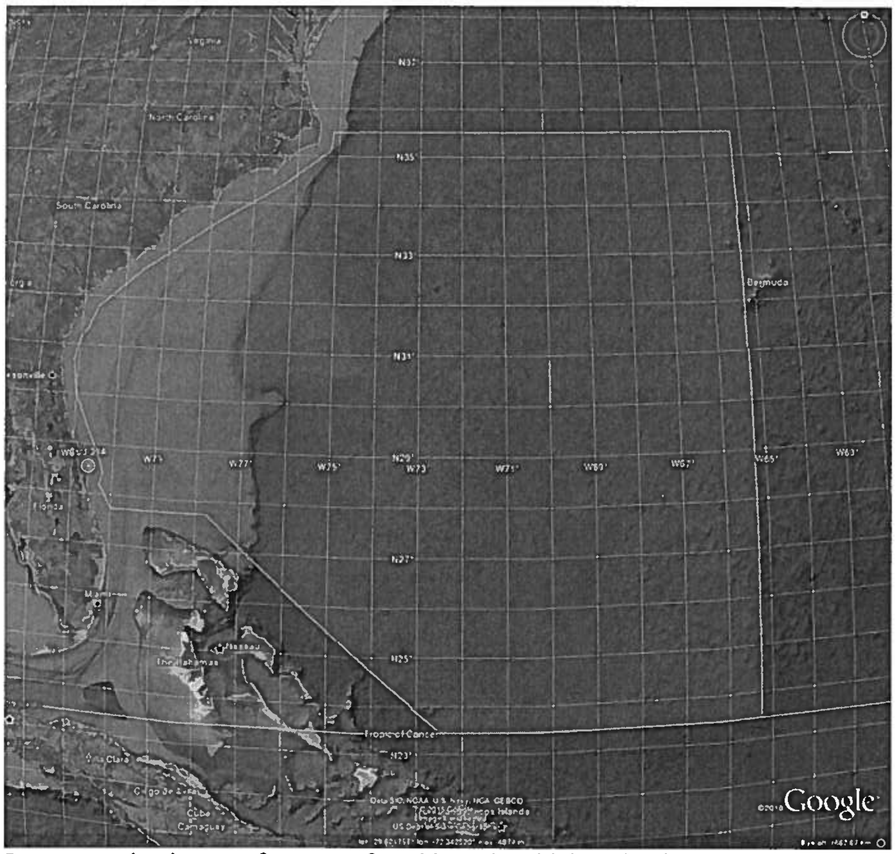
Applicant(s)	**SER Number**	**Project Type(s)**
National Aeronautics and Space Administration (NASA) and Federal Aviation Administration	SER-2016-17894	Waterborne landings of spacecraft

Consultation History

We received your letter requesting consultation on April 11, 2016. We discussed the project with the applicant on May 3, 2016, and requested additional information. During this call, we determined that the project would be expanded from the request to analyze 2 launches with NASA as the lead federal agency to now analyzing all launches occurring from the Kennedy Space Center (KSC), Cape Canaveral Air Force Station (CCAFS), and SpaceX Texas Launch Complex, with the lead federal agency being assigned as NASA, Federal Aviation Administration, or the U.S. Air Force. After exchanging 3 drafts of the project description, we received a final response on July 14, 2016, and initiated consultation that day.

Project Location

Address	Latitude/Longitude	Water body
Kennedy Space Center and Canaveral Air Force Station, Brevard County, Florida	28.608402°N, 80.604201°W (North American Datum 1983) Coordinates provided are for launch pad 39A. Other launch pads at the KSC and CCAFS may be used.	Atlantic Ocean off of Cape Canaveral and Gulf of Mexico
Texas SpaceX Launch Site, 2 miles east of Boca Chica Village, Cameron County, Texas	25.99684°N, 97.15523°W (World Geodetic System 1984)	Gulf of Mexico



Representative image of spacecraft and launch vehicle Atlantic Ocean landing site (Image provided by NASA)

Representative image of spacecraft and launch vehicle Gulf of Mexico landing site (Image provided by NASA)

Existing Site Conditions

The KSC and CCAFS are located on Merritt Island on the northeast coast of Florida. The Texas SpaceX launch site is located on a private site along the east coast of Texas away from the nearby beach. All launch areas are located in upland areas and landing areas are located in open-water within the Atlantic Ocean or Gulf of Mexico, as shown in the images above. The open-water areas for planned landings start a minimum of 5 nautical miles offshore and exclude North Atlantic right whale critical habitat in the Atlantic Ocean.

Project Description

For the purposes of this consultation, the term "spacecraft" will be used to describe modules sent into orbit on the launch vehicle carrying payloads, supplies, or crew. The term "launch vehicle" will be used to describe the rocket and all of its components.

The launch complexes on KSC and CCAFS provide the capability for a variety of vertical and horizontal launch vehicles including, but not limited to, Atlas V, Delta IV, Delta IV Heavy, Liberty, Falcon 9 and 9 v1.1, Falcon Heavy, Antares, RSLV-S, Athena IIc, Xaero, and the Space Launch System to be processed and launched. These launch vehicles and their commercial or government operators are responsible for transporting various spacecraft and payloads into orbit, including reusable manned and unmanned spacecraft such as Orion, Dream Chaser, Boeing CST-100, Liberty Composite Crew Module, and the SpaceX Crew and Cargo Dragon.

The SpaceX Texas launch site provides the capability for operating the Falcon 9 and Falcon Heavy launch vehicles. All Falcon 9 and Falcon Heavy launches would be expected to have payloads including satellites or experimental payloads. Additionally, the Falcon 9 and Falcon Heavy may also carry the SpaceX Dragon spacecraft. Most payloads would be commercial; however, some could be government sponsored launches.

Commercial and government spacecraft launched from KSC, CCAFS and the SpaceX Texas launch complex may result in portions of the spacecraft and/or launch vehicle returning to earth and landing in the Atlantic Ocean or Gulf of Mexico. The launch trajectories are specific to each particular launch vehicle's mission. However, all launches are conducted to the east over the

Atlantic Ocean, similar to past and current launches from KSC and CCAFS. All launch trajectories from the SpaceX Texas launch facility would be to the east over the Gulf of Mexico.

The following is a representative example of a nominal launch, waterborne landing and recovery based on the SpaceX Falcon 9 launch vehicle and the Crew Dragon spacecraft launched from KSC. This scenario is also generally applicable to other launch vehicles and spacecraft launch and recovery operations. It should be noted that currently not all of the above mentioned launch vehicles have a recoverable first or second stage. For example, launch vehicles in the Atlas and Delta family are classified as evolved expendable launch vehicles. These types of launch vehicles destruct upon reentry into the atmosphere and are not recovered. In the unlikely event of a launch failure, pad abort, or assent abort, efforts would be made to attempt to recover any remaining portions of the launch vehicle or spacecraft. Any debris that could not be recovered from the surface would sink to the ocean bottom.

There are several scenarios that could occur due to a launch failure:

- The entire launch vehicle and spacecraft, with onboard propellants, fails on the launch pad and an explosion occurs. The spacecraft may be jettisoned into the nearshore waters.
- The entire launch vehicle and spacecraft, with onboard propellants, is consumed in a destruction action during assent. The launch vehicle is largely consumed in the destruction action and the spacecraft is jettisoned, but residual propellant escapes and vaporizes into an airborne cloud.
- The launch vehicle and spacecraft survive to strike the water intact or partially intact potentially releasing propellants into the surface waters.

The probability of any of these launch failure scenarios is unknown and highly unlikely but could potentially have a short term localized adverse effect on marine life and habitat. To date, NASA has had a 98-99% success rate with launches.

Following the nominal launch of the launch vehicle and following first stage separation the launch vehicle would make a powered decent returning to either a designated landing pad located onshore or a drone ship located approximately 500 miles down range on the Atlantic Ocean east of Cape Canaveral or in the Gulf of Mexico. The manned or unmanned spacecraft, after completion of its mission, would descend into the Atlantic Ocean or Gulf of Mexico either under parachute canopy or propulsive landing. These capsules are relatively small in size, averaging less than 200 square feet (ft^2) in size. The main parachutes may be up to 150 feet (ft) in diameter.

A propulsive landing scenario and parachute landing scenario generally follow the same landing sequence with the main difference being that under a propulsive landing scenario the spacecraft would fire its engines to slow its decent. The spacecraft performs a deorbit burn in orbit and re-enters the atmosphere on a lifting guided trajectory. At high altitudes, the vehicle may perform an "engine burp" in order to test engine health before the propulsive landing. For a propulsive landing, the drogue chutes may be used but the main parachutes will not be deployed. Instead, at an altitude of between approximately 500 and 1,000 meters, the vehicle will light its engines and start to decelerate until ultimately it makes a waterborne landing. In a non-propulsive waterborne landing scenario the main parachutes are deployed at a predesignated altitude and slow the spacecraft to a safe speed prior to entering the water.

Following a successful landing, a contracted vessel will retrieve the parachutes and spacecraft from the water surface. Since the contracted vessel will be in the water to observe the test, recovery of the capsule and parachutes is expected to begin within an hour of the landing. The vessel will either use an overhead crane to load the capsule onto the vessel or tow the capsule back to shore at Port Canaveral or other nearby commercial wharf where it will be offloaded and transported to an inland facility.

A spacecraft reentering the atmosphere for either a propulsive or non-propulsive waterborne landing may contain residual amounts of propellant used to support on-orbit operations, the deorbit burn, entry and attitude control and propulsive landings. Spacecraft are designed to contain residual propellant and it is not expected that there would be a release of any propellants into the water. Once the spacecraft is safely transported back to land the remaining propellants would be offloaded.

In the unlikely event that any propellants are released into the water during a failed launch or a water landing, they would be quickly dispersed and diluted and would not be expected to create any long term effects on habitat or species within proximity to the landing area. According to NASA, spacecraft may carry hypergolic propellants, which are toxic to marine organisms. Specifically, the spacecraft may carry nominal values of monomethylhydrazine fuel and nitrogen tetroxide oxidizer. Propellant storage is designed to retain residual propellant, so any propellant remaining in is not expected to be released into the ocean. Nitrogen tetroxide almost immediately forms nitric and nitrous acid on contact with water, and would be very quickly diluted and buffered by seawater; hence, it would offer negligible potential for harm to marine life. With regard to hydrazine fuels, these highly reactive species quickly oxidize forming amines and amino acids. Prior to oxidation, there is some potential for exposure of marine life to toxic levels, but for a very limited area and time. A half-life of 14 days for hydrazine in water is suggested based on the unacclimated aqueous biodegradation half-life.

Within the overall missions that could potentially have waterborne landings there may be a limited number of pad abort and assent abort testing operations that would involve launching spacecraft on a low altitude non-orbit trajectory resulting in a waterborne landing within 1-20 miles east of the launch site in the coastal waters of the Atlantic Ocean. This type of testing operation would typically involve a non-propulsive landing using both drogue and main parachutes. Recovery operations would be consistent with the description above.

As the space program advances, there is currently a general progression in the development of technology and mission operations to enable both launch vehicles and spacecraft to land on barges at sea and ultimately on land. To that end, the need for open-water landings of routine missions may be phased out in the future. However, it is likely that waterborne landings in the Atlantic Ocean or Gulf of Mexico will be utilized as back-up landing locations to land based landing sites. NASA estimates that approximately 60 open-water landings could occur in the next 10 years including test launches associated with pad abort and ascent abort operations. Open-water landings may occur day or night at any time of year. This consultation address all open-water landings occurring from KSC, CCAFS and the SpaceX Texas Launch Complex result in portions that follow the protective measures defined below.

Construction Conditions

NASA will follow the protective measures listed below:

1) **Education and Observation:** All personnel associated with the project shall be instructed about the presence of species protected under the Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA).
   a) A dedicated observer shall be responsible for monitoring for ESA-species during all in-water activities including transiting marine waters to retrieve space launch equipment. Observers shall survey the area where space equipment landed in the water to determine if any ESA-listed species were injured or killed.
   b) All personnel shall be advised that there are civil and criminal penalties for harming, harassing, or killing ESA listed species or marine mammals.
   c) More information about ESA-listed species is available on our website at: http://sero.nmfs.noaa.gov/protected_resources/section_7/threatened_endangered/index.html

2) **Reporting** of interactions with protected species:
   a) Any collision(s) with and/or injury to any sea turtle, sawfish, or whale, shall be reported immediately to NMFS's Protected Resources Division (PRD) at (1-727-824-5312) or by email to takereport.nmfsser@noaa.gov.
   b) Smalltooth sawfish: Report sightings to 1-941-255-7403 or email Sawfish@MyFWC.com
   c) Sea turtles and marine mammals: Report stranded, injured, or dead animals to 1-877-WHALE HELP (1-877-942-5343).
   d) North Atlantic right whale: Report injured, dead, or entangled right whales to the U.S. Coast Guard via VHF Channel 16.

3) **Vessel Traffic and Construction Equipment**: All vessel operators must watch for and avoid collision with ESA-protected species. Vessel Operators must maintain a safe distance by following these protective measures:
   a) Sea turtles: Maintain a minimum distance of 150 ft.
   b) North Atlantic right whale: Maintain a minimum 1,500 ft (500 yard) distance.
   c) Vessels 65-ft long or more must comply with the Right Whale Ship Strike Reduction Rule (50 CFR 224.105) including reducing speeds to 10 knots or less in Seasonal Management Areas (http://www.fisheries.noaa.gov/pr/shipstrike/).
   d) Mariners shall check various communication media for general information regarding avoiding ship strikes and specific information regarding right whale sightings in the area. These include NOAA weather radio, U.S. Coast Guard NAVTEX broadcasts, and Notices to Mariners.
   e) Marine mammals (i.e., dolphins, whales, and porpoises): Maintain a minimum distance of 300 ft.
   f) When these animals are sighted while the vessel is underway (e.g., bow-riding), attempt to remain parallel to the animal's course. Avoid excessive speed or abrupt changes in direction until they have left the area.

g) Reduce speed to 10 knots or less when mother/calf pairs or groups of marine mammals are observed, when safety permits.

4) **Hazardous Materials Emergency Response**: In the unlikely event of a failed launch or landing, SpaceX would follow the emergency response and cleanup procedures outlined in their Hazardous Material Emergency Response Plan. These procedures may include containing the spill using disposable containment materials and cleaning the area with absorbents or other materials to reduce the magnitude and duration of any impacts. In most launch failure scenarios at least a portion of the fuels will be consumed by the launch, and any remaining fuels will be diluted by seawater and biodegrade over time (timeframes are variable based on environmental conditions).

Effects Determination(s) for Species the Action Agency or NMFS Believes May Be Affected by the Proposed Action

Species	ESA Listing Status	Action Agency Effect Determination	NMFS Effect Determination
Sea Turtles			
Green (North Atlantic and South Atlantic distinct population segment [DPS])	T	NLAA	NLAA
Kemp's ridley	E	NLAA	NLAA
Leatherback	E	NLAA	NLAA
Loggerhead (Northwest Atlantic Ocean DPS)	T	NLAA	NLAA
Hawksbill	E	NLAA	NLAA
Fish			
Smalltooth sawfish (U.S. DPS)	E	NLAA	NLAA
Gulf sturgeon (Atlantic sturgeon, Gulf subspecies)	T	NLAA	NLAA
Shortnose sturgeon	E	NLAA	NLAA
Atlantic sturgeon (Carolina DPS)	E	NLAA	NLAA
Atlantic sturgeon (South Atlantic DPS)	E	NLAA	NLAA
Marine Mammals			
North Atlantic right whale	E	NLAA	NLAA
Blue whale	E	ND	NLAA
Fin whale	E	ND	NLAA
Humpback whale	E	ND	NLAA
Sei whale	E	ND	NLAA
Sperm whale	E	ND	NLAA
E = endangered; T = threatened; NLAA = may affect, not likely to adversely affect; ND = no determination			

Critical Habitat

North Atlantic right whale critical habitat

NASA planned landings are proposed to occur outside of North Atlantic right whale critical habitat. In the unlikely event that a launch failure occurred in nearshore waters near Cape Canaveral, it could occur in North Atlantic right whale critical habitat. The following essential features are present in Unit 2:

- Sea surface conditions associated with Force 4 or less on the Beaufort Scale
- Sea surface temperatures of 7°C to 17°C
- Water depths of 6 to 28 m, where these features simultaneously co-occur over contiguous areas of at least 231 square nautical miles of ocean waters during the months of November through April. When these features are available, they are selected by right whale cows and calves in dynamic combinations that are suitable for calving, nursing, and rearing, and which vary, within the ranges specified, depending on factors such as weather and age of the calves.

We do not believe any of the essential features may be affected by the proposed action.

Loggerhead sea turtle critical habitat

The in-water landing sites are located within the boundary of loggerhead sea turtle critical habitat. The following primary constituent elements (PCEs) are present in the Atlantic Ocean and Gulf of Mexico landing areas that include Units Logg-N-1 to Logg-N-19 plus Logg-S-1 and Logg-S-2. Since the open-water landing areas begin 5 nautical miles offshore, nearshore reproductive habitat is not considered within the planned landing areas. In the unlikely event that a launch failure occurred in nearshore waters near Cape Canaveral, it could occur in loggerhead nearshore reproductive critical habitat.

- Nearshore reproductive habitat: The physical or biological features of nearshore reproductive habitat as a portion of the nearshore waters adjacent to nesting beaches that are used by hatchlings to egress to the open-water environment as well as by nesting females to transit between beach and open water during the nesting season. The following primary constituent elements support this habitat: (i) Nearshore waters directly off the highest density nesting beaches and their adjacent beaches, as identified in 50 CFR 17.95(c), to 1.6 kilometers offshore; (ii) Waters sufficiently free of obstructions or artificial lighting to allow transit through the surf zone and outward toward open water; and (iii) Waters with minimal manmade structures that could promote predators (i.e., nearshore predator concentration caused by submerged and emergent offshore structures), disrupt wave patterns necessary for orientation, and/or create excessive longshore currents.
- Breeding areas: the physical or biological features of concentrated breeding habitat as those sites with high densities of both male and female adult individuals during the breeding season. Primary constituent elements that support this habitat are the following: (i) High densities of reproductive male and female loggerheads; (ii) Proximity to primary Florida migratory corridor; and (iii) Proximity to Florida nesting grounds.
- Constricted migratory habitat: the physical or biological features of constricted migratory habitat as high use migratory corridors that are constricted (limited in width) by land on one side and the edge of the continental shelf and Gulf Stream on the other side. Primary

constituent elements that support this habitat are the following: (i) Constricted continental shelf area relative to nearby continental shelf waters that concentrate migratory pathways; and (ii) Passage conditions to allow for migration to and from nesting, breeding, and/or foraging areas.

- Sargassum habitat: the physical or biological features of loggerhead *Sargassum* habitat as developmental and foraging habitat for young loggerheads where surface waters form accumulations of floating material, especially *Sargassum*. Primary constituent elements that support this habitat are the following: (i) Convergence zones, surface-water downwelling areas, the margins of major boundary currents (Gulf Stream), and other locations where there are concentrated components of the *Sargassum* community in water temperatures suitable for the optimal growth of *Sargassum* and inhabitance of loggerheads; (ii) *Sargassum* in concentrations that support adequate prey abundance and cover; (iii) Available prey and other material associated with *Sargassum* habitat including, but not limited to, plants and cyanobacteria and animals native to the *Sargassum* community such as hydroids and copepods; and (iv) Sufficient water depth and proximity to available currents to ensure offshore transport (out of the surf zone), and foraging and cover requirements by *Sargassum* for post-hatchling loggerheads, i.e., >10 m depth.
- Winter habitat: the physical or biological features of loggerhead winter habitat are warm water habitat south of Cape Hatteras near the western edge of the Gulf Stream used by a high concentration of juveniles and adults during the winter months. Primary constituent elements that support this habitat are the following: (i) Water temperatures above 10° C from November through April; (ii) Continental shelf waters in proximity to the western boundary of the Gulf Stream; and (iii) Water depths between 20 and 100 m.

We do not believe any of the PCEs may be affected by the proposed action.

Analysis of Potential Routes of Effects to Species

Sea turtles, smalltooth sawfish, sturgeon, whales may be affected by open-water landings if they were to be struck by falling materials, spacecraft, or controlled burn water landings. Due to the relative small size of capsules (less than 200 ft^2), NMFS believes that is highly unlikely that protected species will be struck and that the effects are discountable. Smalltooth sawfish and sturgeon are bottom dwelling and unlikely to interact with these items at the surface. Sea turtles and whales spend time at the surface to breath and are thus are at a higher risk of interacting with spacecraft. However, turtles and whales spend the majority of their time submerged as opposed to on the surface, thus lowering the risk of interactions. These launches have been occurring for decades with no known interactions with sea turtles or whales. Also, launches occur intermittently (occurring approximately every few months) and the goal is to ultimately reduce and eliminate the need for open-water landings.

Sea turtles and whales could also become entangled in the parachutes that will transport the capsule to the water surface. However, we believe that these species will avoid the area immediately following a landing and that all materials will be retrieved quickly (approximately 1 hour). Therefore, we believe the risk of entanglement is discountable.

Sea turtles, smalltooth sawfish, sturgeon, and whales could be affected by any hazardous materials spilled into the Atlantic Ocean or Gulf of Mexico during the proposed action.

However, such an effect is highly unlikely (98-99% success rate), failed missions do not necessarily occur over marine waters, and most if not all fuel would be consumed or contained. For planned marine landings, all fuel valves will shut automatically prior to landing to retain any residual fuels. Therefore, although a small fuel spill is possible, it is highly unlikely and any risk to protected species is discountable.

Conclusion

Because all potential project effects to listed species and critical habitat were found to be discountable, insignificant, or beneficial, we conclude that the proposed action is not likely to adversely affect listed species and critical habitat under NMFS's purview. This concludes your consultation responsibilities under the ESA for species under NMFS's purview. Consultation must be reinitiated if a take occurs or new information reveals effects of the action not previously considered, or if the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat in a manner or to an extent not previously considered, or if a new species is listed or critical habitat designated that may be affected by the identified action. NMFS's findings on the project's potential effects are based on the project description in this response. Any changes to the proposed action may negate the findings of this consultation and may require reinitiation of consultation with NMFS.

We have enclosed additional relevant information for your review. We look forward to further cooperation with you on other projects to ensure the conservation of our threatened and endangered marine species and designated critical habitat. If you have any questions on this consultation, please contact Nicole Bonine, Consultation Biologist, at (727) 824-5336, or by email at Nicole.Bonine@noaa.gov.

Sincerely,

for

Roy E. Crabtree, Ph.D.
Regional Administrator

Enc.: 1. *Sea Turtle and Smalltooth Sawfish Construction Conditions* (Revised March 23, 2006)
2. *PCTS Access and Additional Considerations for ESA Section 7 Consultations* (Revised March 10, 2015)

File: 1514-22.V

SEA TURTLE AND SMALLTOOTH SAWFISH CONSTRUCTION CONDITIONS

The permittee shall comply with the following protected species construction conditions:

a. The permittee shall instruct all personnel associated with the project of the potential presence of these species and the need to avoid collisions with sea turtles and smalltooth sawfish. All construction personnel are responsible for observing water-related activities for the presence of these species.

b. The permittee shall advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing sea turtles or smalltooth sawfish, which are protected under the Endangered Species Act of 1973.

c. Siltation barriers shall be made of material in which a sea turtle or smalltooth sawfish cannot become entangled, be properly secured, and be regularly monitored to avoid protected species entrapment. Barriers may not block sea turtle or smalltooth sawfish entry to or exit from designated critical habitat without prior agreement from the National Marine Fisheries Service's Protected Resources Division, St. Petersburg, Florida.

d. All vessels associated with the construction project shall operate at "no wake/idle" speeds at all times while in the construction area and while in water depths where the draft of the vessel provides less than a four-foot clearance from the bottom. All vessels will preferentially follow deep-water routes (e.g., marked channels) whenever possible.

e. If a sea turtle or smalltooth sawfish is seen within 100 yards of the active daily construction/dredging operation or vessel movement, all appropriate precautions shall be implemented to ensure its protection. These precautions shall include cessation of operation of any moving equipment closer than 50 feet of a sea turtle or smalltooth sawfish. Operation of any mechanical construction equipment shall cease immediately if a sea turtle or smalltooth sawfish is seen within a 50-ft radius of the equipment. Activities may not resume until the protected species has departed the project area of its own volition.

f. Any collision with and/or injury to a sea turtle or smalltooth sawfish shall be reported immediately to the National Marine Fisheries Service's Protected Resources Division (727-824-5312) and the local authorized sea turtle stranding/rescue organization.

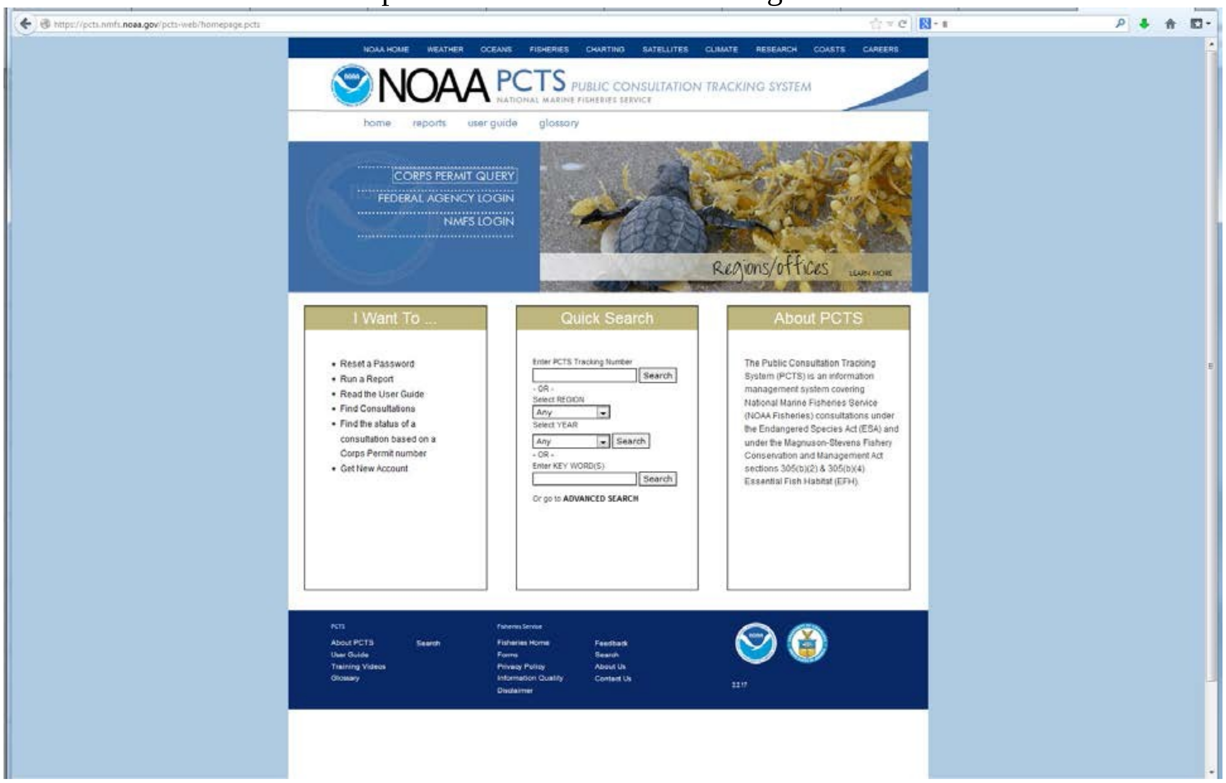
g. Any special construction conditions, required of your specific project, outside these general conditions, if applicable, will be addressed in the primary consultation.

Revised: March 23, 2006

PCTS Access and Additional Considerations for ESA Section 7 Consultations (Revised 03-10-2015)

<u>Public Consultation Tracking System (PCTS) Guidance</u>: PCTS is a Web-based query system at **https://pcts.nmfs.noaa.gov/** that allows all federal agencies (e.g., U.S. Army Corps of Engineers - USACE), project managers, permit applicants, consultants, and the general public to find the current status of NMFS's Endangered Species Act (ESA) and Essential Fish Habitat (EFH) consultations which are being conducted (or have been completed) pursuant to ESA Section 7 and the Magnuson-Stevens Fishery Conservation and Management Act's (MSA) Sections 305(b)2 and 305(b)(4). Basic information including access to documents is available to all.

The PCTS Home Page is shown below. For USACE-permitted projects, the easiest and quickest way to look up a project's status, or review completed ESA/EFH consultations, is to click on either the "Corps Permit Query" link (top left); or, below it, click the "Find the status of a consultation based on the Corps Permit number" link in the golden "I Want To…" window.



Then, from the "Corps District Office" list pick the appropriate USACE district. In the "Corps Permit #" box, type in the 9-digit USACE permit number identifier, with no hyphens or letters. Simply enter the year and the permit number, joined together, using preceding zeros if necessary <u>after</u> the year to obtain the necessary 9-digit (no more, no less) number. For example, the USACE Jacksonville District's issued permit number SAJ-2013-0235 (LP-CMW) must be typed in as 201300235 for PCTS to run a proper search and provide complete and accurate results. For querying permit applications submitted for ESA/EFH consultation by other USACE districts, the procedure is the same. For example, an inquiry on Mobile District's permit MVN201301412 is entered as 201301412 after selecting the Mobile District from the "Corps District Office" list. PCTS questions should be directed to Kelly Shotts at Kelly.Shotts@noaa.gov or (727) 551-5603.

EFH Recommendations: In addition to its protected species/critical habitat consultation requirements with NMFS' Protected Resources Division pursuant to Section 7 of the ESA, prior to proceeding with the proposed action the action agency must also consult with NMFS' Habitat Conservation Division (HCD) pursuant to the MSA requirements for EFH consultation (16 U.S.C. 1855 (b)(2) and 50 CFR 600.905-.930, subpart K). The action agency should also ensure that the applicant understands the ESA and EFH processes; that ESA and EFH consultations are separate, distinct, and guided by different statutes, goals, and time lines for responding to the action agency; and that the action agency will (and the applicant may) receive separate consultation correspondence on NMFS letterhead from HCD regarding their concerns and/or finalizing EFH consultation.

Marine Mammal Protection Act (MMPA) Recommendations: The ESA Section 7 process does not authorize incidental takes of listed or non-listed marine mammals. If such takes may occur an incidental take authorization under MMPA Section 101 (a)(5) is necessary. Please contact NMFS' Permits, Conservation, and Education Division at (301) 713-2322 for more information regarding MMPA permitting procedures.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
http://sero.nmfs.noaa.gov

Nov, 21, 2018 F/SER31:DMB
SER-2018-19649

Daniel Czelusniak
Environmental Specialist
Federal Aviation Administration
800 Independence Avenue Southwest
Suite 325
Washington, DC 20591

Dear Mr. Czelusniak:

This letter responds to your request for re-initiation of consultation with us, the National Marine Fisheries Service (NMFS), pursuant to Section 7 of the Endangered Species Act (ESA) for the following action.

Applicant(s)	**SER Number**	**Project Type(s)**
Federal Aviation Administration (FAA), National Aeronautics and space Administration (NASA), and the U.S. Air Force (USAF)	SER-2018-19649	Waterborne landings of spacecraft

Consultation History

We completed consultation on the proposed action on August 8, 2016 (Public Consultation Tracking System [PCTS] identifier number SER-2016-17894). In that consultation, we determined the proposed action was not likely to adversely affect (NLAA) green sea turtle (North Atlantic and South Atlantic distinct population segments [DPSs]), Kemp's ridley sea turtle, leatherback sea turtle, loggerhead sea turtle (Northwest Atlantic DPS), loggerhead sea turtle designated critical habitat (Units LOGG-N-1 through LOGG-N-19, LOGG-S-1, and LOGG-S-2), hawksbill sea turtle, smalltooth sawfish (U.S. DPS), Gulf sturgeon, shortnose sturgeon, Atlantic sturgeon (Carolina and South Atlantic DPSs), North Atlantic right whale, North Atlantic right whale designated critical habitat (Unit 2), blue whale, fin whale, humpback whale, sei whale, and sperm whale.

On October 19, 2018, we received your letter requesting re-initiation of consultation due to our recent listing of the giant manta ray and the oceanic whitetip shark as threatened under the ESA (83 FR 2916 and 83 FR 4153, respectively). We re-initiated consultation on October 19, 2018.

Project Location

Address	Latitude/Longitude*	Water body
Kennedy Space Center (KSC) and Cape Canaveral Air Force Station (CCAFS) , Brevard County, Florida	28.608402ºN, 80.604201ºW (North American Datum 1983) Coordinates provided are for launch pad 39A. Other launch pads at the KSC and CCAFS may be used.	Atlantic Ocean
Texas SpaceX Launch Site, 2 miles east of Boca Chica Village, Cameron County, Texas	25.99684°N, 97.15523°W (World Geodetic System 1984)	Gulf of Mexico

All launch areas are located in upland areas and landing areas are located in open-water within the Atlantic Ocean or Gulf of Mexico, as shown in Figures 1 and 2 below. The open-water areas for planned landings start a minimum of 5 nautical miles offshore and exclude North Atlantic right whale critical habitat in the Atlantic Ocean.

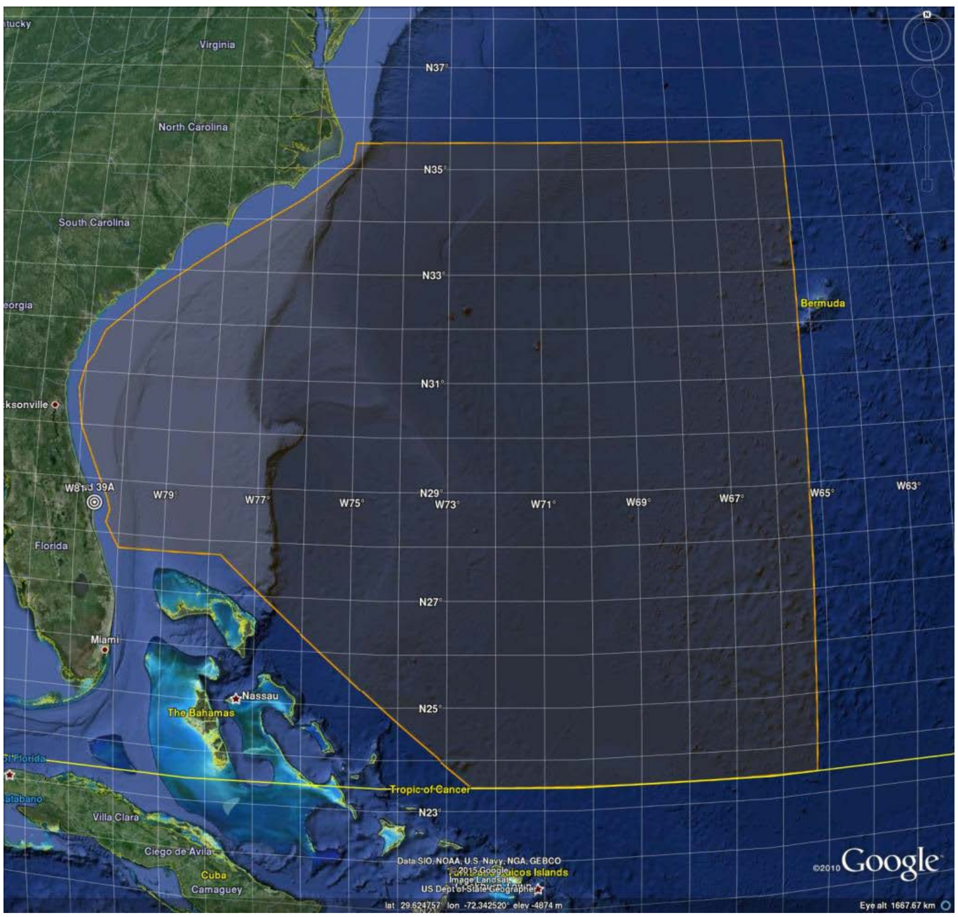


Figure 1. Representative image of action area in the Atlantic Ocean (Image provided by NASA)

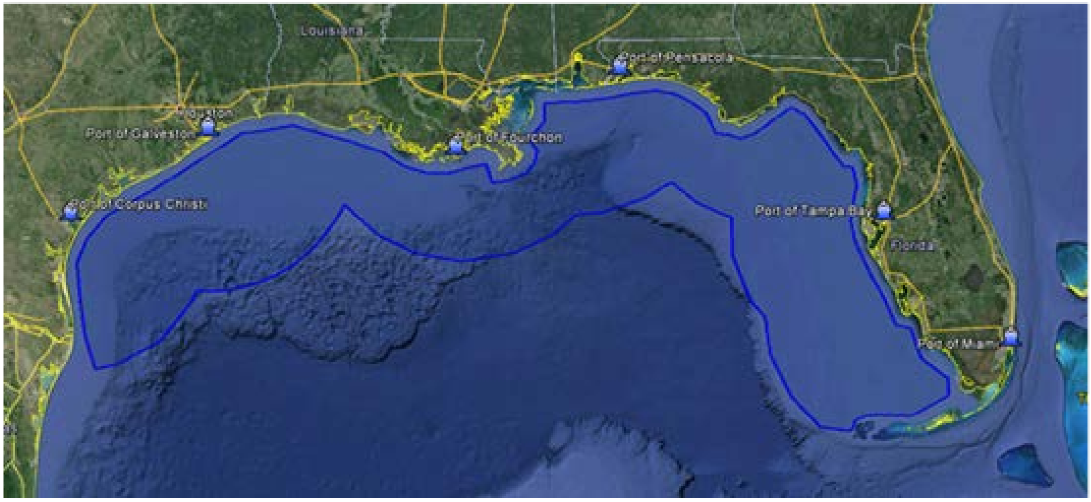


Figure 2. Representative image of action area in the Gulf of Mexico (Image provided by NASA)

Existing Site Conditions
Please refer to PCTS identifier number SER-2016-17894 for existing site conditions. The applicants have not identified any changes to the existing site conditions.

Project Description
Please refer to PCTS identifier number SER-2016-17894 for the existing project description. The applicants are not proposing any changes to the existing project description.

Construction Conditions
Please refer to PCTS identifier number SER-2016-17894 for construction conditions, including Education and Observation, Reporting, Vessel Traffic and Construction Equipment, and Hazardous Materials Emergency Response. The applicants are not proposing any changes to the existing construction conditions.

Effects Determination(s) for Species the Action Agency or NMFS Believes May Be Affected by the Proposed Action

Species	ESA Listing Status	Action Agency Effect Determination	NMFS Effect Determination
Fish			
Scalloped hammerhead shark (Central Atlantic [CA] and Southwest Atlantic [SWA] DPS)	T	--	NLAA
Giant manta ray	T	NLAA	NLAA
Oceanic whitetip shark	T	NLAA	NLAA
Marine Mammals			
Bryde's whale	E (Proposed)	--	NLAA
E = endangered; T = threatened; NLAA = may affect, not likely to adversely affect			

Please refer to PCTS identifier number SER-2016-17894 for the previous effect determinations for species occurring within the action areas. There are no changes to these determinations.

Critical Habitat

The action area is located in North Atlantic right whale critical habitat (Unit 2) and loggerhead sea turtle critical habitat (Units Logg-N-1 through Logg-N-19, Logg-S-1, and Logg-S-2). Please refer to the PCTS identifier number SER-2016-17894 for the previous effect determinations for these critical habitat units.

Because the action area in the Gulf of Mexico starts a minimum of 5 nautical miles offshore, the project is also located within the boundary of Gulf sturgeon critical habitat (Unit 14 – Suwannee Sound). The following primary constituent elements (PCEs) are present in Unit 14:

(1) Abundant prey items within estuarine and marine habitats and substrates for juvenile, subadult, and adult life stages;
(2) Water quality, including temperature, salinity, pH, hardness, turbidity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages;
(3) Sediment quality, including texture and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages; and
(4) Safe and unobstructed migratory pathways necessary for passage within and between riverine, estuarine, and marine habitats (e.g., a river unobstructed by any permanent structure, or a dammed river that still allows for passage).

We believe only the water quality PCE of Gulf sturgeon critical habitat (Unit 14 – Suwannee Sound) may be affected by the proposed action.

Analysis of Potential Routes of Effects to Species

Scalloped hammerhead shark, giant manta ray, oceanic whitetip shark, and Bryde's whale may be affected by open-water landings if they were to be struck by falling materials, spacecraft, or controlled burn water landings. We believe that it is highly unlikely that these species will be struck and that the effects are discountable given the relatively small size of capsules (less than 200 ft^2) compared to the open ocean. These launches have been occurring for decades with no known interactions with these species. Further, launches will occur intermittently (approximately every few months) and the goal is to ultimately reduce and eliminate the need for open-water landings.

Scalloped hammerhead shark, giant manta ray, oceanic whitetip shark, and Bryde's whale may become entangled in the parachutes that will transport the capsule to the water surface. However, we believe the risk of entanglement is discountable. Due to their high mobility, these species will likely avoid the area immediately following a landing. Additionally, all materials will be retrieved quickly (approximately 1 hour). As stated previously, the ultimate goal is to reduce the need for open-water landings, thus reducing the need for parachutes.

Scalloped hammerhead shark, giant manta ray, oceanic whitetip shark, and Bryde's whale may be affected by any hazardous materials spilled into the Atlantic Ocean or Gulf of Mexico during the proposed action. For planned marine landings, all fuel valves will shut automatically prior to landing to retain any residual fuels. We believe any effect to these species from a hazardous materials spill is discountable. While a small fuel spill is possible, hazardous material spills are highly unlikely due to the NASA's 98-99% success rate. Further, failed missions do not necessarily occur over marine waters, and most, if not all, fuel would be consumed (e.g., during an explosion) or contained (according to the applicant's Hazardous Material Emergency Response Plan) during a failed mission.

Analysis of Potential Routes of Effect to Critical Habitat

Water quality, including temperature, salinity, pH, hardness, turbidity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages (PCE 2) of Gulf sturgeon critical habitat (Unit 14 – Suwannee Sound) may be affected by any hazardous materials spilled into Gulf of Mexico during the proposed action. We believe the effect to PCE 2 from a hazardous materials spill is discountable. While a small fuel spill is possible, hazardous material spills are highly unlikely due to the NASA's 98-99% success rate. Further, failed missions do not necessarily occur over marine waters, and most, if not all, fuel would be consumed (e.g., during an explosion) or contained (according to the applicant's Hazardous Material Emergency Response Plan) during a failed mission.

Conclusion

Because all potential project effects to listed species and critical habitat were found to be discountable, insignificant, or beneficial, we conclude that the proposed action is not likely to adversely affect listed species and critical habitat under NMFS's purview. This concludes your consultation responsibilities under the ESA for species under NMFS's purview. Consultation must be reinitiated if a take occurs or new information reveals effects of the action not previously considered, or if the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat in a manner or to an extent not previously considered, or if a new species is listed or critical habitat designated that may be affected by the identified action. NMFS's findings on the project's potential effects are based on the project description in this response. Any changes to the proposed action may negate the findings of this consultation and may require reinitiation of consultation with NMFS.

We look forward to further cooperation with you on other projects to ensure the conservation of our threatened and endangered marine species and designated critical habitat. If you have any questions on this consultation, please contact Dana Bethea, Consultation Biologist, at (727) 209-5974, or by email at Dana.Bethea@noaa.gov.

Sincerely,

David Bernhart
Assistant Regional Administrator
for Protected Resources

File: 1514-22.v

APPENDIX F

Cultural Resource Documents

TECHNICAL MEMO

Phase I Cultural Resources Assessment Survey Near Launch Complex 20, Cape Canaveral Air Force Station, Brevard County, Florida

Prepared for:

45th Space Wing

Cape Canaveral Air Force Station

1224 Jupiter Street

Patrick Air Force Base, FL 32925

Prepared by:

University of South Florida Libraries

Digital Heritage and Humanities Center

4202 East Fowler Avenue LIB 122

Tampa, FL 33620

www.lib.usf.edu/dhhc/

Jaime A. Rogers, M.A.
Project Archaeologist

Lori D. Collins, Ph.D.
Co-Principal Investigator

Travis F. Doering, Ph.D.
Co-Principal Investigator

June 2019

INTRODUCTION

The University of South Florida's Digital Heritage and Humanities Center (DHHC) is conducting ongoing cultural resource assessment surveys (CRAS) of multiple land management units (LMUs) along ICBM road on Cape Canaveral Air Force Station (CCAFS). These projects were performed to comply with Section 110(a)(2)(D) of the National Historic Preservation Act (NHPA). The current technical memo describes our methods and results within LMUs 15 and 18, north and south of Launch Complex 20 (LC-20), respectively (**Figure 1**). LMUs 15 and 18 are part of different ongoing DHHC projects. LMU 15 is under the LMU 13-17 project, which fieldwork is completed for and report writing is underway. LMU 18 is under the ICBM project, which fieldwork is currently underway. Shovel testing is complete in both LMUs.

METHODS

Because this was a Section 110 project, our survey method focused on testing a site probability model created in ArcGIS Pro, rather than overlying an arbitrary shovel test grid on an Area of Potential Effect (APE) as is more common with Section 106 projects. The suitability model generated zones of high, medium, and low site probability, which were tested at 25m, 50m, and 100m intervals, respectively. Several Basic Information Guides (BIGs) from the 50s, 60s, 70s, 90s, and 00s were georeferenced and compared with field findings. Additionally, 2019 FMSF GIS data and previous surveys were reviewed.

RESULTS

A total of 119 shovel tests were excavated within LMU 15. All were negative for cultural material (**Figure 2**). Of the 119 shovel tests, 47 were noted as being disturbed or possibly disturbed. Soil drainage was also recorded, 76 were noted as being well-drained, 30 were medium, and 13 were poorly drained. The poorly drained shovel tests were concentrated in the northeast portion of the LMU.

Generally speaking, the majority of profiles in the south and central areas showed evidence of disturbance. Fill was often observed on the surface in these areas. The shovel tests along the dune ridges, while elevated, showed no evidence of cultural material. Those to the west were not disturbed but were also sterile and within very dense vegetation. The central portion of this LMU had very dense vegetation, but given the low elevation and disturbed surroundings, we do not think there is much probability of encountering sites within the untested area. Clay inclusions or sandy clay strata were noted in a few shovel tests, but there is no spatial pattern between them. Minimal shell inclusions were relatively common throughout most of the LMU. The majority of the tests noted as being disturbed also had small rock inclusions as well. The location of the disturbed tests often aligns with clearings in the historic aerials, although some tests are outside of the apparent disturbance zones.

A total of four Air Force facilities were encountered within LMU 15 (**Figure 3**). Two are identified as a Weather Tower 006 (F. 22101) and associated equipment building (F. 22100) (**Figure 4**). These were constructed in 1990 in the same location as historic structures that served the same function (F. 15523A and F. 15523B). The remnants of the historic facilities were not encountered. Given the year the new weather tower was constructed, the two facilities will not be recorded.

The other two structures are currently unidentified. The first is a small fenced-in area with metal and wood remains (**Figure 5**). When BIGs are georeferenced, the remnants are within 20m of F. 15530, but this facility number designates a contaminated liquids pond. The next closest facility is 90m away and is a Theodolite Building (15521A); however, the structural information provided on the BIGs do not align with the structural remains encountered. It is likely that this facility was short lived during the 80s, given our gap of BIGs during this time. However, there is also a possibility that this structure is pre-Air Force. Regardless, this structure remains unidentified. However, given its small size and deteriorating condition, the DHHC would more than likely recommend the structure ineligible for listing on NRHP.

Lastly, another unidentified structure is present 75m east of Weather Tower 006 (**Figures 6 and 7**). This facility remains unlabeled on BIGs, except for the general area being described as Thrust Block and Valve Pit on the 1966 BIG. Additional maps and documents are currently being reviewed to try and confirm the identity of this structure.

A total of 96 shovel tests were excavated within LMU 18. All were negative for cultural material (**see Figure 2**). Only eight were described as being disturbed. The majority of the disturbed tests are in the southern portion of the LMU boundary. The vast majority of soil was described as being well-drained, some medium-drained, and none were described as being poorly drained. Stratigraphy described in LMU 18 is very similar to those outlined in LMU 15 above.

A total of three Air Force structures were encountered in LMU 18 (**see Figure 3**). In the southern portion of LMU 18, the DHHC encountered a small vented structure with a tunnel attached (**Figure 8**). After a review of an Engineering report done by AMRO (Eley et al. 1962), we have preliminarily identified the structure as an escape tunnel (**Figure 9**). Eley et al. (1962:51) depict a typical launch complex layout. Although their example uses LC-15 and LC-16, the layout for LC-19 should be the same or very similar. **Figure 9** indicates an Air Vent and Escape Tunnel leading northwest from the Blockhouse in the same location as the structure observed by the DHHC. Therefore, the DHHC likely encountered the terminus of the escape tunnel for LC-19 and will be recorded as a structure within the Resource Group associated with LC-19 (8BR216).

The second structure is currently unidentified. It consists of a metal hatched door overlying a few pumps that are currently inundated (**Figure 10**). When georeferenced with BIGs, the closest facilities are storage buildings and an electric substation. We do not currently have a preliminary identification for this structure but considering its size and presumed limited function, we would likely not recommend this eligible for NRHP.

The third structure encountered in LMU 18 is the same type of structure encountered in LMU 15 and has the same location in relation to the respective launch complex (LC-19) (**Figure 11**). Therefore, the structure has been temporarily called a Thrust Block and Valve Pit until a positive identification can be confirmed.

CONCLUSIONS

Fieldwork around LC-20 has been completed, but the identification of Air Force structures within LMUs 15 and 18 is ongoing. In total, five historic structures were encountered. Two are preliminarily identified as Thrust Block and Valve Pit structures associated with LC-19 and LC-20. One is preliminarily identified as an Air Vent and Escape Tunnel associated with LC-19. The remaining two are currently unidentified. The DHHC will continue to review historic maps and documents to try and determine the temporality and function of all of the structures mentioned in this memo. No evidence of prehistoric habitation was encountered in either LMU.

APPENDIX A: FIGURES

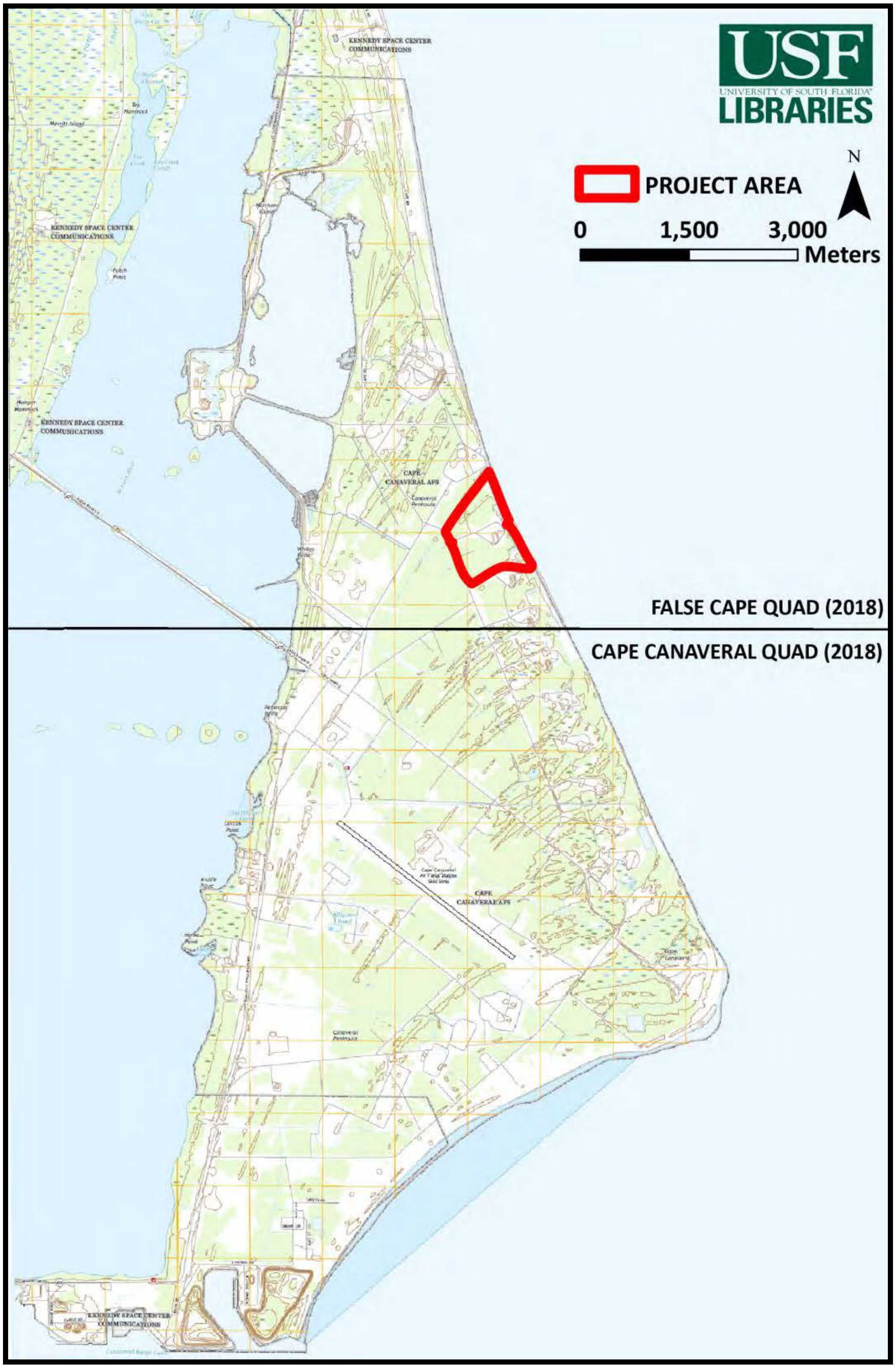


Figure 1. Project area (red) discussed in this memo (LMUs 15 and 18 on CCAFS).

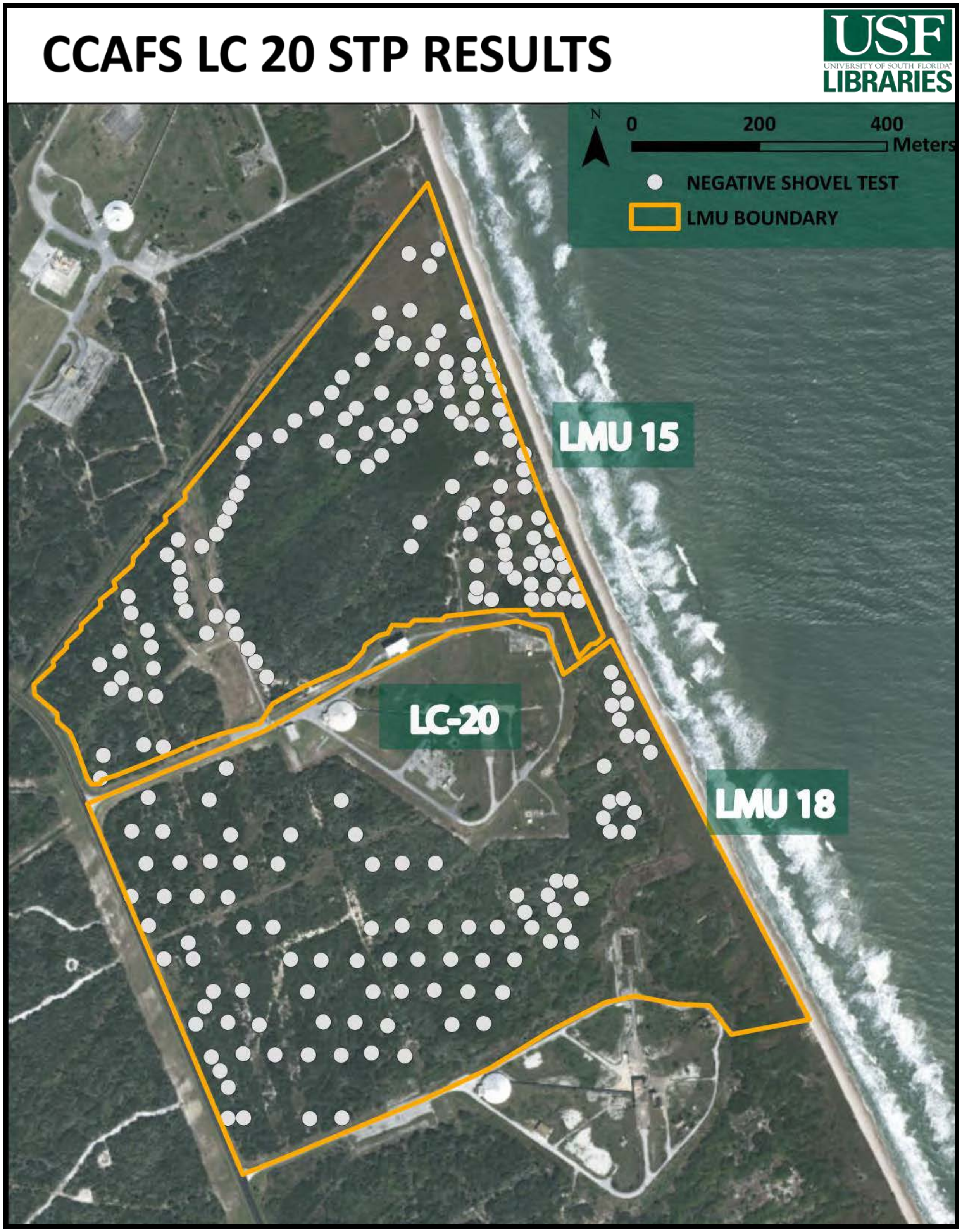


Figure 2. STP results for LMUs 15 and 18.

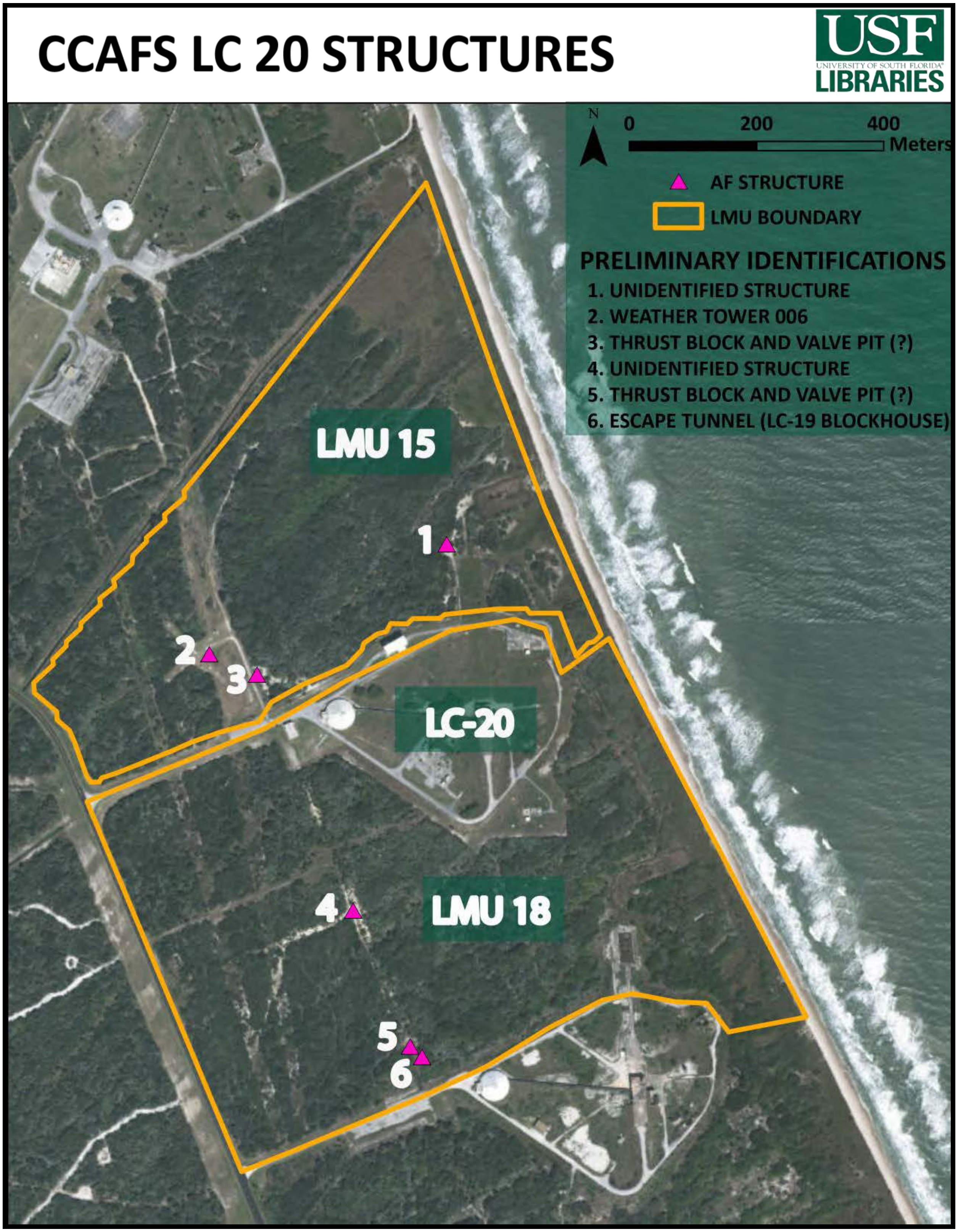


Figure 3. Structures located within LMUs 15 and 18.

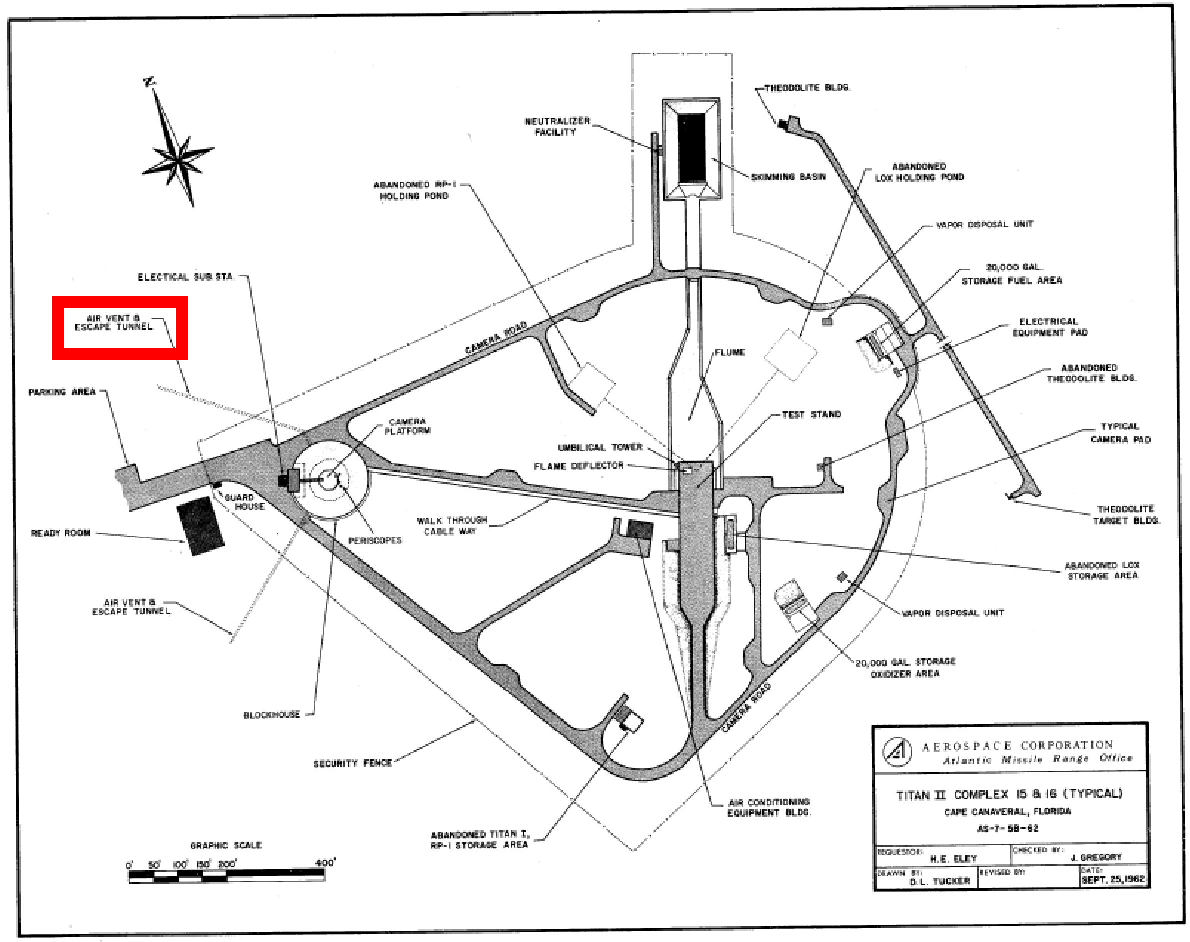
Figure 4. Weather Tower 006 (F. 22101) in the southeast portion of LMU 15 - view facing W.

Figure 5. Unidentified structure (wood and metal remains) in LMU 15 - view facing E.

Figure 6. Backside of structure preliminarily identified as a Thrust Block and Valve Pit – view facing W.

Figure 7. View of water pump on structure preliminarily identified as a Thrust Block and Valve Pit - view facing S.

Figure 8. Vented structure attached to a tunnel located in LMU 18 - view facing S.



II

Figure 9. AMRO Engineering Staff (1962:51) LC 15/16 Plan View. Escape tunnel highlighted in red (Figure II.26).

Figure 10. Unidentified structure in LMU 18.

Figure 11. Similar structure to the one found in LMU 15. Preliminarily identified as a Thrust Block and Valve Pit - view facing N.

WORK CITED

Eley, H. E., T. J. Bryan, Jack L. Gregory, R. L. Thibault, and J. W. Tolbert

1962 The AMRO Handbook Volume VI: Atlantic Missile Range Launch Facilities. Prepared by the AMRO Engineering Staff. Aerospace Corporation. Report No. ATM-63. On File with Pan American World Airways Inc. Master Planning.

FLORIDA DEPARTMENT *of* STATE

RON DESANTIS
Governor

LAUREL M. LEE
Secretary of State

September 12, 2019

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

RE: DHR Project File No.: 2019-5045
Proposed Reuse of Launch Complex 20 (LC-20)
Cape Canaveral Air Force Station, Brevard County, Florida

Mr. Blaylock:

Our office received and reviewed the above referenced project 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*.

A review of our files indicates that this office has previously determined that Facility 18800 - LC-20 Blockhouse (8BR3155 appears to meet the criteria for listing on the *National Register*. However, based on the information provided, this office concurs with your determination that the proposed undertaking will have no adverse effect on the historic character of the blockhouse or other historic resources.

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

FLORIDA DEPARTMENT *of* STATE

RON DESANTIS
Governor

LAUREL M. LEE
Secretary of State

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

June 9, 2020

RE: DHR Project File No.: 2020-3034
Project: SAI# FL202005128941C
Department of Defense – Department of the Air Force
Environmental Assessment for the Reconstitution and Enhancement of Space Launch Complex 20 Multi-User Launch Operations
Cape Canaveral Air Force Station, Brevard County

Mr. Stahl:

The Florida State Historic Preservation Officer reviewed the referenced project for possible effects on historic properties listed, or eligible for listing, on the National Register of Historic Places. The review was conducted in accordance with Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulations in 36 CFR Part 800: Protection of Historic Properties.

We have reviewed Sections 3.4, 4.4 and 5.3.4 of the referenced document which deal with Cultural Resources. The 45th Space Wing Cultural Resources Manager evaluated the areas that would be affected by the Proposed Action, and no historical or cultural resource issues were found within the Proposed Action boundaries or surrounding areas with the exception of Facility 18800 - LC-20 Blockhouse (8BR3155).

The Blockhouse was previously determined by this office to appear to meet the criteria for listing in the *National Register*. The Proposed Action proposes to use the facility as it was originally intended and to maintain the exterior similar to its original construction.

Therefore, based on the information provided, it is the opinion of this office that the document has adequately addressed cultural resources and it is our opinion that proposed undertakings will have no adverse effect on the historic character of the blockhouse or other historic resources.

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,

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

Please note:

The resource identified as **BR03152 (Fac. 15500AD-LH2 Holding Area**) within Thomas Pender's survey report #21667, is now recorded as **BR03157.** BR03152 was already recorded as an archaeological site prior to survey #21667 submission to the Site File. Please see BR03157 for more information on the Fac. 15500AD-LH2 Holding Area.

-CGF 4/22/2015

Ent D (FMSF only)

Survey Log Sheet

Florida Master Site File
Version 4.1 1/07

Survey # (FMSF only) 21667

Consult *Guide to the Survey Log Sheet* for detailed instructions.

Identification and Bibliographic Information

Survey Project (name and project phase) Determination of Eligibility Survey of Launch Complex 20

Report Title (exactly as on title page) Determination of Eligibility for Launch Complex 20 (8BR3272), Cape Canaveral Air Force Station, Brevard County, Florida

Report Authors (as on title page, last names first) 1. Penders, Thomas E. 2. 3. 4.

Publication Date (year) 2015 Total Number of Pages in Report (count text, figures, tables, not site forms) 250

Publication Information (Give series, number in series, publisher and city. For article or chapter, cite page numbers. Use the style of *American Antiquity*.)

Supervisors of Fieldwork (even if same as author) Names Penders, Thomas E.

Affiliation of Fieldworkers: Organization US Air Force City Patrick AFB, Fl.

Key Words/Phrases (Don't use county name, or common words like *archaeology, structure, survey, architecture, etc.*)

1. Military
2. Missiles
3. Launch Complex
4. Cold War
5. ICBMs
6.
7.
8.

Survey Sponsors (corporation, government unit, organization or person directly funding fieldwork)

Name 45th Space Wing Organization US Air Force

Address/Phone/E-mail 1224 Jupiter St., Patrick AFB, Fl 32925/321-853-0886

Recorder of Log Sheet Penders, Thomas E. Date Log Sheet Completed 1-13-2015

Is this survey or project a continuation of a previous project? ☒No ☐Yes: Previous survey #s (FMSF only)

Mapping

Counties (List each one in which field survey was done; attach additional sheet if necessary)

1. Brevard
2.
3.
4.
5.
6.

USGS 1:24,000 Map Names/Year of Latest Revision (attach additional sheet if necessary)

1. Name FALSE CAPE Year 1984
2. Name Year
3. Name Year
4. Name Year
5. Name Year
6. Name Year

Description of Survey Area

Dates for Fieldwork: Start 9-9-2014 End 12-12-2014 Total Area Surveyed (fill in one) ____ hectares 25 acres

Number of Distinct Tracts or Areas Surveyed ____

If Corridor (fill in one for each) Width: ____ meters ____ feet Length: ____ kilometers ____ miles

Research and Field Methods

Types of Survey (check all that apply): ☐archaeological ☒architectural ☒historical/archival ☐underwater ☐damage assessment ☐monitoring report ☐other(describe): ______

Scope/Intensity/Procedures Determination of eligibility survey for inclusion in the NRHP

Preliminary Methods (check as many as apply to the project as a whole)

☒Florida Archives (Gray Building) ☒library research- *local public* ☒local property or tax records ☒other historic maps
☒Florida Photo Archives (Gray Building) ☒library-special collection - *nonlocal* ☒newspaper files ☒soils maps or data
☒Site File property search ☒Public Lands Survey (maps at DEP) ☒literature search ☒windshield survey
☒Site File survey search ☒local informant(s) ☐Sanborn Insurance maps ☒aerial photography
☒other (describe): BIGs, Master Plans, As-builts, ACES data

Archaeological Methods (check as many as apply to the project as a whole)

☒Check here if NO archaeological methods were used.

☐surface collection, controlled ☐shovel test-other screen size ☐block excavation (at least 2x2 m)
☐surface collection, uncontrolled ☐water screen ☐soil resistivity
☐shovel test-1/4"screen ☐posthole tests ☐magnetometer
☐shovel test-1/8" screen ☐auger tests ☐side scan sonar
☐shovel test 1/16"screen ☐coring ☐pedestrian survey
☐shovel test-unscreened ☐test excavation (at least 1x2 m) ☐unknown
☐other (describe): ______

Historical/Architectural Methods (check as many as apply to the project as a whole)

☐Check here if NO historical/architectural methods were used.

☐building permits ☐demolition permits ☐neighbor interview ☐subdivision maps
☐commercial permits ☒exposed ground inspected ☐occupant interview ☐tax records
☒interior documentation ☒local property records ☒occupation permits ☐unknown
☒other (describe): BIGs, Master Plans, As-builts, ACES data

Survey Results (cultural resources recorded)

Site Significance Evaluated? ☒Yes ☐No

Count of Previously Recorded Sites 0 **Count of Newly Recorded Sites** 7

Previously Recorded Site #'s with Site File Update Forms (List site #'s without "8". Attach additional pages if necessary.) NA

Newly Recorded Site #'s (Are all originals and not updates? List site #'s without "8". Attach additional pages if necessary.) BR3272(RG), BR3151-3156.

Site Forms Used: ☒Site File Paper Form ☒Site File Electronic Recording Form

*****REQUIRED: ATTACH PLOT OF SURVEY AREA ON PHOTOCOPY OF USGS 1:24,000 MAP(S)*****

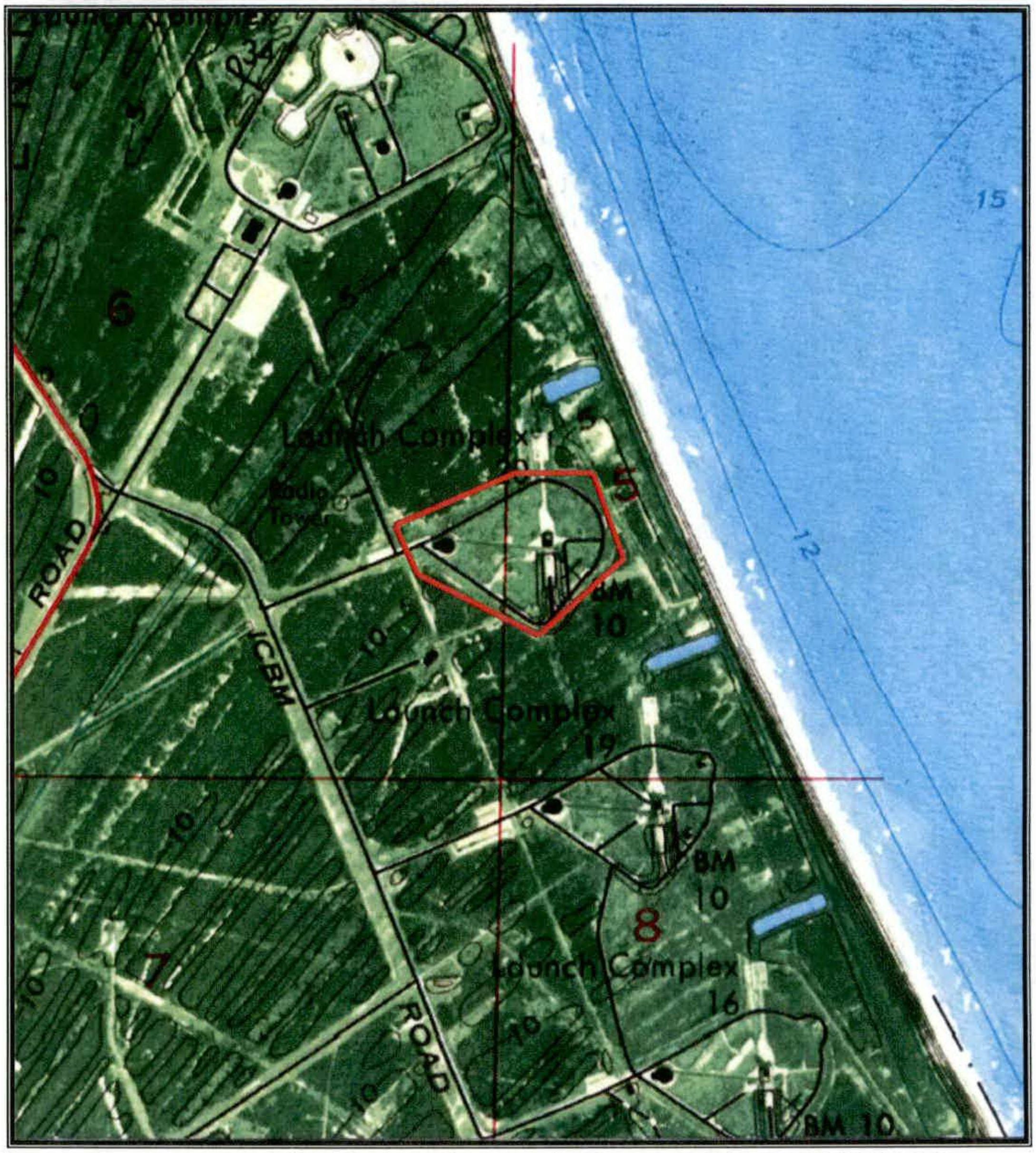
SHPO USE ONLY SHPO USE ONLY SHPO USE ONLY

Origin of Report: ☐872 ☐CARL ☐UW ☐1A32 # ______ ☐Academic ☐Contract ☐Avocational
☐Grant Project # ______ ☒Compliance Review: CRAT # 2015-1183

Type of Document: ☐Archaeological Survey ☐Historical/Architectural Survey ☐Marine Survey ☐Cell Tower CRAS ☐Monitoring Report ☐Overview ☐Excavation Report ☐Multi-Site Excavation Report ☐Structure Detailed Report ☐Library, Hist. or Archival Doc ☐MPS ☐MRA ☐TG ☐Other: ______

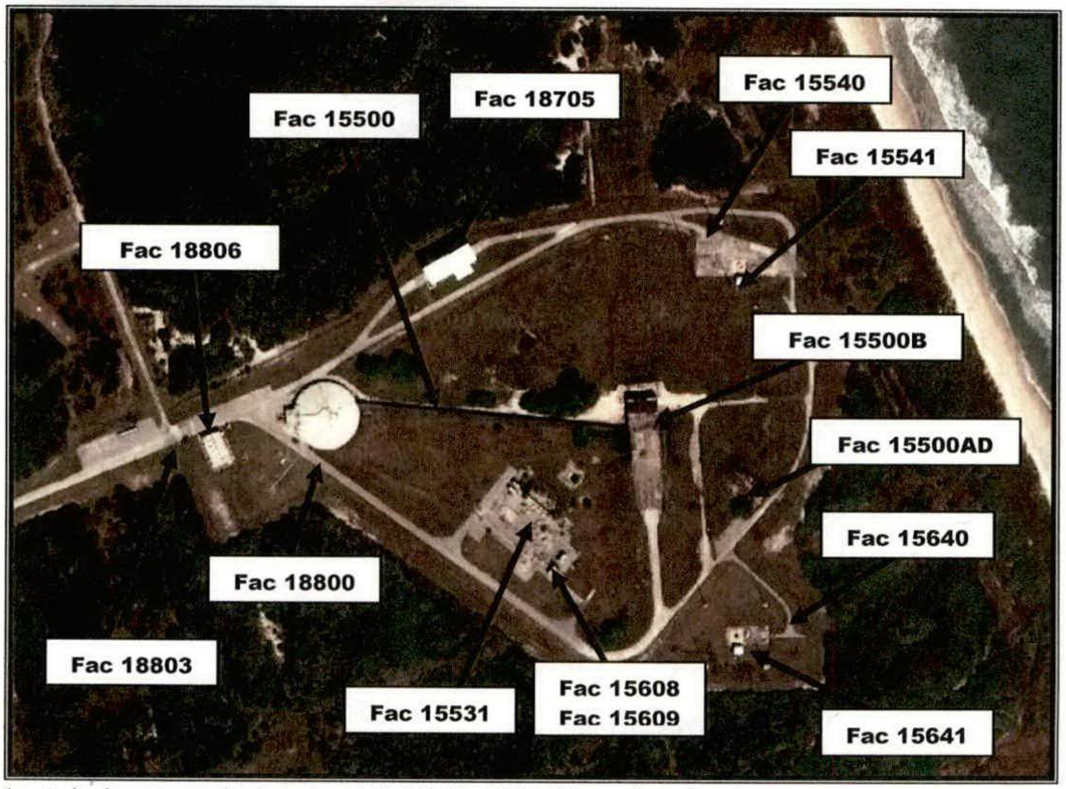
Document Destination: ______ Plotability: ______

#21667



Excerpt from a current USGS map indicating the location of LC-20 (8BR3272).

#21667



Aerial photograph showing LC-20 (8BR3272) and its facilities.

MS#21667

FLORIDA DEPARTMENT of STATE

RICK SCOTT
Governor

KEN DETZNER
Secretary of State

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

April 8, 2015

RE: DHR Project File No.: 2015-1183, Received by DHR: March 9, 2015
Project: *Determination of Eligibility Survey of Launch Complex 20, Cape Canaveral Air Force Station (CCAFS), Brevard County, Florida*

Dear Mr. Blaylock:

Our office received and reviewed the above referenced survey report in accordance with Section 106 and Section 110 of the *National Historic Preservation Act of 1966*, for possible impact to cultural resources (any prehistoric or historic district, site, building, structure, or object) listed, or eligible for listing, in the National Register of Historic Places.

In October and November 2014, the Civil Engineering Squadron/ Installation Management and Environmental Element (CES/CEIE), 45th Space Wing (45 SW) conducted a survey to evaluate the eligibility of Launch Complex 20 and associated resources for listing on the National Register. Based on the information provided, this office concurs with your finding that Launch Complex 20 (LC-20) – Resource Group (BR3272), which includes the Control Cableway (BR3151), LH2 Holding Area (BR3152), Retaining Wall (BR3153), Launch Stand & Ramp (BR3154), Payload Assembly Building (BR3156), Facility 15540 Launch Pad A-BMDO, Facility 15541-Equipment Building, Facility 156-Power Center, Facility 15609-Control Center, Facility 15640-Launch Pad B—BMDO, Facility 15611-Equipment Building, Facility 18705 Warehouse, and Facility 18803-Guard House do not appear to meet the criteria for listing on the National Register. Therefore, these historic properties will not be affected by the proposed reuse of LC-20 or construction of a new launch complex adjacent to LC-20.

However, it is the opinion of this office that the Launch Complex 20 Blockhouse (BR3155) appears to meet the criteria for listing in the National Register under Criterion A for Military and C for Architecture and Engineering. Although identical historic properties have been

#21667

Documented and/or mitigated, blockhouses are very rare and distinctive buildings that are increasingly being demolished.

The reuse of LC-20 or the construction of a new launch complex adjacent to LC-20 may constitute an adverse effect on the blockhouse. However, at this time our office does not have enough information about the proposed undertaking to determine its effect on the blockhouse. Once additional information is available for the proposed undertaking our office will continue the Section 106 review process.

If you have any questions, please contact Jason Aldridge, Historic Sites Specialist, by email at *Jason.Aldridge@dos.myflorida.com*, or by telephone at 850.245.6333 or 800.847.7278.

Sincerely,

Timothy A. Parsons for

Robert F. Bendus, Director
Division of Historical Resources
& State Historic Preservation Officer

2015-1183
106-USAF-PAFB
#21667

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

RECEIVED
BUREAU OF
HISTORIC PRESERVATION
2015 MAR -9 A 10:33

MEMORANDUM FOR STATE HISTORIC PRESERVATION OFFICER
ATTENTION: DR. TIMOTHY PARSONS
HISTORIC PRESERVATION COMPLIANCE REVIEW SECTION
R.A. GRAY BUILDING, 4TH FLOOR
500 SOUTH BRONOUGH STREET
TALLAHASSEE FL 32399-0250

12 January 2015

FROM: 45 CES/CEIE
1224 Jupiter Street, MS-9125
Patrick AFB FL 32925-3343

SUBJECT: Determination of Eligibility Survey of Launch Complex 20, Cape Canaveral Air Force Station (CCAFS), Brevard County Florida.

1. Launch Complex 20 (LC-20) has never been adequately assessed to determine if the complex and the individual facilities within are eligible for listing in the National Register of Historic Places (NRHP). The Cultural Resources manager (CRM) of the Civil Engineering Squadron/Installation Management and Environmental Element (CES/CEIE), 45th Space Wing (45 SW) conducted a historic properties survey in October and November 2014 to determine if the complex and its individual buildings and structures were eligible for listing in the NRHP. The report is enclosed on the survey is enclosed.

2. Launch Complex 20 (LC-20) consists of 14 facilities, of these a total of four date to its original construction in 1959, two date to the period of use for *Titan-III* launches and the remainder of the date to 1989s or later. The original function of LC-20 was as a R&D facility of the Cold War-era *Titan* ICBM which was a vital component of our nation's missile defense. However, its contribution to the *Titan I* and *III* missile programs was negligible. Most of the Titan I testing was conducted at LC-19 and only four *Titan III* missiles were launched from the complex before the program was moved to LCs 40 and 41. It later played a minor R&D role in short-lived missile programs R&D in the 1990s. Based on the criteria established by Lewis et al. (1995), LC-20 has a minor Cold War relationship as well as a low rating for identifying the base's role within the national Cold War context. It also has minor importance with respect to science, theories or ideas.

3. At this time a proposal has been submitted to the 45 SW to either reuse LC-20 or building a new launch complex adjacent to the west. In either case the proposed undertakings will have a direct impact on the existing launch complex. It is the opinion of the 45 SW that since LC-20 and its facilities are ineligible for listing in the NRHP and the proposed undertakings will have no adverse effect on historic properties.

4. The enclosed package is being submitted in accordance with Section 106 of the National Historic Preservation Act and 36 CFR 800.

#21667

3. Point of contact for this matter is Tom Penders at 321-853-0886, or e-mail, Thomas.Penders@patrick.af.mil.

Michael Blaylock

MICHAEL A. BLAYLOCK
Chief, Environmental Conservation
CCAFS

3 Attachments:
1 Determination of no adverse effect report
1 DVD of supporting documents
1 Set of FMSF forms

DETERMINATION OF ELIGIBILITY FOR LAUNCH COMPLEX 20 (8BR3272), CAPE CANAVERAL AIR FORCE STATION, BREVARD COUNTY, FLORIDA

45th Space Wing, U. S. Air Force
Civil Engineering Squadron/
Installation Management and Environmental Element
(45CES/CEIE)
1224 Jupiter Street
Patrick Air Force Base, Florida 32925

DETERMINATION OF ELIGIBILITY FOR LAUNCH COMPLEX 20 (8BR3272), CAPE CANAVERAL AIR FORCE STATION, BREVARD COUNTY, FLORIDA

Prepared For:

Florida State Historic Preservation Office
R.A. Gray Building, 4th Floor
500 South Bronough Street
Tallahassee, Florida 32399

Prepared By:

45th Space Wing, U. S. Air Force
Civil Engineering Squadron/
Installation Management and Environmental Element
(45CES/CEIE)
1224 Jupiter Street
Patrick Air Force Base, Florida 32925

Thomas E. Penders
Archaeologist/Cultural Resources Manager

January 2015

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ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Definition
AC	Acre
AFB	Air Force Base
AFETR	Air Force Eastern Test Range
AFMTC	Air Force Missile Test Center
AFSC	Air Force Systems Command
AFS&MM	Air Force Space and Missile Museum
AMOS	Air Force Maui Optical Station
AST	Above Ground Storage Tank
ASTM	American Society of Testing and Materials
BAR	Bureau of Archaeological Research
BIG	Basic Information Guide
BMCO	Ballistic Missile Construction Office
BMDO	Ballistic Missile Development Office
BR	Brevard County
BRNAS	Banana River Naval Air Station
CA	Circa
CCAFS	Cape Canaveral Air Force Station
CE	Contributing Element
CERL	Construction Engineering Research Laboratory
CES/CEIE	Civil Engineering Squadron/Installation Management and Environmental Element
CFR	Code of Federal Regulations
CIA	Central Intelligence Agency
CM	Centimeter(s)
CRM	Cultural Resources Manager
CX	Complex
E	East, Eligible
ENG	Engineering
ETR	Eastern Test Range
FAC	Facility

ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Definition
FDEP	Florida Department of Environmental Protection
FDHR	Florida Division of Historical Resources
FDOT	Florida Department of Transportation
FMSF	Florida Master Site File
FS	Florida Statute, Field Specimen
FT	Foot, Feet
FY	Fiscal Year
HA	Hectare
HABS	Historic American Buildings Survey
HAER	Historic American Engineering Record
ICBM	Intercontinental Ballistic Missile
ICRMP	Integrated Cultural Resource Management Plan
IN	Inch(es)
INF	Intermediate Nuclear Force
IOMS	Infrastructure Operations and Maintenance Services
IRBM	Intermediate Range Ballistic Missile
JCWS	Johnson Controls World Services
JDMTA	Jonathan Dickinson Missile Tracking Annex
JLRPG	Joint Long Range Proving Ground
KG	Kilograms
KM	Kilometer(s)
KSC	Kennedy Space Center
KT	Kiloton
LBS	Pounds
LC	Launch Complex
LH2	Liquid Hydrogen
LOX	Liquid Oxygen
LRPG	Long Range Proving Ground
LV	Launch Vehicle
M	Meter(s)

ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Definition
MAD	Mutual Assured Destruction
MCC	Mission Control Center
MI	Mile(s)
MM	Millimeters
MOB	Manned Orbiting Laboratory
MSL	Missile
MST	Mobile Service Tower
MT	Megaton
MTA	Malabar Tracking Annex
N	North
NAS	Naval Air Station
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NCE	Non-contributing Element
NE	Northeast
NHL	National Historic Landmark
NM	Nautical Mile
NPS	National Park Service
NRHP	National Register of Historic Places
NW	Northwest
OSC	Orbital Sciences Corporation
PAB	Payload Assembly Building
PAFB	Patrick Air Force Base
PANAM	Pan American Airways
R&D	Research and Development
RAI	Resource Analysts, Inc.
RD	Road
RSCH	Research
SDC	Space Data Corporation
SDIO	Strategic Defense Initiative Office

ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Definition
SE	Southeast
SGS	Space Gateway Support
SR	State Road
SSP	Strategic Systems Program
START	Strategic Arms Reduction Treaty
SW	Southwest
SWAT	Short Wave Adaptive Technology
T	Ton
TFE	Tracking Field Experiments
TNT	Trinitrotoluene
USACE	United States Army Corp of Engineers
USAF	United States Air Force
USASDC	United States Army Strategic Defense Command
USDA	United States Department of Agriculture
USDI	United States Department
USGS	United States Geological Survey
USSR	Union of Soviet Socialist Republics
UVPI	Ultraviolet Plume Instrument
VLF	Vertical Launch Facility

EXECUTIVE SUMMARY

Launch Complex 20 (LC-20) has never been adequately assessed to determine if the complex and the individual facilities within are eligible for listing in the National Register of Historic Places (NRHP). The Cultural Resources manager (CRM) of the Civil Engineering Squadron/Installation Management and Environmental Element (CES/CEIE), 45th Space Wing (45 SW) conducted a historic properties survey in October and November 2014 to determine if the complex and its individual buildings and structures were eligible for listing in the NRHP.

Launch Complex 20 (LC-20) consists of 14 facilities, of these a total of four date to its original construction in 1959, two date to the period of use for *Titan-III* launches and the remainder of the date to 1989s or later. The original function of LC-20 was as a R&D facility of the Cold War-era *Titan* ICBM which was a vital component of our nation's missile defense. However, its contribution to the *Titan I* and *III* missile programs was negligible. Most of the Titan I testing was conducted at LC-19 and only four *Titan III* missiles were launched from the complex before the program was moved to LCs 40 and 41. It later played a minor R&D role in short-lived missile programs R&D in the 1990s. Based on the criteria established by Lewis et al. (1995), LC-20 has a minor Cold War relationship as well as a low rating for identifying the base's role within the national Cold War context. It also has minor importance with respect to science, theories or ideas.

Using the NRHP criteria, the Launch Complex 20 Historic District and its components are not eligible due to the lack of integrity and the fact that it played only a minor role in our nation's defense and missile development history. Also, its eligibility is questionable due to its redundant design and characteristics.

DETERMINATION OF ELIGIBILITY FOR LAUNCH COMPLEX 20,
CAPE CANAVERAL AIR FORCE STATION, BREVARD COUNTY, FLORIDA

1.0 INTRODUCTION

1.1 Background

Launch Complex 20 (LC-20) has never been adequately assessed to determine if the complex and the individual facilities within are eligible for listing in the National Register of Historic Places (NRHP). The Cultural Resources manager (CRM) of the Civil Engineering Squadron/Installation Management and Environmental Element (CES/CEIE), 45th Space Wing (45 SW) conducted a historic properties survey in October and November 2014 to determine if the complex and its individual buildings and structures were eligible for listing in the NRHP.

This study utilized methodology that complied with Section 106 of the National Historic Preservation Act of 1966, as amended by Public Law 89-665; the Archaeological and Historic Preservation Act, as amended by Public Law 93-291; Executive Order 11593; and Chapters 267 and 337, Florida Statutes. All work was carried out in conformity with the standards contained in *The Historic Preservation Compliance Review Program of the Florida Department of State, Division of Historical Resources Manual* (Tesar 1990) and *Cultural Resources Management Standards and Operations Manual* (FDHR 2002). The Principal Investigator for this project meets the Secretary of the Interior's *Standards and Guidelines for Archaeology and Historic Preservation* (36 CFR, Part 66, Appendix C).

1.2 Cape Canaveral Air Force Station Location and Description

Cape Canaveral Air Force Station (CCAFS) is located north of the city of Cape Canaveral on the east coast of Florida in Brevard County (Figure 1). Geographically, it is located on the Canaveral Peninsula which is a barrier island approximately 249 kilometers (km) or 155 miles (mi) (south of Jacksonville, 338 km (210 mi) north of Miami, and approximately 96 km (60 mi) east of Orlando.

The northern boundary of CCAFS abuts the Kennedy Space Center (KSC) boundary on the barrier island. The southern boundary abuts Port Canaveral. Cape Canaveral Air Force Station is separated from KSC by the Banana River. The Atlantic Ocean borders CCAFS along its eastern margin. In total the base occupies approximately or 6,394 ha (15,800 ac). It is 7.2 km (4.5 mi)

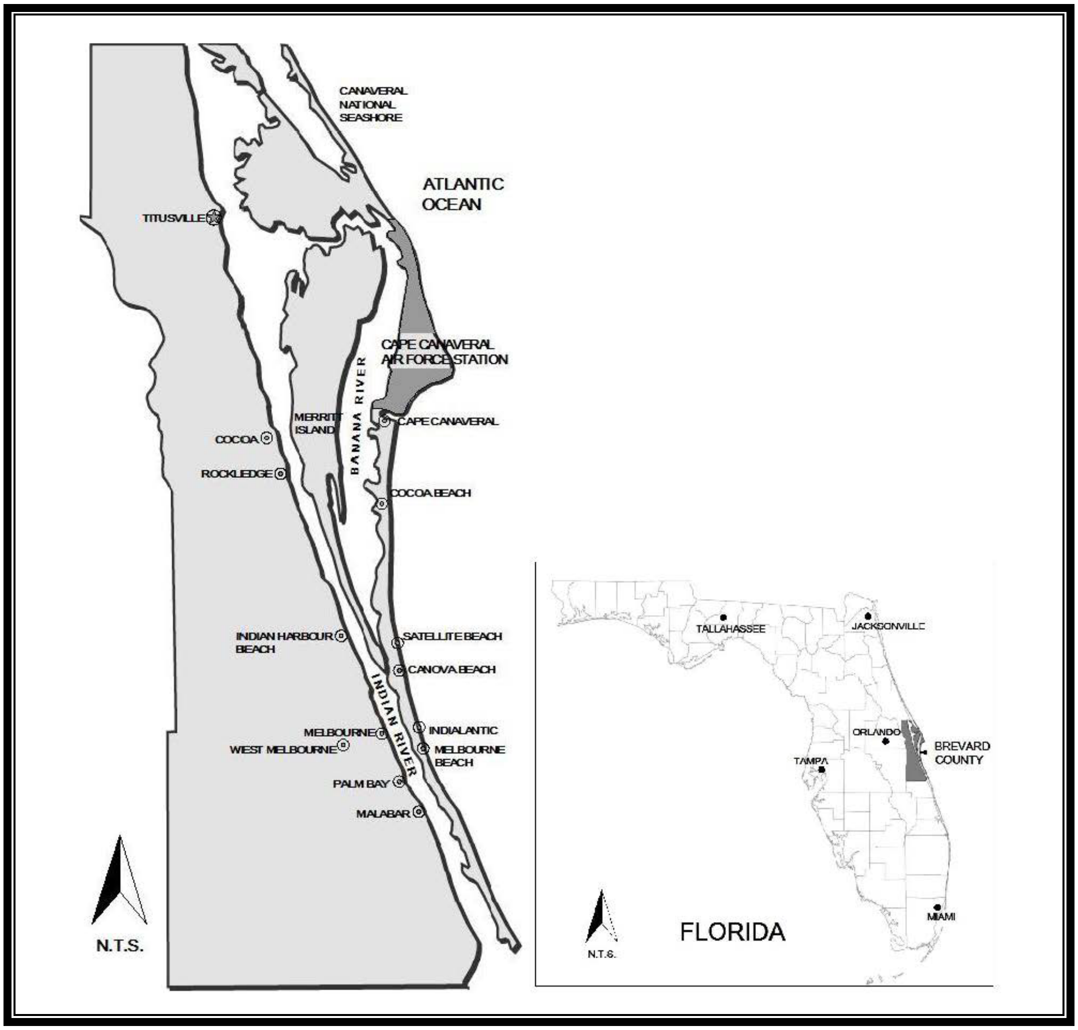

Figure 1. Location of the project area in Brevard County, Florida.

wide at its widest point. Cape Canaveral Air Force Station is accessible primarily from State Road 528 (SR 528) to the south and from KSC which is to the west and north.

There are currently four active and 12 inactive launch pads at 12 launch complexes (LCs) and the 3.05 km (10,000 ft) east to west Skid Strip. Along with the various launch and support facilities, CCAFS maintains a centralized industrial complex to support the technical, mechanical, and administrative needs of each launch program. The industrial complex contains structures that support the LCs and includes warehouse and hangar space used to store critical spares and package payloads, and serves as a base of operations for Civil Engineering, base operations, and command personnel.

1.3 Launch Complex 20 Location and Description

Launch Complex 20 is located within the northeastern portion of CCAFS, off of ICBM Rd

Figure 2. Excerpt from a current USGS map indicating the location of LC-20 (USGS 1984).

(Figure 2). The legal description of the complex is the SW¼ of Section 5 and SE¼ of Section 6 in, Township 23 South, Range 38 East of the United States Geological Survey *False Cape* Quadrangle Map (USGS 1984) (Figure 2).

Launch Complex 20 is surrounded by dense coastal scrub consisting of vegetative cover consisting of dense hardwood and palmetto brush, with cacti common. The project area itself is a complex of several original structures, semi-permanent structures from the 1990s, an old missile on mounting pedestals, and a guard shack surrounded by a double chain link fence. It can be accessed by way of ICBM Rd (Figure 3).

Figure 3. Current aerial photograph indicating the project area and current conditions.

2.0 METHODOLOGY

2.1 Historical Research

A review of the literature was performed as the first step in preparation of the archaeological and historical study. Copies of historical survey reports for Brevard County and the project area were obtained from the Florida Master Site File (FMSF) of the Bureau of Archaeological Research (BAR) in Tallahassee. The reports were reviewed to become familiar with the current state of research for the site area and Brevard County. Archaeological publications for the area were reviewed and literature searches were also conducted at the Tebeau Field Library of Florida History and University of Central Florida for documents and references that may have relevance to the project area. The files of the Brevard County Historical Society, Brevard County Planning Office, Brevard County Property Appraiser's Office, and Tebeau Library of Florida History were reviewed for the parcels and adjoining parcels. This research included land records, maps, genealogical records, historic documents, and aerial photographs of the area. A search was conducted of the Title and Records Section, Florida Department of Environmental Protection (FDEP) for historic records and information from previous surveys conducted in the project area. Additional research included research of the Historic American Building Survey (HABS) and Historic American Engineering Record (HAER) database for historic properties. Other databases used include historical Florida Department of Transportation (FDOT) aerials, historical structures, and topographic maps. The standards set forth in the American Society of Testing and Materials (ASTM) Standard Practice for Phase I Environmental Site Assessments (E-1527-00) were also utilized for this project. This includes a conducting reviewing at least one aerial photograph dating back at least 50 years and in intervals of 10 to 15 years, review of floodplain maps, wetland maps, construction documents, Soil Conservation Service county soil books, interviews, and general public records.

A review was conducted of historical installation maps, photographs, and the Basic Information Guides (BIGs)[1] from 1957 to present on file at the Air Force Space and Missile Museum (AFS&MM). As-built drawings (construction plans) and Real Property cards archived at the base operations contractor's office were reviewed for information on the original use and configuration of the buildings.

2.2 Determination of Eligibility

2.2.1 National Register of Historic Places Eligibility

Following the background research and field survey historic resources within the subject property were evaluated for eligibility to be listed in the NRHP. The application of NRHP criteria was guided by United States Department of Interior (USDI), National Park Service (NPS) publications on the subject (Andrus et al. 1992; Derry et al. 1985; O'Donnell 1998; Potter and Boland 1992; Seifert et al. 1997; Sherfy and Luce 1996; Townsend et al. 1993; USDI 1997). The basic criteria are:

Criterion A: Associated with events that have made a significant contribution to the broad patterns of our history.

Criterion B: Associated with the lives of significant persons in or past.

Criterion C: Embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction.

1. BIGs are manuals that document the construction date, square footage, location, ownership, occupants, and basic use of CCAFS facilities.

Criterion D: Have yielded or may be likely to yield, information important in history or prehistory.

As a rule, resources that have achieved significance within the last 50 years are not eligible for inclusion in the National Register. Fifty years is a general estimate of the time required for some historic perspective on a resource to have developed, and for its significance to be evaluated. This helps to safeguard against listing of resources of fleeting contemporary interest. However, under Criteria Consideration G, resources that have achieved significance within the past 50 years may be listed in the NRHP if they are of "exceptional importance" (Andrus et al. 1992; Derry et al. 1985; O'Donnell 1998; Seifert et al. 1997; Sherfy and Luce 1996; Townsend et al. 1993; USDI 1997, 1998).

Typically resources such as cemeteries, birthplaces, or graves of historical figures, properties used for religious purposes, structures that have been moved from their original locations, reconstructed historic buildings, properties primarily commemorative in nature, and properties that have achieved significance within the past 50 years shall not be considered NRHP eligible. However, these properties can qualify if they are integral parts of districts that do meet the criteria or if they fall within the following categories (Andrus et al. 1992; Derry et al. 1985; O'Donnell 1998; Seifert et al. 1997; Sherfy and Luce 1996; Townsend et al. 1993; USDI 1997):

1. A religious property deriving primary significance from architectural or artistic distinction or historical importance.

2. A building or structure removed from its original location but which is significant primarily for architectural value, or which is the surviving structure most importantly associated with a historic person or event.

3. A birthplace or grave of a historical figure of outstanding importance if there is no appropriate site or building directly associated with his productive life.

4. A cemetery which derives its primary significance from graves or persons of transcendent importance, from age, from distinctive design features, or from association with historic events.

5. A reconstructed building when accurately executed in a suitable environment and

presented in a dignified manner as part of a restoration master plan, and when no other building or structure with the same association has survived.

6. A property primarily commemorative in intent if design, age, tradition, or symbolic value has invested it with its own exceptional significance.

7. A property achieving significance within the past 50 years if it is of exceptional importance.

2.2.2 Cold War Resources Ranking

The 45 SW CRM adapted the methodology developed in 1995 for the assessment of Cold War resources for Air Force Combat Command (Lewis et al. 1995). The priority ranking matrix is an equation developed to determine if a property is NRHP eligible. The equation used by Lewis et al. (1995) was adapted as follows:

1. Relationship of a particular resource to the role the base played in the Cold War. Resources were ranked from highest to lowest based on:

   a. Direct Cold War relationship: through being part of the technological advance important to the base, or through a significant association with an event or important figure.

   b. Indirect Cold War relationship: includes resources that are part of the period that may relay information about local history, construction technology, or local persons of importance.

   c. No direct relationship to the Cold War but are of the period.

   d. Resources that may be important in their own right but are not of the period.

2. Level of importance of a particular property:
   a. Premier: is a property that has major importance in identifying the base's role within the national Cold War context or has a major importance with respect to science.

theories or ideas.

b. High: is a property that has importance to the base's role although not necessarily at the national level.

c. Medium: properties that have limited importance in the individual base Cold War context.

d. Low: does not reflect Cold War or the period.

2.2.3 Man in Space National Historic Landmark Theme Study Criteria

In 1983, RAI conducted an architectural and engineering evaluation of facilities at CCAFS (Barton and Levy 1984). This study became the basis for the joint 1984 USAF and NPS nomination of six launch complexes (LCs 5/6, 13 MST, 14, 19, 26, and 34) and Mission Control Center (MCC) as a NHL district. The study, which became known as the *Man in Space National Historic Landmark Theme Study*, categorized historic resources based on the following themes (Butowsky 1984):

1. Technical Foundations before 1958.
2. The Effort to Land a Man on the Moon.
3. The Exploration of Planets and the Solar System.
4. The Role of Scientific and Communications Satellites.

2.3 Definition of Facility

At CCAFS and PAFB, the term "facility" has historically referred to any area, facility, or structure designated with a number and used for a specific purpose or activity. In order to avoid potential future confusion among USAF personnel who may be reviewing this document and implementing further assessment based on its recommendations, it was decided to continue using the term "facility" in its historical CCAFS/PAFB context, rather than employing a more generic term. For consistency, the term "facility" will be used throughout this document when officially referring to the numbered designation for a structure. Historically, facilities on CCAFS may have been assigned multiple facility numbers over the years. To avoid confusion, duplicate facility numbers were eliminated during the screening process and the most recent facility number was used for reference.

3.0 HISTORICAL CONTEXT

3.1 The Cold War (1946-1991)

The start and end of the Cold War has been debated by historians. Some suggest it began in the 1945-1948 timeframe, and ended in 1989, having been a dispute over the division of Europe. For others, Cold War began in 1917 with the Bolshevik Revolution in Russia, and ended in 1991 with the collapse of the Union of Soviet Socialist Republics (USSR or Soviet Union), having been a conflict between Bolshevism and Democracy. The most widely accepted date for the start of the Cold War was at the end of World War II (1945). For the purposes of this paper it ended with the fall of the USSR in 1991. The term "Cold War" was first used in 1947 by Bernard Baruch, senior advisor to US President Harry Truman, in reference to the frequently occurring crises between the United States and the USSR (Bair 2003; Global Security 2012; Mannino 1999; Mark 2005; Park 1986).

The beginning of the Cold War was marked when much of Europe was devastated by years of warfare during World War II. By the end of World War II approximately 36.5 million Europeans had died in the conflict and millions were homeless. Refugee camps and rationing dominated much Europe. The United States wanting to realize free elections and free trade were committed to helping Europe recover from the war. Communists aided by the USSR were threatening elected governments across Europe. The first few years of the early Cold War (between 1945 and 1948), the conflict was more political than military. This changed in February 1948 when the Communist Party of Czechoslovakia, with covert backing from the USSR, overthrew the government in that country. Then, in reaction to the democratic consolidation of West Germany, the USSR blockaded Allied-controlled West Berlin in a bid to consolidate their hold on the German capital (Bair 2003; Global Security 2012; Mannino 1999; Mark 2005; Park 1986).

During the Cold War, the Soviet leaders' doctrine was to prepare the way for the final triumph of Communism, to assure the military security of the USSR by keeping down the defeated Germany, and by creating in Eastern Europe governments they considered friendly. These countries would also form a buffer between USSR and the west in the event of a war (NATO 2011; Park 1986). The "Iron Curtain", a phrase coined by Winston Churchill in 1946 discussing Soviet domination in Eastern Europe, became a reality in the form of border defenses between

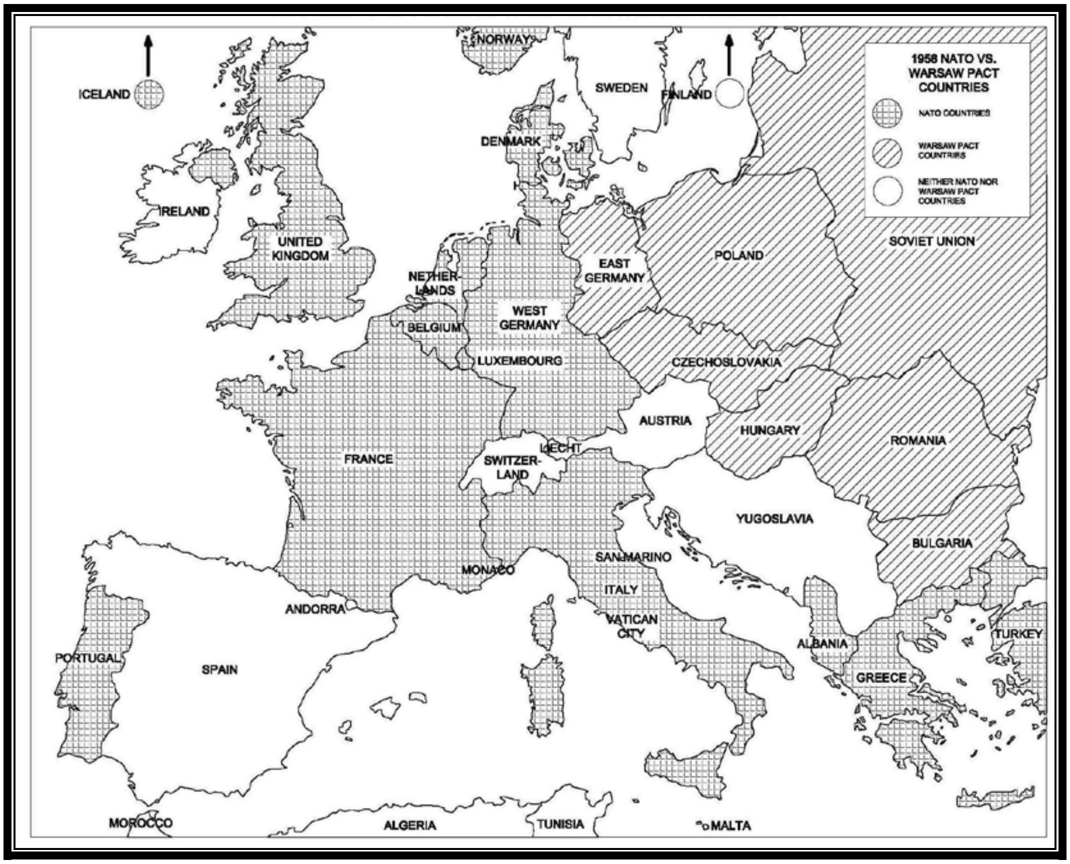

Figure 4. Map of Cold War Europe (from Penders 2012).

the countries of western and eastern Europe. The wall that divided East and West Berlin became the most well-known section of this dividing line. To prevent the consolidation of Europe under the USSR, Washington opposed any spread of Soviet influence into Western Europe, the Middle East, or the Far East. It was during this time that the US joined Canada and the western European countries in the North Atlantic Treaty Organization (NATO) which was founded to deter Soviet expansionism, forbid the revival of nationalist militarism in Europe such as was seen in Germany and Italy during World War II, and encourage European political integration (NATO 2011; Park 1986). By 1952, the Cold War map of east versus west in Europe had been drawn (Figure 4).

In the early years, the forces of the USSR stationed in East Germany could have easily overrun Western Europe by sheer numbers of troops. But as the western allies' strength grew, Soviet offensive action would have required considerable augmentation of their forces stationed in East Germany with reserve formations from within the USSR. It was thought if those forces could be prevented from reaching the front line of any offensive action the odds for stopping a Soviet attack would be less formidable. So the US doctrine during the early years of the Cold War was to use missile and air warfare systems to attack both frontline and rear troops and to destroy rear area (USSR) logistical assets (Bair 2003; Mark 2005; Park 1986). The official nuclear policy became of the United States was one of "massive retaliation", as coined by President Dwight D. Eisenhower's Secretary of State John Foster Dulles, which called for massive attack against the Soviet Union if they were to invade Europe, regardless of whether it was a conventional or a nuclear attack. This later developed into the doctrine of Mutual Assured Destruction (MAD) which assumes that each side has enough nuclear weaponry to destroy the other side; and that either side, if attacked for any reason by the other, would retaliate without fail with equal or greater force resulting in mutual, total and assured destruction. The payoff of the MAD doctrine was expected to be a tense but stable global peace. Except for direct confrontations with the USSR during the Cold War with the Cuban Missile Crisis (1962) and the closest we came to a real war with the USSR during the Able Archer Exercise in 1983. The US and USSR typically opposed each other in a series of proxy wars such as the Korean War (1950-1953), Vietnam War (1957-1975), and the civil wars in Angola, El Salvador, and Nicaragua (1970s-1980s).

Within this escalating tension between the US and USSR, that the Soviet Union demonstrated its military and space technological advantage in 1957 with the launch of the first intercontinental ballistic missile (ICBM) and their satellites *Sputnik* 1 and 2. The *Sputnik* launches greatly increased the attention of Congress and the general public on the issues of technology and space capabilities. This led to a generalized fear that we were lagging behind the Soviets and funding to military and space programs were increased to catch up. This gap, known as the “missile gap” was the perception that deployed Soviet missiles was significantly greater than the number deployed by the United States. Throughout the late 1950s and 1960, the missile gap became a US presidential campaign platform and to pump funding into our military and space programs (Bair 2003; Mark 2005).

A recently declassified document best illustrates the tension and paranoia exhibited during this time. The US space program, from the Soviet point of view, described *Project Mercury* as a means to place human occupied armed satellites into space and the manned lunar program as a means to establish a base on the moon to attack the USSR (Korenevskiy 1961). Meanwhile, Central Intelligence Agency (CIA) declassified documents from 1959 and 1965 show the missile gap was not as large as previously believed and that their missile and space programs were having series difficulties (CIA 1959, 1965). In fact, recent estimates indicated the US had more nuclear ICBM’s than the USSR until 1978 (Norris and Kristensen 2006). However, one must not lose sight of the fact that during the 1950s and 1960s there was a real fear of communist domination of the world which led to our missile and space programs.

The development of these missile and space programs required a huge investment of resources and money by the US government on a scale never seen in the history of this country to promote technology and science to counter the perceived advancements by the USSR. As the launching site for a majority of the U.S. missile and space programs, both military and civilian, CCAFS played a critical role during the Cold War. This era in history, spanning roughly from 1946 to 1989, pitted the ideologies, economies, technologies, and military power of the United States and the Soviet Union against each other. This struggle originated in Europe but eventually spread around the globe. The defining feature of the Cold War was the massive arms race that developed between the Soviet Union and the United States. This arms race relied heavily on constantly advancing technology. The Soviet Union and the United States both developed massive missile and space programs after World War II. Although military and political goals fueled the early missile and space efforts of the United States, one important offshoot of these efforts was the emergence of a separate civilian space program. The civilian space program, which included both manned and unmanned missions, grew alongside and benefited from the military missile and space programs. The military programs, in turn, also benefited from the successes of the civilian space program.

3.2 History of CCAFS and PAFB

With the exception of the Cape Canaveral Lighthouse, all extant buildings and structures are related to the military period (after 1940 for Patrick Air Force Base [PAFB] and after 1950 for CCAFS). The few earlier buildings left standing after the military arrived were eventually demolished. Neither installation was a static entity; facilities are periodically changed, reused, or demolished. As technical operations are updated, parts of facilities have been adapted, sold for scrap, or salvaged for use on other structures. PAFB was initially developed in 1940 as the Banana River Naval Air Station (BRNAS).

Banana River NAS faced closure in 1947, but in 1948 the Navy transferred it to the jurisdiction of the Air Force as a base for the Joint Long-Range Proving Ground (JLRPG) to be used by the Army, Navy, and Air Force. The gradual advancement of the U.S. missile research program made a testing range necessary, and the National Security Act of 1947 gave the newly-created Department of the Air Force the responsibility of implementing the recommendations of the Joint Research and Development Board. The Florida site was recommended for missile testing because off-shore bases were available for downrange observation stations, and the length of the range could be extended as the distances increased. Other factors included a suitable launching site at Cape Canaveral with good climate, as well as undeveloped sparsely-settled land which was isolated enough to minimize harm to nearby communities (Barton and Levy 1984; Cleary 1991; McCarthy et al. 1993; Penders 2014).

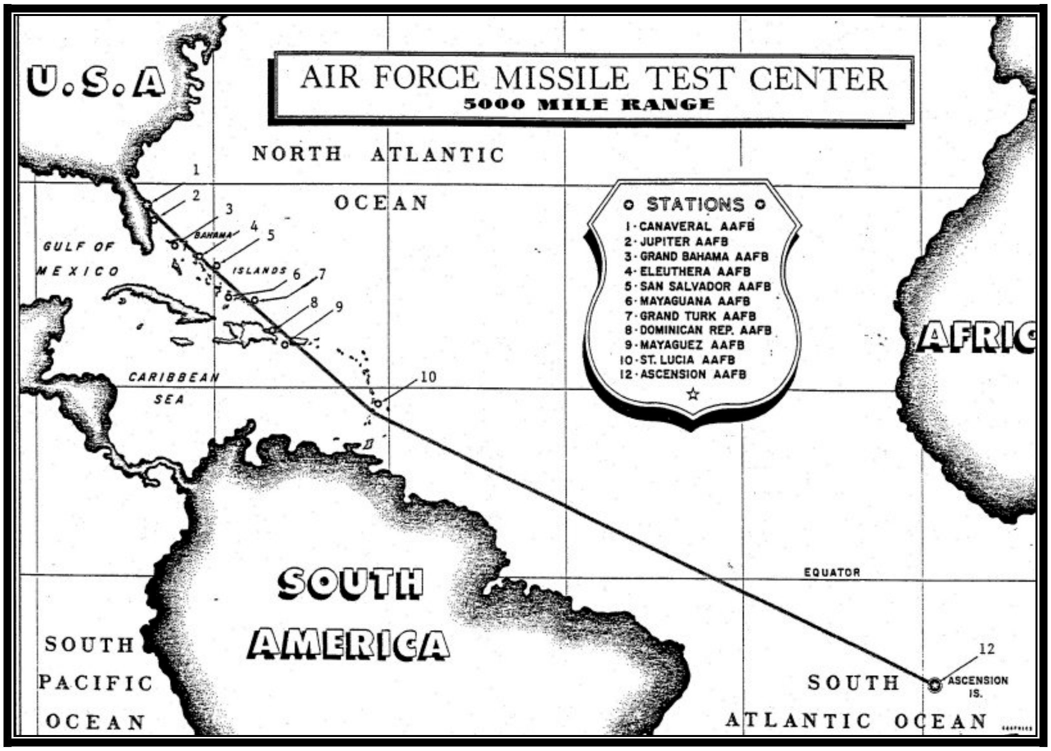

Figure 5. Eastern Test Range ca. 1957 (45 SW, USAF).

In 1950, the joint operation was discontinued and the installation was designated the LRPG with the status of major Air Command. Agreements with the British government in 1950 permitted a 1,609-km (1,000-mi) range (Figure 5), and later extensions brought the range 7,081 km (4,400 mi) to Ascension Island and eventually to the Indian Ocean. Construction of the first missile launch pads and support facilities at the Cape, along with new roads and downrange tracking stations, was begun in 1950. These early structures proved limited in keeping up with the technical demands of rapidly changing missile technology, and by the 1960s launch facilities were developed with a greater degree of flexibility to support operational changes. The tremendous amount of construction activity in the 1950s also resulted in new administrative and technical facilities at PAFB. In 1951 a draft LRPG Master Plan was released, and major base improvements were begun at PAFB. During this early Cold War period, operational and support buildings were related to the active programs of research and testing new missile systems. Facility 312, PAFB's assembly site for the *Matador* missile, was secured as the first restricted area on the base (Barton and Levy 1984; Cleary 1991; McCarthy et al. 1993; Penders 2014).

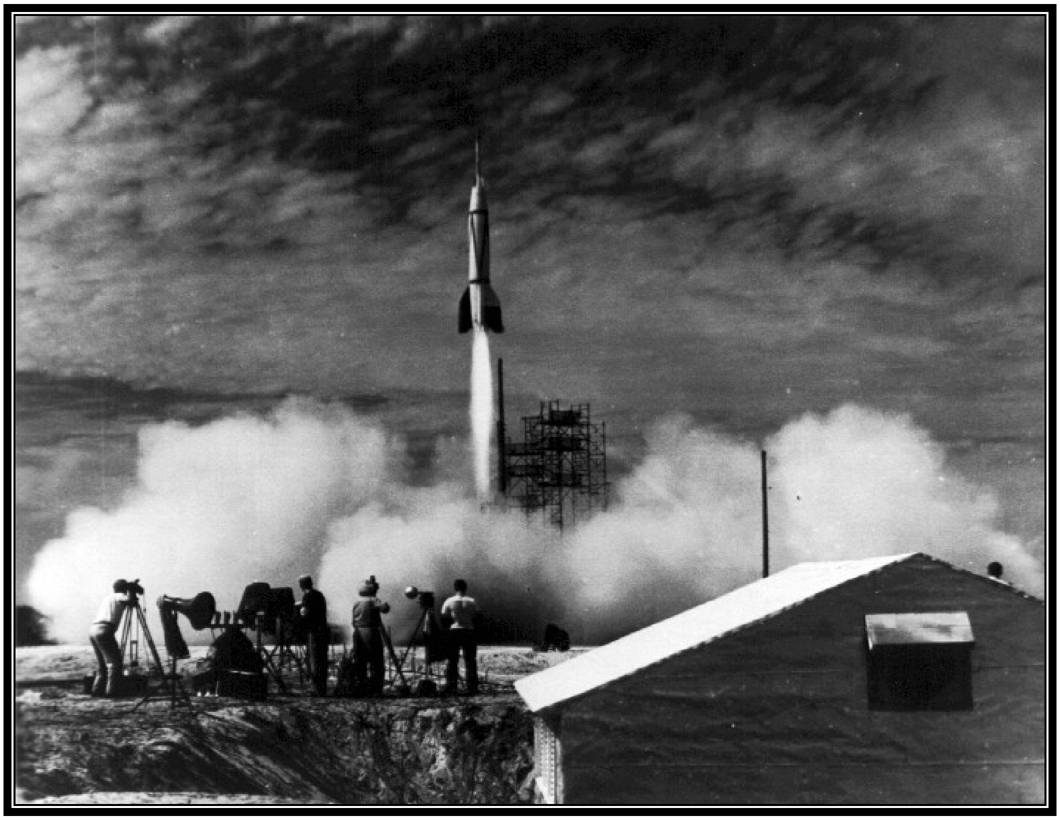

Figure 6. Launch of *Bumper 8*, July 24, 1950 (45 SW History Office).

The first missile, a German V-2 rocket with an Army *WAC Corporal* second stage, was launched from the Cape on July 24, 1950 (Figure 6). During the next three years various cruise-type missiles were tested, including the *Matador* in 1951 and later the *Snark* and *Bomarc*. Conditions were primitive for these early launches with gantries constructed from painters' steel scaffolding and plywood platforms, and blockhouse facilities of slit trenches surrounded by sandbags. After 1953, facility construction supported the Intermediate Range Ballistic Missile (IRBM) and ICBM programs with increasingly sophisticated support structures. Due to their proximity to the launch pads, launch control centers (blockhouses) were highly reinforced buildings designed to withstand the shock if a missile should go awry. Depending on the type of launch complex, other structures might include service towers, umbilical towers, launch stands, fuel facilities, camera stations, liquid oxygen systems, deflectors, skimming basins, and other facilities (Barton and Levy1984; Cleary 1991; McCarthy et al. 1993; Penders 2014).

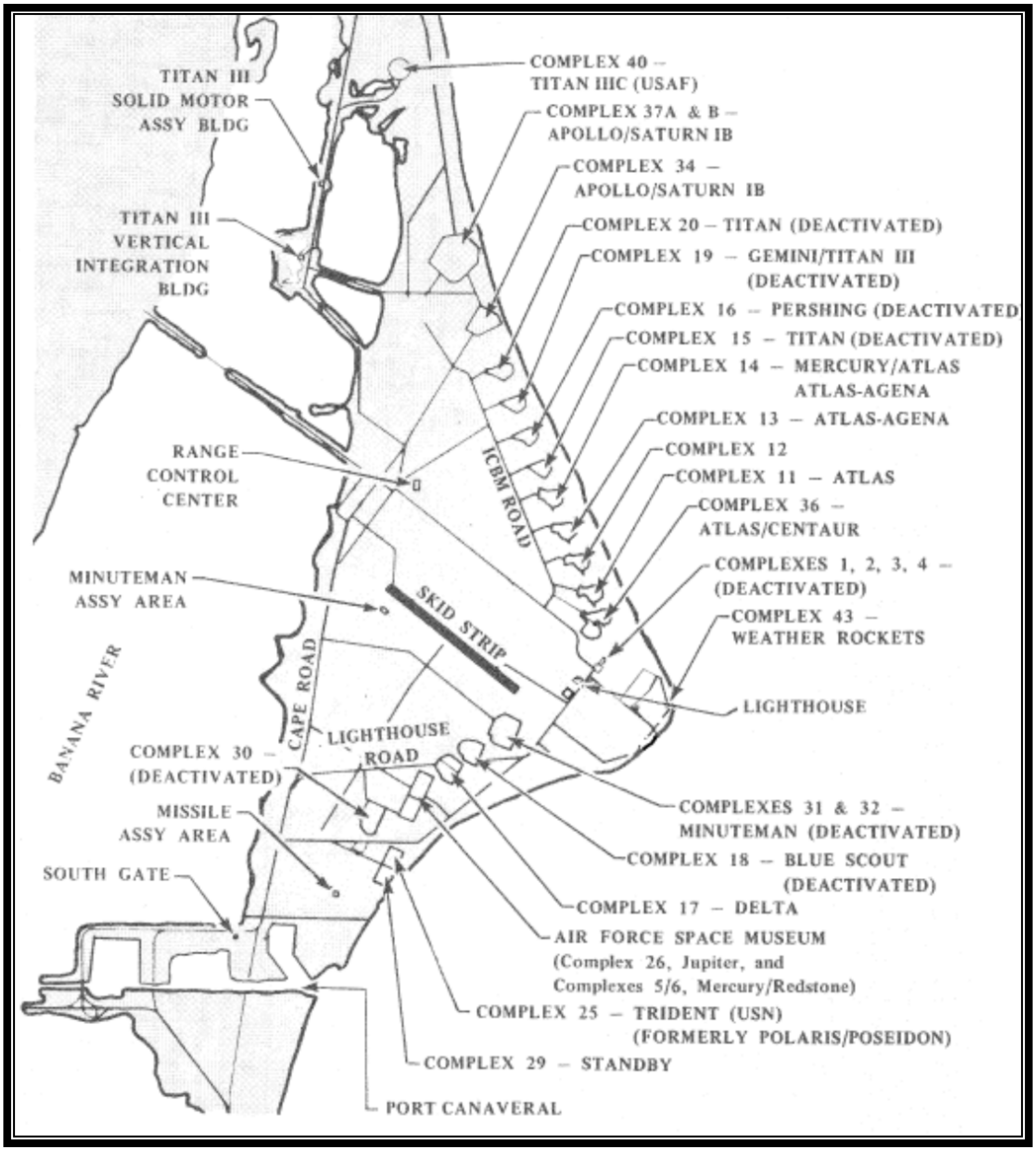

Figure 7. Launch complexes on CCAFS.

By the 1960s, numerous launch complexes (some with dual pads) had been constructed on the Cape (Figure 7). The early satellite launches and all manned *Mercury* and *Gemini* flights originated from CCAFS. When the Manned Lunar Landing Program was initiated in 1961, a large section of Merritt Island across the Banana River from CCAFS was selected as the launch center for the *Apollo* Program. Those complexes directly related to manned space flight were LCs 5/6, 14, 19, 26 and 34. Other facilities included the original MCC and the MST at LC-13. Activities at CCAFS had reached their peak in 1966, and the years following saw a gradual decline in many phases of operations. Launch complexes and support buildings which had served their purposes were adapted to other uses, deactivated, or put on standby. Many facilities which had been transferred to the National Aeronautic and Space Administration (NASA) during the early 1960s gradually returned to USAF control. Current Air Force launch programs include ballistic missile operations and commercial launch vehicles. Operation and maintenance of the missile test range has been the responsibility of a civilian contractor since 1953. PAFB continues as the center of administrative activities of Headquarters 45th Space Wing, including CCAFS, Antigua Air Station, Ascension Auxiliary Air Field, Malabar Transmitter Annex (MTA), and Jonathan Dickinson Missile Tracking Annex (JDMTA) (Barton and Levy 1984; Cleary 1991; McCarthy et al. 1993; Penders 2014).

The development of the space industry also dramatically transformed the surrounding communities, including Eau Gallie, Melbourne, Cocoa, and Titusville. Their population expanded greatly, and all had to cope with the demands of a suddenly enlarged workforce for social and educational services. Support industries appeared on the periphery of both installations. State and local governments strained to install the physical infrastructure to accommodate the new population and activity, while at the same time tourism was also increasing along what came to be known as the "Space Coast" (Penders 2014).

4.0 MISSILE SYSTEMS AT LAUNCH COMPLEX 20

Launch Complex 20 was originally constructed in 1958 and 1959 for the *Titan* missile program. It was used from 1960 through 1961 for the *Titan I* missile program and in 1964 for the *Titan III* program. There was almost a 30 year break and additional launch programs were conducted at the complex between 1993 and 2000. The various programs are summarized below and in Table 1.

4.1 *Titan* Missile Program

A development contract for what would become the *Titan* ICBM was issued to the Martin Company in October 1955; subsequently, the missile was named after the Greek mythological father of Zeus. *Titan* was intended to be a backup to the *Atlas* and not intended for full-scale development and production unless *Atlas* would be significantly delayed. In October 1957 this changed in after the USSR launched *Sputnik*. It was decided to deploy both *Atlas* and *Titan* by 1962. The *Titan* was developed under the management of the Air Force Systems Command (AFSC), Space Division. The program objective was to design a multi-purpose launch vehicle to serve many different roles. The *Titan* has the distinctions of being the second ICBM of the USAF, the USAF's first multistage design launch vehicle, and the largest ICBM ever deployed by the US

Figure 8. *Titan I* J-5 missile launch from LC-20 on August 30, 1960 (USAF 1960a).

(Cleary 1991, 1994, 1995a; Garcia 1988; Hundley 2008a, 2008b; Lanius 2002; Lonnquest and Winkler 1996; Neufeld 1990; Parsch 2014; Wade 2014).

4.1.1 *Titan I* ICBM

The USAF accepted delivery of the first *Titan I* in June 1958, followed by a test program that culminated in the successful inaugural launch of the missile from CCAFS on February 6, 1959. In December 1961 it was declared operational *Titan I* used two stages, both equipped with Aerojet engines that burned liquid oxygen and missile quality kerosene known as RP-1, and could deliver a four-megaton (4-MT) warhead over a distance of 12,900 km (8015.7 mi). Inertial guidance incorporated groundbreaking digital computer technology (Cleary 1991, 1994, 1995; Hundley 2008a, 2008b; Lanius 2002; Lonnquest and Winkler 1996; Neufeld 1990; Parsch 2014; Piper 1964; Wade 2014). An example of a *Titan I* can be seen in Figure 8.

Three months later the USACE Ballistic Missile Construction Office (BMCO) started construction of the first *Titan I* underground silos at Lowry AFB, Colorado. The missiles were stored in underground silos. After fueling, the *Titan I* had to be lifted out of the silo for launch. As with the

Table 1. Launches from Launch Complex 20

Date	Launch Vehicle	Vehicle No.	Notes
July 1, 1960	*Titan I*	J-2	Mk 4 re-entry vehicle test. Destroyed 90 m above pad
July 28, 1960		J-4	Mk 4 re-entry vehicle test. Failed 130 km from pad
August 30, 1960		J-5	Mk 4 re-entry vehicle test.
October 7, 1960		J-3	
December 20, 1960		J-9	Mk 4 re-entry vehicle test. Failure.
February 10, 1961		J-11	Mk 4 re-entry vehicle test.
March 3, 1961		J-12	Mk 4 re-entry vehicle test. Failure.
March 31, 1961		J-15	Mk 4 re-entry vehicle test. Failure.
May 23, 1961		J-16	Mk 4 re-entry vehicle test.
July 20, 1961		J-18	
August 3, 1961		J-19	
September 6, 1961		J-17	
September 28, 1961		J-20	
October 24, 1961		J-21	
November 21, 1961		J-22	First launch by all USAF personnel, Mk 4 re-entry vehicle test
December 13, 1961		J-23	NTMP TV Test
September 1, 1964	*Titan IIIA*	65-210	*Titan IIIA* Transtage I. Transtage pressurization failure caused premature shutdown
December 10, 1964		65-209	*Titan IIIA* Transtage 2. Launch vehicle test.
February 11, 1964		65-211	LES-1. Lincoln Experimental Satellite.
May 6 ,1964		65-214	LCS-1. Aluminum sphere used for radar calibration. LES-2. Lincoln Experimental Satellite.
December 18, 1990	*Starbird*		LACE UVPI Target mission.
June 18, 1991	*Joust-1*	VEH-1	*Prospector I*. Microgravity mission. Material and biological experiments. Failure.
August 20, 1991	*Red Tigress*	1A	SDIO Experiment
October 14, 1991		1B	
May 23, 1993	*Red Tigress II*		
May 28, 1993			
January 21, 2000	*Super Loki*		*LiteStar*. Education mission
December 12, 2000	*Loki*		Test Mission.
December 13, 2000	*Super Loki*		*LiteStar*. Test Mission.

Atlas, the non-storable liquid fuels were a safety hazard and also lead to a reaction time from order to launch of about 20 minutes. The first *Titan I* squadron at Lowry AFB and its complement of nine *Titan I*'s was placed on operational alert in 1962. When the *Minuteman* and *Titan II* became operational in 1963, it was decided to phase out the *Titan I* (together with the *Atlas*) as quickly as possible. Between January and April 1965, all deployed *Titan I*'s were retired from service. A total of 47 *Titan I* launches were conducted at CCAFS from LCs 15, 16, 19 and 20. It should be noted, unlike the *Titan II*, the *Titan I* was modified for spaceflight (Cleary 1991, 1994, 1995; Hundley 2008a, 2008b; Lanius 2002; Lonnquest and Winkler 1996; Neufeld 1990; Parsch 2014; Piper 1964; Wade 2014).

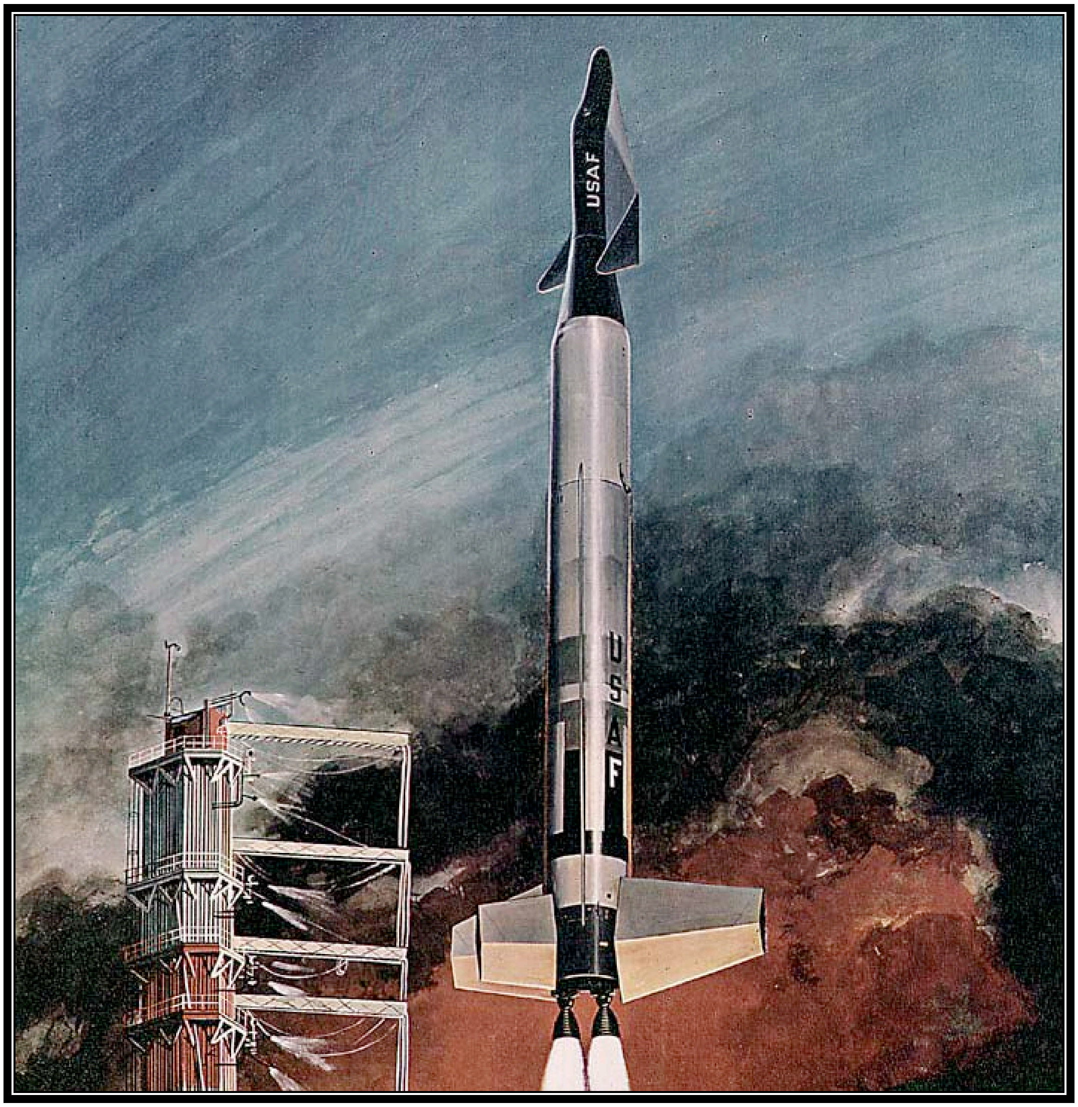

Figure 9. An artist's conception from 1961 of a Dyna-Soar launch (USAF 1961a).

4.1.2 Dyna-Soar Program

The *Dyna-Soar* (Figure 9) was America's first spacecraft which actually reached the hardware stage. It was conceived in 1957 by the USAF to use a *Titan II* missile and the *Dyna-Soar* as their first step into the military use of outer space. They planned numerous versions of the ship, including satellite inspection and electronic and photographic intelligence gathering. Later versions were also planned as mini-space stations which could carry "stand-off" nuclear weapons into orbit. The project was cancelled in 1963 with only one non- flying mock-up completed. The USAF's astronaut corps shifted into training for the MOL or NASA's manned space program (Cleary

1991, 1994, 1995a; Hundley 2008a, 2008b; Lanius 2002; Lonnquest and Winkler 1996; Neufeld 1990; Parsch 2014; Wade 2014; Willis and Bamford 2008).

4.1.3 *Titan III* ICBM

The *Titan III* was the second type of *Titan m*issile tested and launched from LC-20. The launch vehicle was the result of an effort by military planners to increase low orbit payload weight to 11340 kilograms (kg) or 25,000 pounds (lbs), establish a high degree of standardization, and provide significantly greater economies of operation, using a vehicle assembled from standard building blocks and possessing high reliability and mission flexibility. The choice for the core was *Titan II*, most powerful American ICBM. The concept grew to include a new pressure fed third stage topped by a control module and a standard payload fairing. This basic "core," designated *Titan IIIA*, would be capable of lofting significant payload weights. The technically unique element of the system was the addition of solid propellant motors to vastly augment an otherwise nominal payload capacity. The *Titan III* family of launch vehicles was born out of a need for rockets capable of carrying payloads heavier than those that could be handled by the *Atlas-Centaur*. It was originally conceived as a carrier of manned military spacecraft: *Dyna-Soar*, *Gemini B* and Manned Orbital Laboratory (MOL), and launching space planes in support of the MOL follow-on space stations. All of these projects were cancelled in turn (Cleary 1991, 1994, 1995; Hundley 2008a, 2008b; Lanius 2002; Neufeld 1990; Parsch 2014; Piper 1964; Wade 2014).

4.1.3.1 Titan IIIA ICBM

Development of a third generation *Titan* began in 1961 when the need for a larger payload capability became evident. In 1962, the *Titan IIIA* was selected by the USAF as its standard launch vehicle for military payloads. It differed from the *Titan II* by more powerful first and second stages as well as the addition of the “Transtage” as a third stage. Introduced in 1964, the *Titan IIIA* (Figure 10) was a two-stage liquid-propellant vehicle that employed two solid-propellant motors to augment the thrust capability of the basic vehicle during lift-off. *Titan IIIA* flew four development missions between September 1964 and May 1965, then was integrated into the *Titan IIIC* configuration which was launched from LCs 40 and 41 (Cleary 1991, 1994, 1995a; Garcia 1988; Hundley 2008a, 2008b; Lanius 2002; Neufeld 1990; Parsch 2014; Piper 1964; Wade 2014).

Figure 10. *Titan IIIA* launch from LC-20 in 1964 (USAF 1964a).

4.2 *Starlab/Starbird* Missile Program

The *Starbird* missile was linked to the *Starlab* program. The *Starlab* mission was a module placed within the cargo bay of the Space Shuttle orbiter to be used to conduct acquisition, tracking and pointing experiments (Figure 11). The purpose of these experiments is to resolve critical technology issues associated with the development of space based defenses against strategic ballistic missiles (Cleary 1994, 1995a; Herrick et al. 1990).

Starlab program activities included (1) passive experiments for collecting and analyzing ultraviolet and infrared; (2) experiments using small space test objects deployed from the orbiter to sight the lasers and to demonstrate the capability of rapidly changing from tracking one object to acquiring and tracking a second; (3) ground calibration engagements that locate and actively

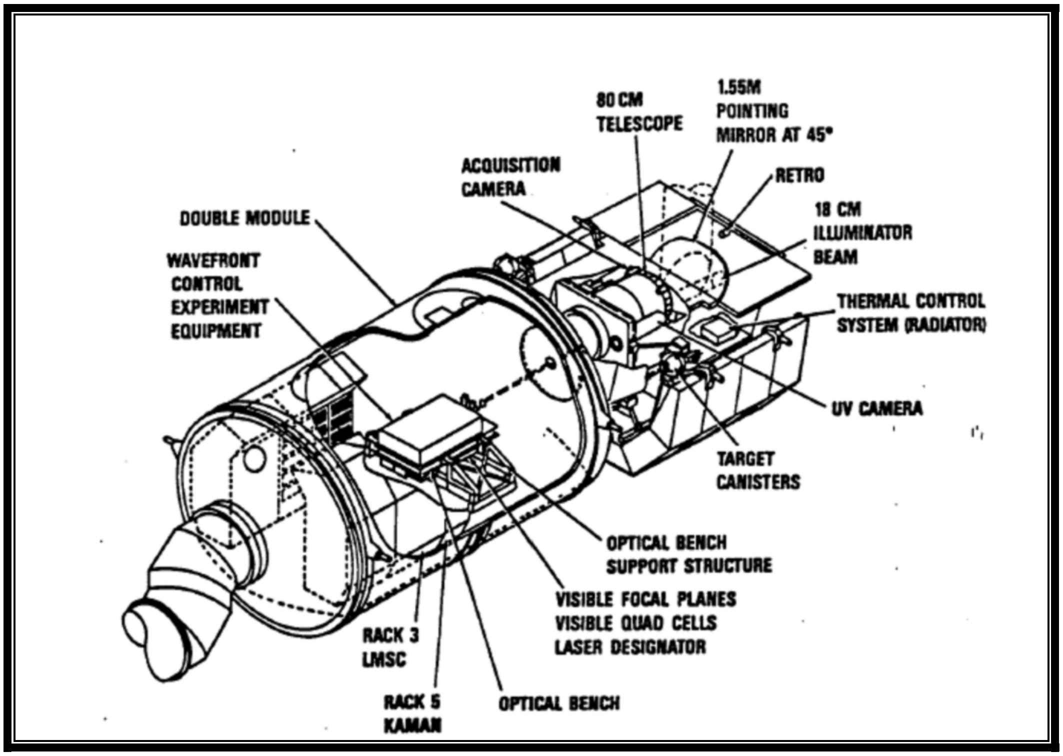

Figure 11. Drawing of the *Spacelab* module (from Herrick et al. 1990).

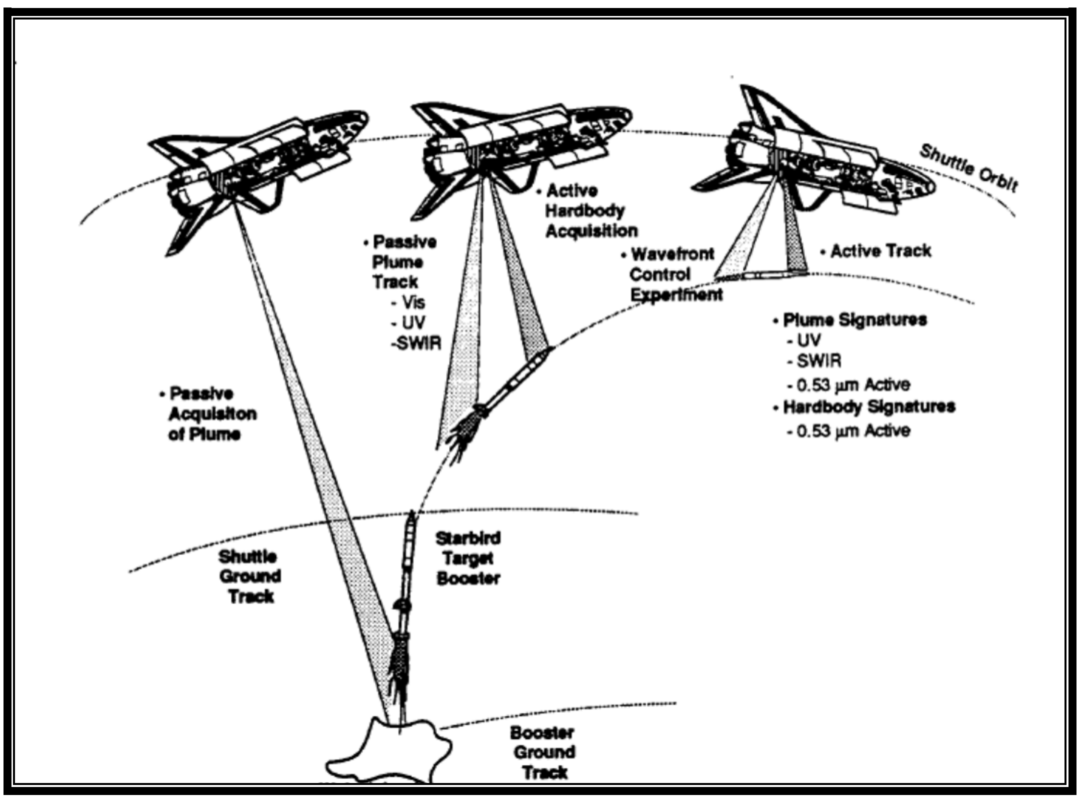

Figure 12. Planned monitoring of the *Starbird* missile from *Spacelab* on the shuttle (from Herrick et al. 1990).

Figure 13. First *Starbird* to be launched from LC-20 (Bionetics 1993a).

scan sites on Antigua and Ascension Island with lasers, which are then reflected back to the shuttle; (4) engagements with ground launched rockets (i.e., *Starbird* vehicles) that actively identify and track *Starbird* vehicles launched from Cape Canaveral and Wake Island and their plumes; and (5) a Short Wave Adaptive Technology (SWAT) experiment that actively links the obiter with the Air Force Maui Optical Station (AMOS) in Hawaii using blue and green lasers from AMOS and red lasers from the *Starlab* (Figure 12) (Cleary 1994, 1995a; Herrick et al. 1990).

As mission partners NASA was the mission manager for the proposed action and was responsible for overall operation and coordination of the Space Shuttle. The USAF Space Systems Division was responsible for the *Starlab* payload in the obiter and the SWAT experiment. The Space Systems Division was responsible for the construction of the launch sites and the launch of the *Starbird* vehicles (Cleary 1994, 1995a; Herrick et al. 1990).

The first four-stage *Starbird* vehicle was launched from LC-20 on December 18, 1990 (Figure 13). The primary objective of the first flight was to provide a booster and target vehicle for the US Army's Ultraviolet Plume Instrument to demonstrate its ability to acquire, point cameras and track the *Starbird*'s third and fourth stages. The Innovative Science and Technology Facility on Merritt Island was tasked to cover the *Starbird*'s first stage separation and impact, and the Atlantic Laser Ground Station at MTA directed a laser on the vehicle in a demonstration of passive and active tracking abilities. The launch and mission took only 228 seconds to complete, and the vehicle's fourth stage splashed down approximately 421.6 km (262 mi) downrange. In that brief space of time, the flight validated the *Starbird*'s performance and allowed the US Army to characterize the vehicle's rocket plumes (Cleary 1994, 1995a; Herrick et al. 1990).

Figure 14. *Prospector-1* being assembled on launcher at LC-20 (Bionetics 1990a).

4.3 *Prospector-1/Joust-1* Missile Program

Prospector was part of Orbital Sciences Corporation (OSC) *Starbird* family of suborbital vehicles. *Prospector* was a 14 m (46 ft) tall, single-stage suborbital rocket, using the Castor IV-A solid propellant rocket motor (Figure 14). The Litton Guidance and Control Systems inertial navigation system generated the steering commands for the vehicle control system to keep the rocket on course. Attached to the payload was a nose cone containing the parachute recovery system. The rocket has jet vanes and movable air vanes for thrust control. After parachute deployment, the payload descends to the ocean, about 50 km (31 mi) down range, where it is recovered (Ferguson 1991; Wessling and Lundquist 1990).

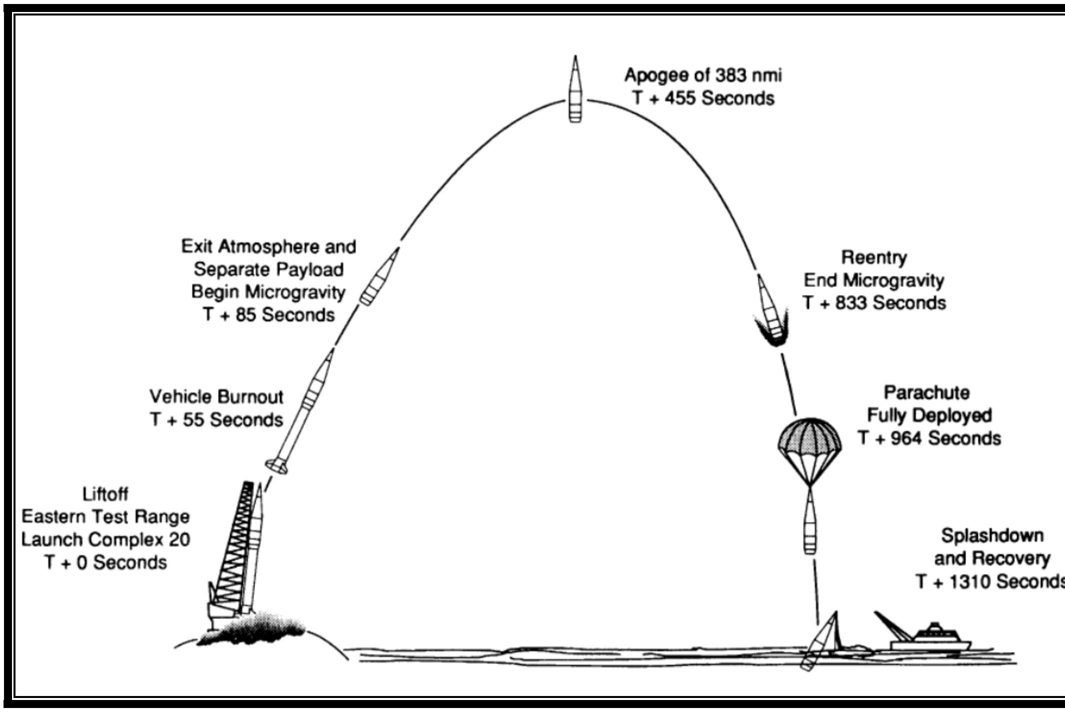

Figure 15. *Joust-I* launch scenario (from Ferguson 1991).

The launch of *Joust-1*, a commercial suborbital payload carrying 10 materials and biotechnology experiments, launched on March 29, 1990 from LC-20. The *Joust-1* mission was sponsored by the University of Alabama in Huntsville's Consortium for Materials Development in Space (UAH CMDS), a NASA Center for Commercial Development of Space. Orbital Sciences Corp., Space Data Division, Chandler, Ariz., under a contract with UAH CMDS, provided the rocket and launch services. The vehicle was to launch vehicle to lift the *Joust-1* payload approximately 643.7 km (400 mi) into space. The one-stage rocket was to provide about 13 minutes of microgravity for the experiments. Following reentry, the payload was to splash down in the Atlantic Ocean about 322 km (200 mi) downrange (Figure 15). There was a failure and the vehicle was lost (Cleary 1994, 1995a; Ferguson 1991; Wessling and Lundquist 1990).

4.4 *Red Tigress* Missile Program

Aries Red Tigress I was a solid-fueled rocket built by OSC. The rocket was launched twice in support of Strategic Defense Initiative Office (SDIO) research efforts. The launches were conducted under the *Red Tigress* program, an effort to identify and track enemy missiles. *Red Tigress I* was launched on August 20, 1991. The mission was a failure as the rocket developed severe guidance difficulties and was destroyed by the Range Safety Officer. Launch of *Red Tigress II* (Figure 16) was delayed as a result, but was successfully conducted on October 14,

Figure 16. *Red Tigress II* on launcher at Launch Complex 20 (Bionetics Corporation 1993).

1991. Tracking Field Experiments (TFE) were successfully completed during *Red Tigress* II. In addition to tracking multiple small payloads and decoys, the TFE experiments established a stabilized track of the rocket's plume using lasers and cameras (Associated Press 1991; Cleary 1994, 1995a; Dillow 1991).

4.5 *Loki/Super Loki* Missile Program

Loki (Figure 17) was an American unguided anti-aircraft rocket based on the German

Figure 17. *Loki* launch from Launch Complex 20 (USAF n.d.).

Taifun developed during World War II. Like the *Taifun, Loki* never saw service in its original role, but later found widespread use as a sounding rocket. It was so successful in this role that several advanced versions were developed on the basic *Loki* layout, including the final *Super Loki*. The US Army had initially studied the *Taifun* in 1946, and the German engineers now working for the Army were convinced the concept deserved more development. When similar concerns about the development time of their own guided missile projects were raised, the *Taifun* was reconsidered and a development program started at Bendix in 1948. One major change was to replace the warhead area with a dart-like version, which was separated from the main rocket body at engine burnout to continue on without the drag of the airframe and thereby reach higher altitudes. The

US Army, Navy and Air Force attempted to use the *Loki* as an anti-missile missile. Many other *Lokis* were sold into the civilian market, where they were used for meteorological work. These were named the *Loki-Dart*. A larger-diameter motor with 50 percent more fuel was developed in 1957, creating the *Loki II*, the original retroactively becoming *Loki I*. Other companies developed additional versions (Bollermann and Walker 1972; Parsch 2014; Wade 2014; Walker 1965).

In 1963, Space Data Corporation (SDC) formed to provide small sounding rockets to the various defense agencies. They used the meteorological rockets and created an instrument payload for the *Loki*. The SDC version was slightly heavier than the original *Loki* in order to improve stability during "cruise", which lowered maximum altitude by about 3048 m (10,000 ft). This heavier version was known as the *Loki Datasonde* and was produced from 1966 to 1985. The USAF requested a version that would not require radar tracking, and SDC responded by placing a transponder in the payload. This increased payload weight further increasing launch weight. To reach the required altitudes, SDC developed a much larger booster, which also increased overall weight and further improved stability. The resulting *Super Loki* first flew in 1968, and since then 9,000 have been delivered. Orbital Sciences Corporation bought SDC in 1990. The production of the *Super Loki* and continued until 2001 when the product line was abandoned (Bollermann and Walker 1972; Parsch 2014; Wade 2014; Walker 1965).

5.0 LAUNCH COMPLEX 20 (8BR3272) DETERMINATION OF ELIGIBILITY

5.1 Previous Investigations at Launch Complex 20

In 1983 RAI conducted an architectural and engineering evaluation of facilities at CCAFS (Barton and Levy 1984) which resulted in the determination of NRHP eligibility of 21 launch complexes, the lighthouse, Hangar S, and the original Mission Control Center (MCC). This study became the basis for the joint 1984 USAF and NPS nomination of six launch complexes (LCs 5/6, 13 MST, 14, 19, 26, and 34) and MCC as a NHL district. This discontinuous district contains the only NRHP properties currently listed on 45 SW bases. They never did determine if the complex was eligible for listing in the NRHP (Barton and Levy 1984).

In 1993, CERL evaluated 16 of the facilities from the previous RAI study for possible NRHP eligibility (McCarthy et al. 1993). Their study recommended six additional launch complexes (LCs 1/2, 3/4, 17, 21/22, 25, and 31/32) for nomination to the NRHP. It was suggested that the remaining facilities (LCs 10, 11, 12, 15, 16, 18, 30, 37, and Hangar S) should be documented in lieu of being preserved. It is unknown why LC-20 was never assessed during their survey.

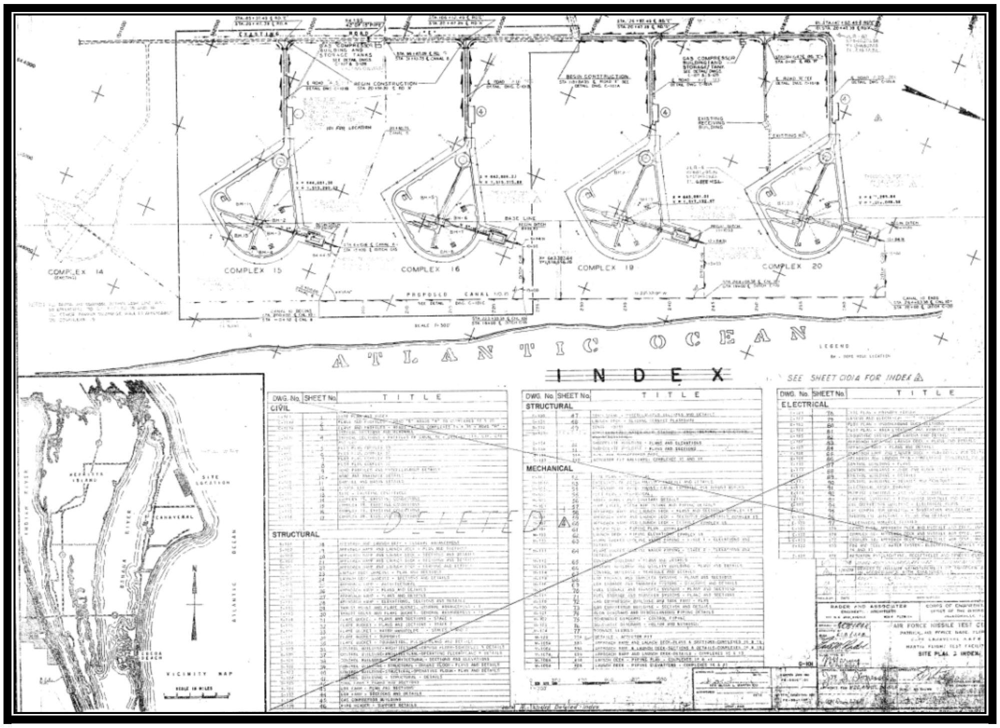

Figure 18. As-built drawing from 1959 showing LCs 15, 16, 19 and 20 (Rader and Associates 1959).

5.2 History of Use and Development

Complex 20 is located along the northern section of Cape Canaveral Air Station, one of four similar and adjacent complexes known as part of ICBM Row, each with a single-pad, single blockhouse design. These four sites were used for launching *Titan* missiles, and were originally configured for the requirements of the *Titan I*. This can be seen in the 1959 as-built drawing (Figure 18) and the description of a "typical" Titan launch complex (Figure 19).

Site preparation work on the four Titan complexes began in October 1956, and LC-20 was activated in June 1959. The USAF had the Martin Company prepare the launch complex design, which the Jacksonville District USACE constructed through subcontracts. Martin's Denver office supplied the drawings and plans, and the USACE hired Rader and Associates of Miami, Florida to modify them to suit local conditions. Construction was originally contracted to the MacDonald Construction Company, who defaulted on the contracts after four months. The Diversified Construction Company of California completed the work. Contracts for the launch complex components unique to the *Titan* missile (i.e. umbilical tower and erector) were overseen by the missile's developer and builder, the Martin Company (Cleary 1991).

Launch Complex 20 in its *Titan I* launch configuration, consisted of a blockhouse connected

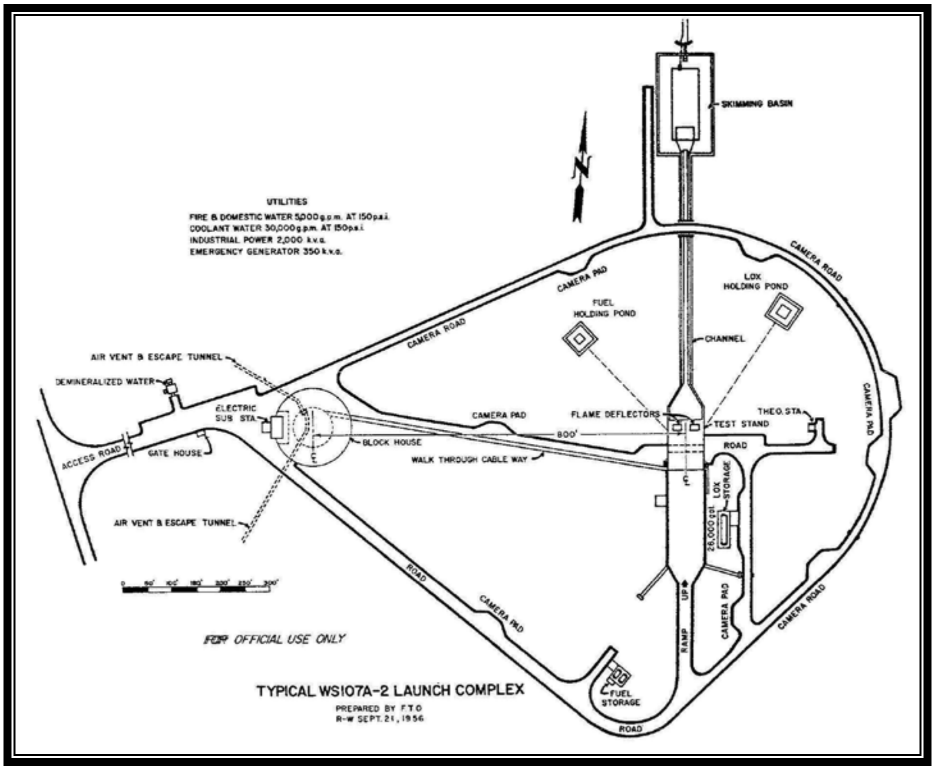

Figure 19. Drawing from the 1960 real property manual for CCAFS showing a "typical" *Titan* launch complex (DCS 1960).

to the launch stand and ramp by a cableway. There was a fuel farm southwest of the stand and ramp as well as a Liquid Oxygen (LOX) facility adjacent to the stand. Separate holding ponds were north of the launch stand and ramp. A deluge system ran from the stand and ramp north to a skimming pond. On the launch stand and ramp was a steel I-beam erector. In addition there was a mobile service tower (MST) and umbilical tower (UST). These were used for missile access and various connector points to the *Titan I*. East of the launch stand and ramp was a theodolite building used to insure the missile was properly aligned for launch. The entire complex was surrounded by a perimeter road which also contained camera pads. At the entrance to the complex was a structure known as the Ready Building (Figure 20). Launch Complex 20 remained in this configuration from the first *Titan I* launch on July, 1, 1960 until the last launch on December13, 1961. In total, 16 launches occurred here during this time period. As with most of the early launch attempts there were numerous mishaps. Of the 16 *Titan I's* launched from LC-20, only five were successful (Cleary 1991, 1994, 1995a, 1995b; PanAm 1960, 1963, 1965; 45 SW Real Property 2014).

Launch Complex 20 was shut down after the *Titan I* program ended. However, plans were already being developed to modify the launch site for the *Titan II Dyna-Soar* program. In these

Figure 20. Aerial photograph from 1960 of Launch Complex 20 (USAF 1960b).

drawings the plan was to add hydrazine and oxidizer farms and eliminate the existing fuel farm (Figure 21). From 1963 until 1964, LC-20 underwent significant modifications to handle the larger *Titan III* launch vehicle. In addition to the change in propellant farms, etc there was a major modification to the launch stand and ramp including a larger erector/gantry (Figure 22). The complex was used to support four *Titan IIIA* flights which took place between September 1, 1964 and May 7, 1965. The site was deactivated in April 1967. By July 1967 major components of the complex were being demolished and removed from the complex including all the components of the propellant farms as well as the erector and UT (Cleary 1991, 1994, 1995a, 1995b; PanAm 1960, 1963, 1965, 1967; 45 SW Real Property 2014).

The complex reportedly served as a drum crushing operation and a waste liquid storage area for an approximate 10-year period from the late 1970's to the late 1980's. This was located within the area occupied by Facility 15531 which is within the southern portion of the complex (Parsons Engineering 1999; 2014 45 SW Real Property).

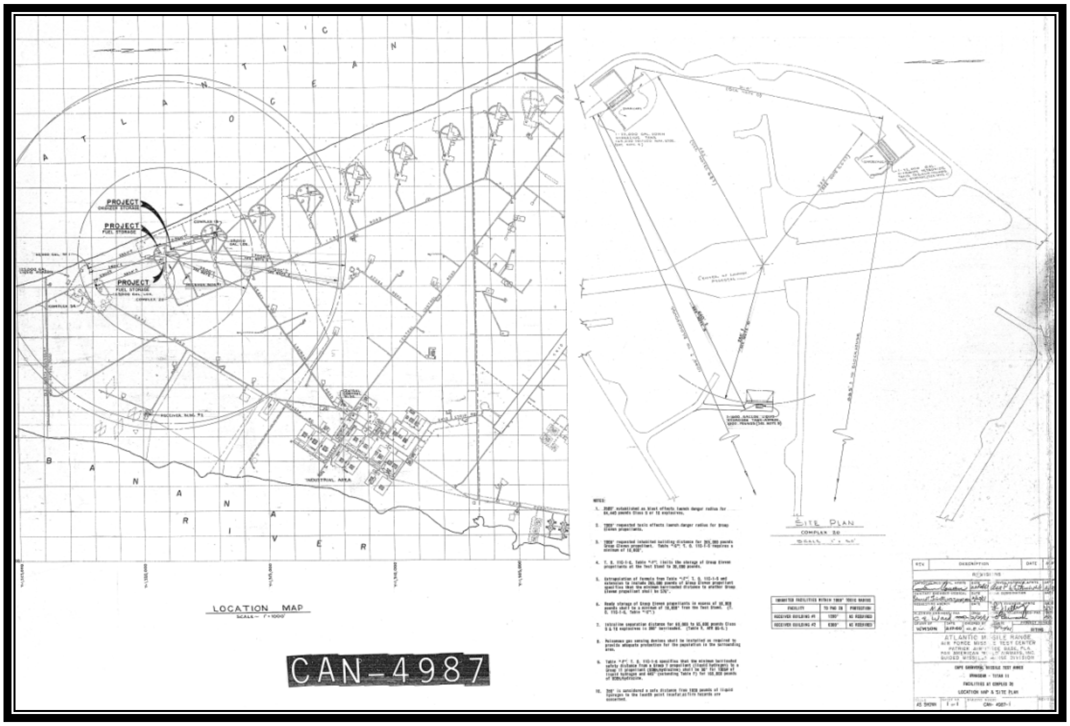

Figure 21. As-built drawing for modification to LC-20 for the *Titan II Dyna-Soar* program (PanAm 1961).

Figure 22. Photograph from 1963 of modifications to Launch Stand and Ramp (USAF 1963).

Figure 23. Aerial photograph from 1993 showing conditions at Launch Complex 20 (FDOT 1993).

Launch Complex 20 remained abandoned in in place until 1987. In 1987, LC-20 was selected to be used for the *Starbird/Starlab* program. The design package for *Starbird* launch facilities (LC-20) was sent to the Army in October 1987 for approval. The contract for *Starbird* modifications to the launch site was awarded to Butler Construction Company in November 1988. Butler went to work in early January 1989 under the supervision of the USACE. The new *Starbird* facility consisted of two launch pads with 17.7-m (58-ft) tall rail launchers, two Launch Equipment Buildings, a Launch Support Center, additions to the fuel farm, and a Payload Assembly Building. It also had a Payload Support Center, Vehicle Support Center at the blockhouse and a Missile Assembly Building off-site. Facility construction was virtually complete by the fall of 1990, and the only *Starbird* was launched on December 18, 1990 (Cleary 1991, 1994, 1995a, 1995b; Ferguson 1990; 45 SW Real Property 2014).

The pad was used for between June 1991 and May 1993, the complex supported the commercial *Prospector-I/Joust-I* launch and four *Red Tigress* and *Red Tigress II* missions sponsored by the SDIO. By June 1993, the complex was again abandoned in place (Figure 23). Two years later most of LC-20's electronic equipment and both of its rail launchers were removed rendering the site inactive. As part of a contamination cleanup the flume and skimming basin was removed and the actuator pit within the launch stand and ramp was drained and filled (Cleary 1994, 1995a, 1995b; JCWS 1993, 45 SW Real Property 2014).

In 1999, the LC-20 was re-activated to support new launch facilities under the direction of Space Florida for commercial launches. The re-activation included the construction of a new building along the perimeter road, northeast of the blockhouse. Other than the construction of a warehouse it appears the complex was never used by Space Florida. From 2000 to 2012, LC-20 was occupied by NASA's Advanced Technology Development Center, a research and development project to provide infrastructure to test, demonstrate and qualify new spaceport technologies. At that time the site is shared with the Florida Air National Guard. LC-20 is now being considered for use again as a launch complex as part of the *Blue Origin* Program (Clements 2000; InDyne Inc. 2010; Parsons Engineering 1999; SGS 2000, 2003, 2005, 2008; 45 SW Real Property 2014).

5.3 Integrity

Launch Complex 20 (8BR2272) has never been moved and still sits at the same location where it was constructed. Most of the original components have been removed from the complex and a series of modifications and new construction occurred at the complex in the 1990s. Due to then extensive modifications he complex's integrity of association between the buildings and the events associated with its historic context (*Titan* missile program) no longer exists.

5.4 NRHP Eligibility

The original function of LC-20 was as a R&D facility of the Cold War-era *Titan* ICBM which was a vital component of our nation's missile defense. It later played a minor role in missile R&D in the 1990s. Based on the criteria established by Lewis et al. (1995), LC-20 has a minor Cold War relationship as well as a low rating for identifying the base's role within the national Cold War context. It also has minor importance with respect to science, theories or ideas.

Using the NRHP criteria, the Launch Complex 20 Historic District not is recommended eligible as a historic district due to the lack of integrity and the fact that it played only a minor role in our nation's defense and missile development history Again, its eligibility is also questionable due to its redundant design and characteristics.

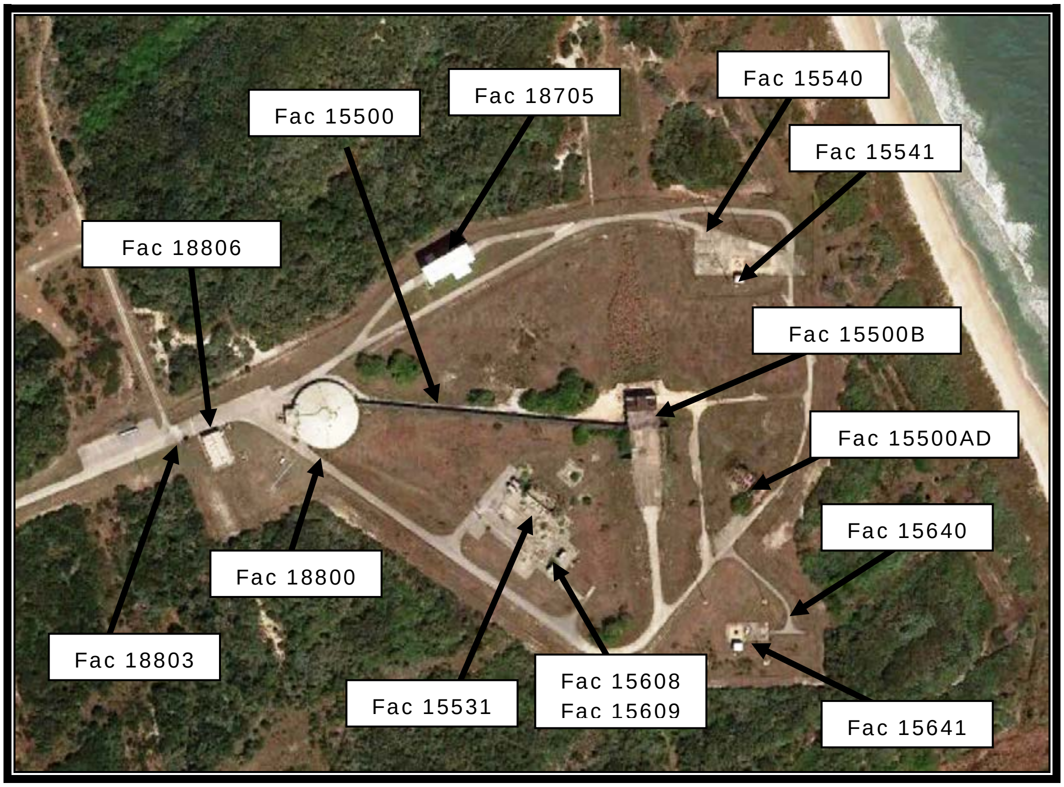

Figure 24. Aerial photograph showing LC-20 and its facilities.

5.5 Facilities

Launch Complex 20 consists of 14 facilities, of these a total of four date to its original construction in 1959, two date to the period of use for *Titan-III* launches and the remainder of the date to 1989s or later (Table 1). The descriptions provided below of the facilities will not include septic tanks, lift stations, drainfield, etc. It will focus on those facilities associated with the use of LC-20 as a missile R&D site. The extant facilities at the complex are discussed in narrative form below, shown in Figure 24, and summarized in Table 2. Additional photographs are located in Appendix A, as-builts are in Appendix B, and FMSF forms are located in Appendix C.

<u>5.5.1 Facility 15000-Control Cableway (8BR3151)</u>

5.5.1.1 Location

Facility 15000-Control Cableway (8BR3151) is located within the central portion of the complex. It is in the SW¼ of Section 5 and SE¼ of Section 6 in Township 23 South and Range 38 East of the *False Cape*, (USGS 1984) Quadrangle Map (Figure 25).

Table 2. Facilities and NHRP Eligibility

Site #	Original Name	Current Name	Year Built	Contributing or Non-Contributing Element	Individual NRHP Eligibility
8BR3151	Fac.15500-Control Cableway	Fac.15500-Control Cableway	1959	CE	NE
8BR3152	Fac. 15500AD- Fuel Holding Area	Fac. 15500AD-Liquid Hydrogen Holding area	1963	NCE	NE
8BR3153	Fac. 15500AF- Oxidizer Holding Area	Fac. 15531-Retaining Wall	1964	NCE	NE
8BR3154	Fac. 15500B- Launch Stand & Ramp	Fac. 15500B-Launch Stand & Ramp	1959	CE	NE
	Fac. 15540-Launch Pad A-*BMDO*	Fac. 15540-Launch Pad A-BMDO	1989	NCE	NE
	Fac. 15541-Equipment Bldg-Pad A	Fac. 15541-Equipment Bldg..	1989	NCE	NE
	Fac 15608-Power Center	Fac 15608-Power Center	2003	NCE	NE
	Fac 15609-Control Center	Fac 15609-Control Center	2003	NCE	NE
	Fac. 15640-Launch Pad B-*BMDO*	Fac. 15640-Launch Pad B-BMDO	1989	NCE	NE
	Fac. 15641-Equipment Bldg-Pad A	Fac. 15641-Equipment Bldg..	1989	NCE	NE
	Fac. 18705-Warehouse	Fac. 18705-Warehouse	1999	NCE	NE
8BR3155	Fac.15500A-Blockhouse	Fac.18800-Blockhouse	1959	CE	NE
	Fac. 18803-Guard House	Fac. 18803-Guard House	1999	NCE	NE
8BR3156	Fac 15500C-Ready Building	Fac. 18806-Payload Assembly Bldg.	1959	NCE	NE

5.5.1.2 History

Facility 15000-Control Cableway (8BR3151) was built in 1959 as part of the original *Titan-I* missile complex. The above ground, walk through cableway, provided environmental protection, blast protection, and ease of maintenance for the thousands of feet of cabling connecting the Blockhouse to the Launch Stand and Ramp. It was abandoned in place after the end of the *Titan-III* program at LC-20. A 1965 aerial photograph (Figure 26) shows Facility15000 as it appeared during the *Titan-III* program (PanAm 1960, 1963, 1965, 45 SW Real Property 2014).

5.5.1.3 Description

The concrete cableway extends toward Facility 15500B-Launch Stand and Ramp (8BR3154) from the east side of Facility 18800-Blockhouse (8BR3156). It was built above ground for the protection, and ease of maintenance for the thousands of feet of cabling connecting the two facilities. Interior dimensions of the cableway are 2.4 x 2.1 m (8 x 7 ft). Both

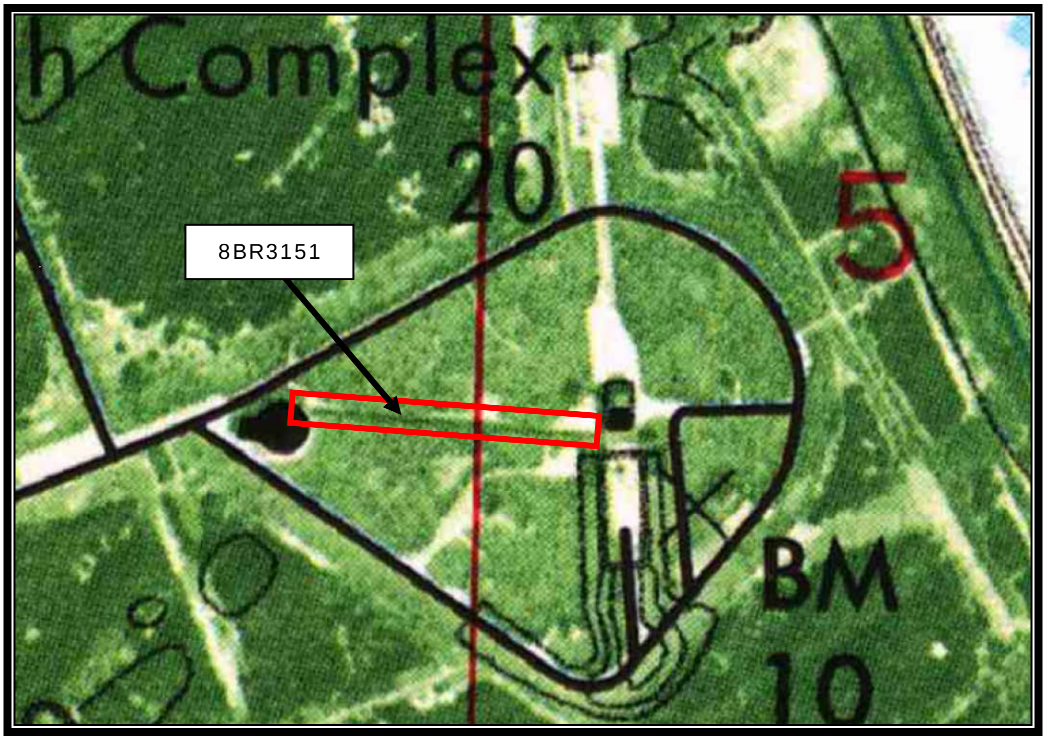

Figure 25. USGS map showing the location of Facility 15000-Control Cableway (8BR3151) (USGS 1984).

Figure 26. Aerial photograph from 1965 looking southeast at Launch Complex 20 (AFMTC 1965)

Figure 27. View to the northwest of Facility 15500-Control Cableway (8BR3151).

Figure 28. Photograph from the top of the Launch Stand and Ramp of Facility 15500-Control Cableway (8BR3151), looking west.

sides of the cableway were lined with 51 cm (20 in) wide cable baskets. The baskets, spaced 20.3 to 22.9 cm (8 to 9 in) apart vertically, spanned the entire length of the cableway. Steel doors on either side of the cableway allowed personnel to enter or exit the passage as needed. The cableway is covered with a built-up asphalt and pea gravel roof (Figures 27 and 28).

5.5.1.4 Integrity

Facility 15000-Control Cableway (8BR3151) has never been moved and still sits at the same location where it was constructed LC-20. The structure's setting and design remains intact and illustrates the military industrial character of CCAFS and its launch complexes. The original concrete block and poured concrete materials that make up the building are still intact. The standardized military workmanship is intact. The building retains its integrity of feeling or its ability to evoke the sense of its historic past and period of significance. All of the above characteristics convey the building's integrity of association between the building and the events associated with its historic context.

5.5.1.5 NRHP Eligibility

Looking at the three methods of determining significance and NRHP eligibility, Facility 15500-Control Cableway (8BR3151) has no association with the Man in Space thematic study.

Using the criteria established by Lewis et al. (1995), Facility 15500-Control Cableway (8BR3151) has an indirect/minor relationship in the Cold War through an association with the development of the *Titan I and III ICBMs*. Only a handful of *Titan* missiles were launched from LC-20 and it was quickly abandoned after the end of the program.

Looking at the NRHP criteria, Facility 15500-Control Cableway (8BR3151) does not meet the criteria for listing in the NRHP. While an important component for launch operations at LC-20 the entire complex itself only played a minor role in Titan ICBM research and development. There are better examples of the cableway found at the NHL listed LCs 14, 19 and 34. Other similar examples can be found at several other launch complexes at CCAFS.

<u>5.5.2 Facility 15500AD-Liquid Hydrogen Holding Area (8BR3152)</u>

5.5.2.1 Location

Facility 15500AD-Liquid Hydrogen Holding Area (8BR3152) is located within the eastern portion of the complex along the perimeter road. It is the SW¼ of the NE¼ of Section 36,

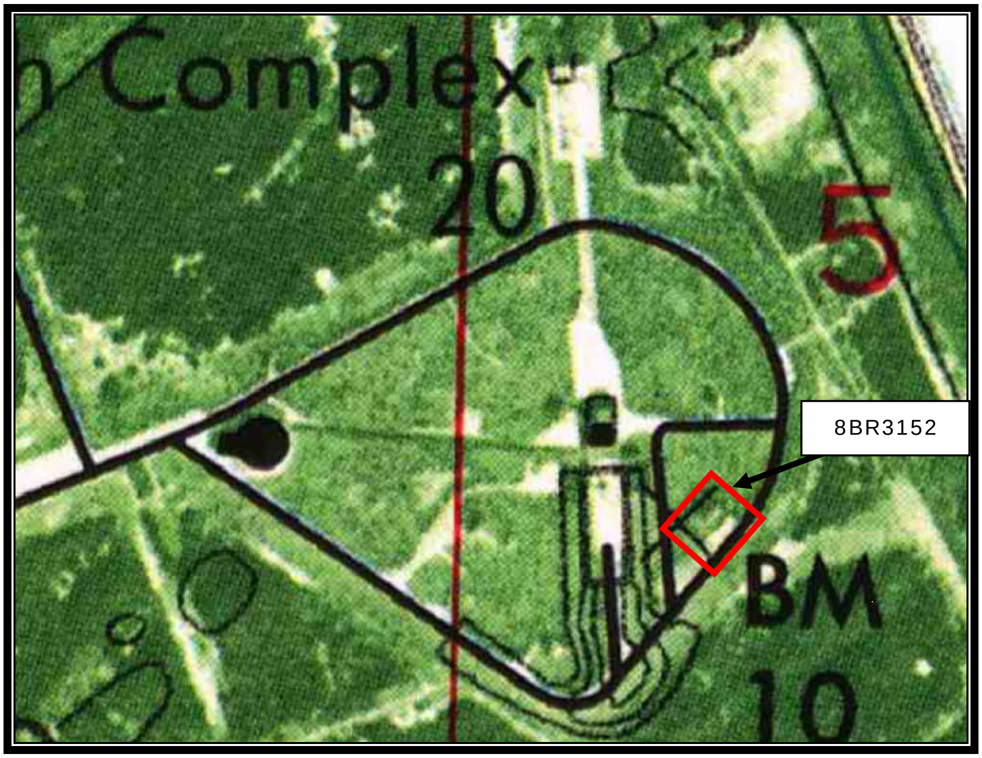

Figure 29. USGS map showing the location of Facility 15500AD-Liquid Hydrogen Holding Area (8BR3152) (USGS 1984).

Township 23 South and Range 38 East of the *False Cape*, United States Geological Survey (USGS 1984) Quadrangle Map (Figure 29).

5.5.2.2 History

Facility 15500AD-Liquid Hydrogen Holding Area (8BR3152) was not an original component of LC-20. It was constructed in 1963 as part of the conversion of the complex from the *Titan-I* to *Titan-III* configuration. As-built drawings for the conversion of the complex for the *Titan-II Dyna-Soar* Program do not show a liquid hydrogen farm. However, this commodity was used in the *Titan III*. So it can be assumed the farm was constructed for use in the *Titan-III* tests conducted at LC-20 during 1964 (PanAm 1963, 1965; 45 SW Real Property 2014).

5.5.2.3 Description

Facility 15500AD-Liquid Hydrogen Holding Area (8BR3152) is located 100 m (328 ft) east of the Launch Stand and Ramp. When constructed in 1963 it consisted of the tank area, transfer/control room, and truck access area (Figure 30). The tank area is a 5.5 x 16.7 m (18 x 55 ft) concrete trough enclosed by 4.0 m (13 ft) high concrete walls. The trough surrounded the tank and protected the surrounding site from potential fuel spills. Earth berms were constructed on

Figure 30. Photograph from 1963 showing LC-20 undergoing renovations with Facility 15500AD-Liquid Hydrogen Holding Area (8BR3152) in the foreground (Photograph courtesy of the AFS&MM).

Figure 31. View to the northwest at Facility 15500AD-Liquid Hydrogen Holding Area (8BR3152).

Figure 32. View to the east at Facility 15500AD-Liquid Hydrogen Holding Area (8BR3152).

the west, north and south sides of the tank area to increase the blast protection of the tank. A concrete and steel stairway and walkway was located on the south side of the trough for access to the fuel tank by launch personnel. The truck access area was covered with a metal gabled roof set on a steel I-beam frame. Liquid hydrogen was pumped through above ground pipes to a second fuel holding area located next to the test stand on the east side of the Launch Stand and Ramp. Today none of the original equipment remains at the facility. All that remains is the earthern berm, concrete walls, AST holding area, and the truck parking area (Figures 31 and 32).

5.5.2.4 Integrity

Facility 15500AD-Liquid Hydrogen Holding Area (8BR3152) has never been moved and still sits at the same location where it was constructed at LC-20 in 1963. The structure's setting and design illustrates the military industrial character of CCAFS and its launch complexes. The original concrete block and poured concrete materials that make up the building are still intact. The standardized military workmanship is intact. However, all the equipment associated with its use as a liquid hydrogen fueling facility has been removed. The building no longer retains its integrity of feeling or its ability to evoke the sense of its historic past and period of significance. All that remains is the general structure of the facility.

5.5.2.5 NRHP Eligibility

Looking at the three methods of determining significance and NRHP eligibility, Facility 15500AD-Liquid Hydrogen Holding Area (8BR3152) has no association with the Man in Space thematic study.

Using the criteria established by Lewis et al. (1995), Facility 15500AD-Liquid Hydrogen Holding Area (8BR3152) played a minor role in the Cold War through a very limited association with the development of the *Titan III ICBMs*. Only four *Titan III* missiles were launched from LC-20 and it was quickly abandoned after the end of the program.

Looking at the NRHP criteria, Facility 15500AD-Liquid Hydrogen Holding Area (8BR3152) does not meet the criteria for listing in the NRHP. It played a very minor role in the Cold War through a very limited association with the development of the *Titan III ICBMs*. Only four *Titan III* missiles were launched from LC-20 and it was quickly abandoned after the end of the program. This style of construction was used for oxidizer, hyrdrazine, RP-1, RP-4, liquid nitrogen, and a host of similar fuel farms within the launch complexes at CCAFS and is considered typical of those facilities. In addition, better examples remain at LCs 14, 19 and 34 which are components of the Man in Space NHL district.

5.5.3 Facility 15531-Retaining Wall (8BR3153)

5.5.3.1 Location

Facility 15531-Retaining Wall (8BR3153) is located within the south central portion of the complex. It is the SW¼ of Section 5 and SE ¼ of Section 6 in Township 23 South and Range 38 East of the *False Cape* (USGS 1984) Quadrangle Map (Figure 33).

5.5.3.2 History

The facility was built in 1962 and was originally identified as Facility 15500AF-Oxidizer Holding Area. A new fueling system (hypergols) was installed during the conversion of the LC-20 to the *Titan II* and *Titan III* Programs. Hypergolic fuel is a combination of an oxidizer (nitrogen tetroxide), and a fuel (Aerozine-50). Liquid nitrogen tetroxide is toxic, will not burn by itself, will support combustion and is more stable than Aerozine-50. Aerozine-50 is a mixture of hydrazines, water and other soluble chemicals. Oxidizers and hydrazines are combined to create a controlled explosion for liftoff and thus require the two "fuel farms" to be at opposite ends of the launch complex. Typically these chemicals are stored at Fuel Storage Area 1 on CCAFS where they are

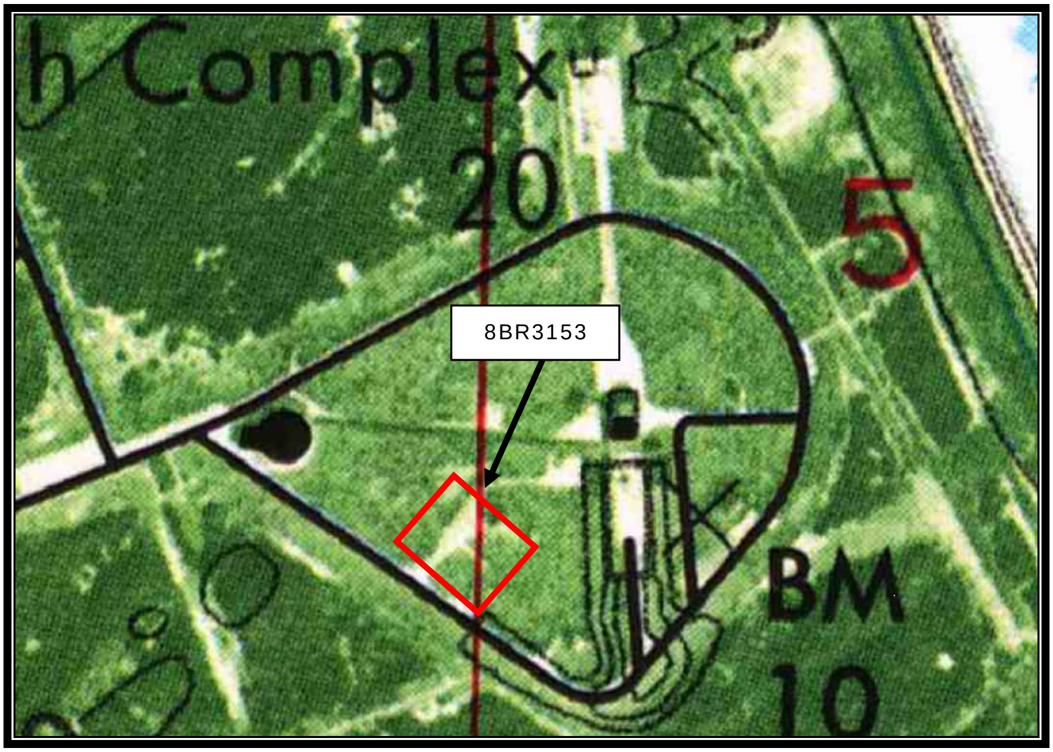

Figure 33. USGS map showing the location of Facility 15531-Retaining Wall (8BR3153) (USGS 1984).

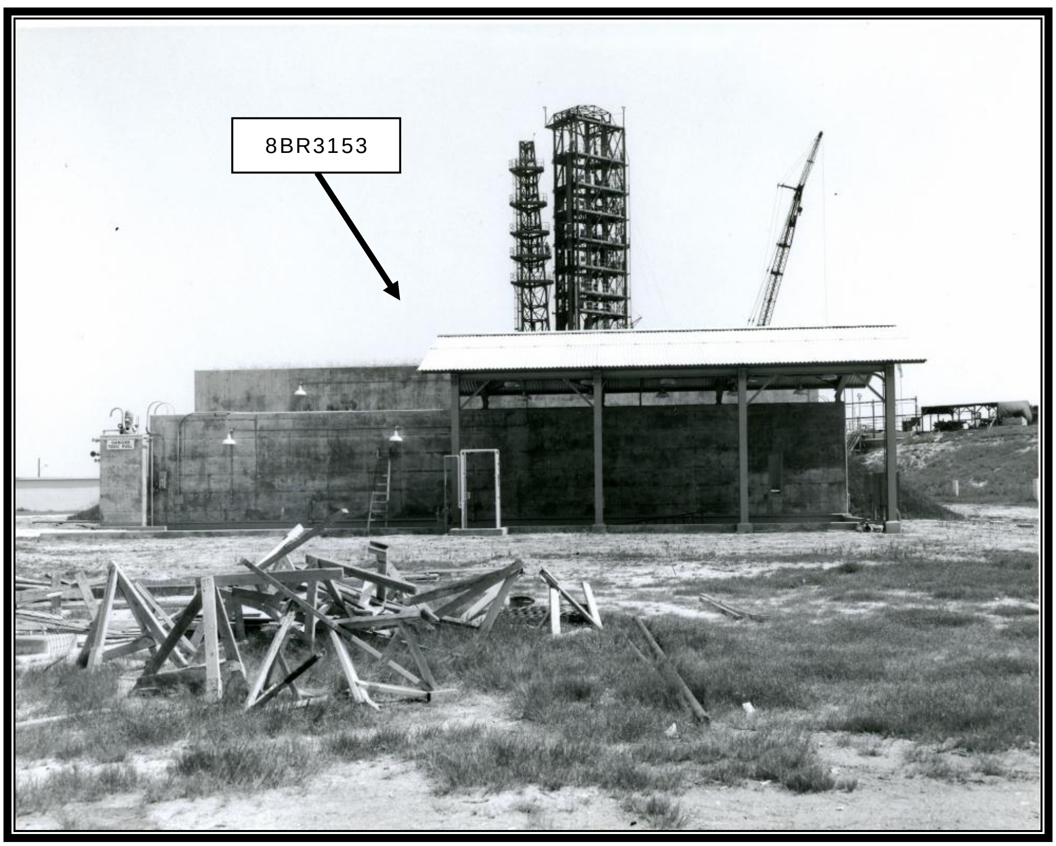

Figure 34. Photograph from 1963 of Facility 15531 (Photograph courtesy of the AFS&MM).

scrubbed and then conveyed to the launch complex where they are offloaded into ASTs. From here they are conveyed to the launch stand and ramp via an above ground cross country pipeline (PanAm 1960, 1963, 1965, 1967, 1969, 1971, 1973, 1975, 1977; SGS 1998, 2000, 2003, 2005, 2008; 45 SW Real Property 2014).

When originally built it looked almost identical to Facility 15500AD-Liquid Hydrogen Holding Area. The fuel holding area is located 30.5 m (100 ft) southwest of the test stand. The fuel holding area consisted of the fuel tank area, transfer/control room, and truck access area (Figure 34). The tank area is a 5.5 x 16.7 m (18 x 55 ft) concrete trough enclosed by 4.0 m (13 ft) walls. The "trough" surrounded the AST and protected the surrounding site from potential fuel spills Earth berms were constructed on the north, east, and west sides of the AST area to increase the blast protection of the tank. For launch personnel to reach the tank, a concrete and steel stairway, constructed on the south side, accessed a steel ladder and walkway. A concrete and steel stairway and walkway was located on the south side of the trough for access to the fuel tank by launch personnel. An open concrete drive, located next to the transfer/control room, became the transfer location of the oxidizer from the truck to the tank. A steel-grate area drain spanned the length of the drive to collect spills that may occur. The spills were then drained to a contaminated fuel holding area. From my experience of working ten years in launch support there should be a vapor “stack” (tall metal pipe chimney) to vent vapors as needed. No vapor stack was observed in the historic photographs nor is one shown in the BIGs.

From 1963 to 1970 the facility was identified in the BIGs and 45 SW Real Property Holding Area (Former Facility 15500AF). From 1973 to 1976 the designation was changed to Facility 15531-Contaminated Liquids Tank. The facility reportedly served as a drum crushing operation and a waste liquid storage area for an approximate 10-year period from the late 1970’s to the late 1980’s. In 1977 and until 1992 Facility 15531 was identified as the Contaminated Liquids Storage-CX 20 (PanAm 1963, 1965, 1967, 1969, 1971, 1973, 1975, 1977; Parsons Engineering 1999; 45 SW Real Property 2014).

Then in 1993 it was changed again to just Contaminated Liquids Storage. It retained that name until 2003. As can be seen in Figure 35 the facility remained abandoned in place without its AST through the 1990s. In 1997 the facility, along with the entire launch complex was under NASA ownership (JCWS 1993, 1995, 1997; 45 SW Real Property 2014).

Figure 35. Aerial photograph from February 1990 of the LC-20 configuration for the *Starbird* program (USAF 1990b).

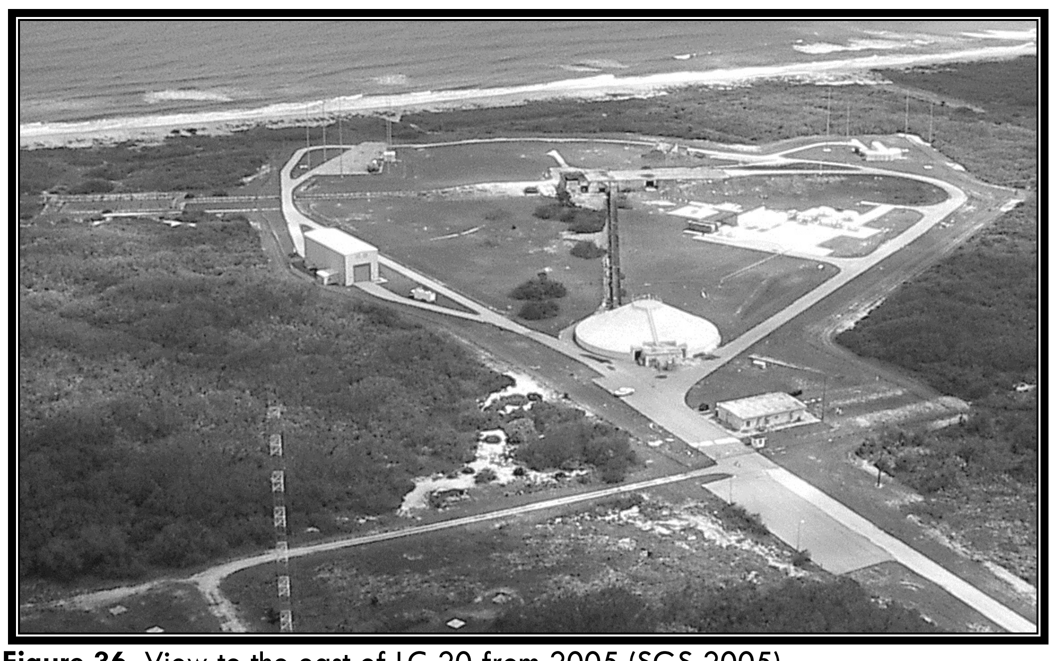

Figure 36. View to the east of LC-20 from 2005 (SGS 2005).

Beginning in 2003 there were significant changes to the facility. At that time the name was changed to Facility 15531-Liquids Storage. It was partially demolished so only the berms and three retaining walls remained, a large AST was added, and a large paved area was created along with the addition of three facilities: Facility 15614-Equipment Building, Facility 15615-Substation, and Facility 15616-Substation. In 2005 the area became a large chemical processing area primarily associated with liquid oxygen (LOX). The facility was renamed to Facility 15531-Retaining Wall. Nine new facilities were added including a nitrogen storage tank area (Fac. 15603), two storage buildings (Facs 15610 and 15611), two LOX ASTs (fac. 15605 and 15607), Facility 15608-Power Storage, Facility 15609-Control Center, and an elevated cableway (Facility 15620) from the blockhouse to this location (Figure 36). However, by 2010 the complex was abandoned in place and by 2012 was back in USAF ownership (InDyne Inc. 2010; SGS 2003, 2005, 2008; 45 SW Real Property 2014).

5.5.3.3 Description

Today little remains of Facility 15531. Most of the components of the original Oxidizer Holding Area are gone. All that remains of the original facility is the earthen berms and concrete retaining walls. Also most of the ca. 2003-2005 structures have been removed as well (Figures 37 and 38).

5.5.3.4 Integrity

Facility 15531-Retaining Wall (8BR3153) has never been moved and still sits at the same location where it was constructed at LC-20 in 1962. The structure's setting and design illustrates the military industrial character of CCAFS and its launch complexes. The original concrete block and poured concrete materials that make up part of the structure are still intact. The standardized military workmanship is no longer intact. All the equipment associated with its use as an oxidizer storage facility have been removed. The building no longer retains its integrity of feeling or its ability to evoke the sense of its historic past and period of significance. All that remains is the part of the general structure and remnants of the 2003-2005 use of the facility.

5.5.3.5 NRHP Eligibility

Looking at the three methods of determining significance and NRHP eligibility, Facility15531-Retaining Wall (8BR3153) has no association with the Man in Space thematic study.

Figure 37. View to the west of the Facility 15531 area.

Figure 38. View to the northwest of the Facility 15531 area.

Using the criteria established by Lewis et al. (1995), 15531-Retaining Wall (8BR3153) played a minor role in the Cold War through a very limited association with the development of the *Titan III ICBMs*. Only four *Titan III* missiles were launched from LC-20 and it was quickly abandoned after the end of the program.

Looking at the NRHP criteria, Facility 15531-Retaining Wall (8BR3153) does not meet the criteria for listing in the NRHP. It played a very minor role in the Cold War through a very limited association with the development of the *Titan III ICBMs*. Only four *Titan III* missiles were launched from LC-20 and it was quickly abandoned after the end of the program. This style of construction was used for oxidizer, hyrdrazine, RP-1, RP-4, liquid nitrogen, and a host of similar fuel farms within the launch complexes at CCAFS and is considered typical of those facilities. Better examples remain at LCs 14, 19 and 34 which are components of the Man in Space NHL district. Finally, there is very little of the facility left intact.

5.5.4 Facility 15500B-Launch Stand and Ramp (8BR3154)

5.5.4.1 Location

Facility 15500B-Launch Stand and Ramp (8BR3154) is located at the center of the complex. It is the SW¼ of Section 5 in Township 23 South and Range 38 East of the *False Cape* United States Geological Survey (USGS 1984) Quadrangle Map (Figure 39).

5.5.4.2 History

Facility 15500B-Launch Stand and Ramp (8BR3154) was constructed between 1957 and 1959 for the *Titan-I* program (Figure 40). The pivotal point of the launch pad is the launch stand and ramp (also known as the launch support building or LSB in some documents). Extending off the south side of the launch stand and ramp is the 91.4 m (300 ft) paved approach ramp. Extending to the north was the test stand, flume, and deluge basin. Directly on top, was the launch deck that supported the erector/service towers (erectors) and vehicle transporters. The launch stand was a multipurpose structure used to support the launch vehicle. The main function was to conduct the prelaunch checkout of the launch vehicle. Several mechanical systems within the building supplied the launch vehicle with power, instrumentation, communication and propellant lines, as well as hydraulic and pneumatic pressure (InDyne Inc. 2010; JCWS 1993, 1995, 1997; PanAm 1960, 1963, 1965, 1967, 1969, 1971, 1973, 1975, 1977; SGS 1998, 2000, 2003, 2005, 2008; 45 SW Real Property 2014).

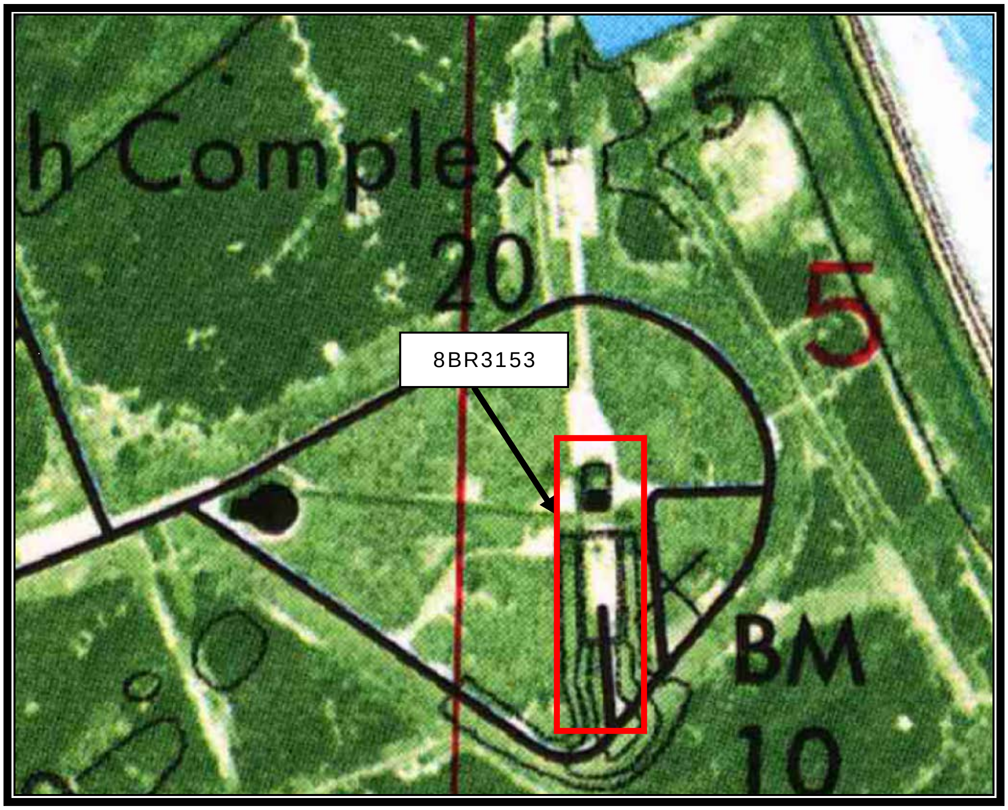

Figure 39. USGS map showing the location of Facility 15500B-Launch Stand and Ramp (8BR3154) (USGS 1984).

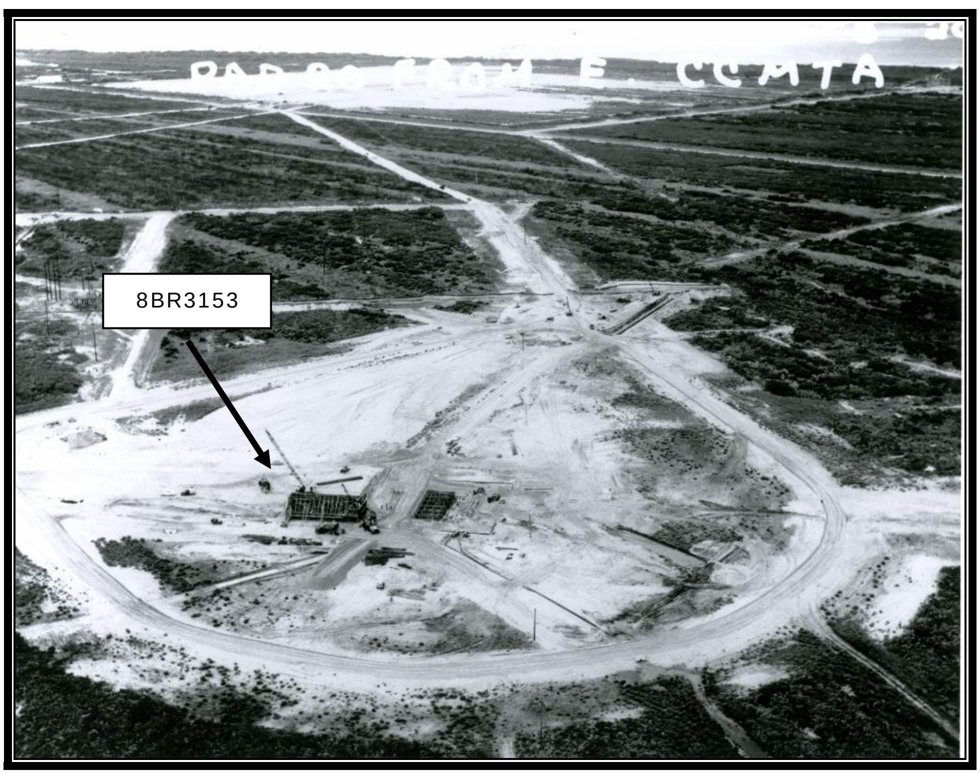

Figure 40. Photograph from 1957 of LC-20 under construction with Facility 15500B-Launch Stand and Ramp (8BR3154) in the foreground (USAF 1957).

The two-story Launch Stand and Ramp is constructed of steel framing and reinforced concrete. When it was originally constructed it was 20.4 m (67 ft) wide and 137.1 m (450 ft) long. Housed on the first floor were the Terminal Room, Hydraulic Checkout Room, and a combination Equipment and Shop area. Located in the second floor was the Instrumentation/Shop area. The roof functioned as the launch deck. The reinforced concrete and steel surface allowed launch vehicle transporters to deliver the *Titan-I* missile stages to the two staging areas as well as provide a horizontal surface for the erectors (Figure 40).

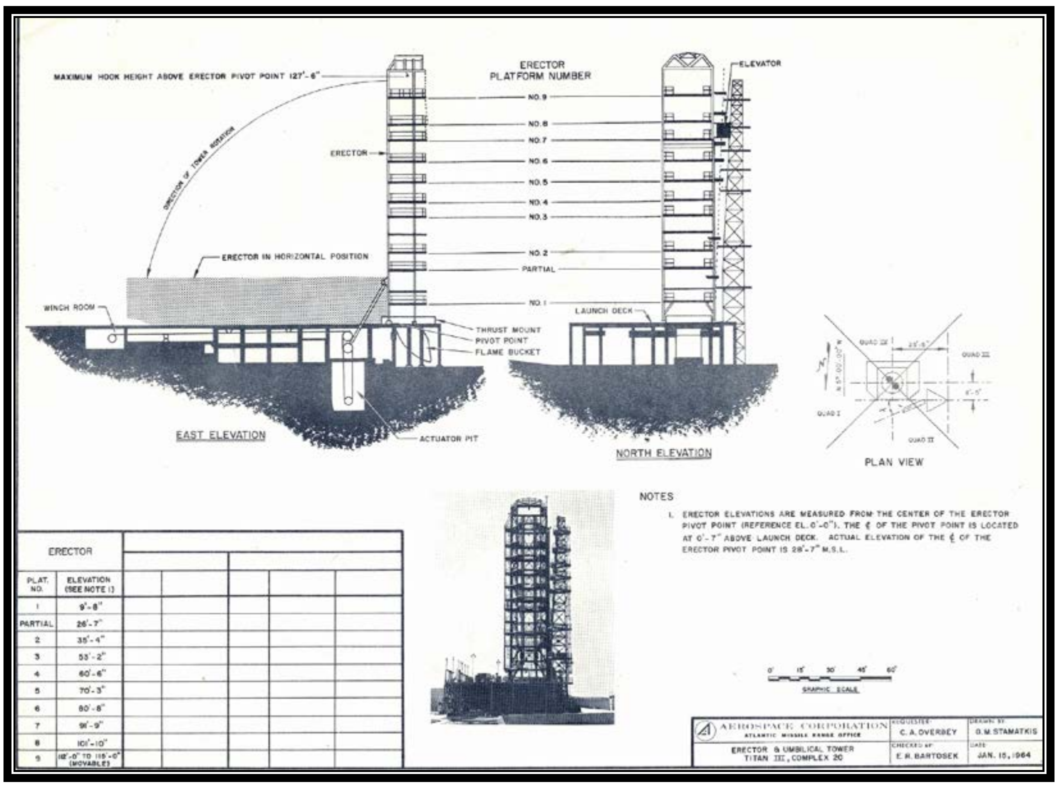

Figure 41. Diagram of the launch gantry at Launch Complex 20 (Aerospace Corporation 1964).

The actuator pit, located in the north end of the Launch Stand and Ramp, contained hydraulic and pneumatic pressure units used to raise and lower the erectors. The pit was a four-story room with of the levels below ground. The equipment, connected to a winch cableway and winch pit, was located in the south end of the Launch Stand and Ramp. The winch activated the hydraulic equipment. Each erector contained two steel "arms ". The arms extended through the actuator slots on the launch deck to push the erector into position. The erector pivoted around the load strut and came to rest over the test stand (Figure 41).

Now gone, there were two staging areas on the Launch Stand. Each staging area consisted of a launch mount, thrust mount, and flame bucket). The uppermost part of each staging area was the launch mount. The west mount consisted of a fixed-in-place, steel-frame mount containing four steel arms that locked the missile in place. Each arm contained an explosive bolt that when sufficient thrust was attained during launch, each bolt exploded and the missile lifted from the pad. The east mount consisted of two smaller steels rings with four wedge-shape supports that vertically cradled the stage during testing. Located directly below each thrust mount was a "wet" flame bucket. The deluge, or "wet" system, was a series of pipes and nozzles constructed as an integral part of each bucket that sent thousands of gallons of water onto the launch deck, UT, erector, flame bucket, roadway and pad. The purpose of the flame buckets was to direct the blast, away from the missile, launch stand and ramp and sensitive launch equipment. It was also used to cool surrounding equipment, dilute spewed propellants, and provide sound attenuation (Figure 41).

The two side-by-side erectors installed at LC-20 were steel-frame, multi-level towers used to position the first and second stages of the *Titan I* missiles into a vertical position. The purpose of the 33.5 m (110-ft) west erector, the larger of the two, was twofold. First, the erector raised the first stage of the Titan I missile into place to conduct static firing. Second, the erector was used to mate the first and second stages of the *Titan I* missile. The smaller east erector, approximately 15.2 m (50-ft) tall, raised the second stage of the *Titan I* missile into a vertical position for static firing. Once testing was completed on both stages, both erectors returned to a horizontal position. While the first stage remained in the vertical position the second stage was lowered and placed into the lowered west erector. Then, the second stage was again raised to a vertical position and mated to the first stage as can be seen in Figure 42.

While remaining in the vertical position, both erectors acted as service towers for launch personnel. Numerous platforms on each erector wrapped around their respective vehicle to allow personnel to conduct final mating procedures and prelaunch checkout. The west erector contained seven work platforms connected by a steel-rung ladder and elevator. The east erector contained a single steel stairway. Prior to static firing the stages and during missile launch the erectors returned to their horizontal position on the launch deck. Although the erectors remained on the launch deck during testing or launch, they sustained very little damage from the blast.

Figure 42. First and second *Titan* stages being erected at LC-20 (USAF 1964b).

During the conversion of LC-20 to the *Titan III* program, the physical structure of the launch stand and ramp was not modified. The introduction of new propellant, communication and monitoring systems, however, required extensive modification to the original mechanical systems within the launch stand and ramp Also, the launch stand and ramp was outlined with additional air conditioning, communication and power systems to specifically support the missile. Propellant lines were replaced to support the new fueling requirements of the missile. Propellant piping from both the oxidizer and fuel area was routed through the launch stand and ramp via a new oxidizer and fuel distribution shelter.

In the 1990s most of the components of the Launch Stand and Ramp were demolished or removed. The rooms within the facility were converted for use as part of the *Red Tigress* program. In 1990, it was renamed Facility 15507-Electric Gear/Transformer Building, BMDO and retains that name to this day (InDyne Inc. 2010; JCWS 1993, 1995, 1997; SGS 1998, 2000, 2003, 2005, 2008; 45 SW Real Property 2014). In 2011, the actuator pit was opened and drained of groundwater as part of a contamination cleanup. It was then sealed.

5.5.4.3 Description

Today the facility is in a ruinous state. Very little of the original components remain. It is essentially the outer concrete walls that remain. All the exterior doors have been removed and some of the entrances are sealed. The exterior metal stairways are on the verge of collapse. There is spalling concrete on all the exterior walls. The railings on the launch deck are severely corroded. The actuator pits were cleaned in 2011 and access to them have been covered with plywood panels. Interior rooms contain spalling concrete and are deteriorating. Some of the rooms contain their original electrical system components. Areas of the floor have metal panels that allow access to cableways in the floor (Figures 43 through 46).

5.5.4.4 Integrity

Facility 1500B-Launch Stand and Ramp (8BR3154) has never been moved and still sits at the same location where it was constructed at LC-20 in 1962. The structure's setting and design illustrates the military industrial character of CCAFS and its launch complexes. The original concrete block and poured concrete materials that make up part of the structure are still intact. The standardized military workmanship is no longer intact. All the equipment associated with its use have been removed. The building no longer retains its integrity of feeling or its ability to evoke the sense of its historic past and period of significance.

5.5.4.5 NRHP Eligibility

Looking at the three methods of determining significance and NRHP eligibility, Facility 1500B-Launch Stand and Ramp (8BR3154) has no association with the Man in Space thematic study.

Using the criteria established by Lewis et al. (1995), Facility 1500B-Launch Stand and Ramp (8BR3154) played a minor role in the Cold War through a very limited association with the development of the *Titan I and III ICBMs*. Only 20 *Titan* missiles were launched from LC-20 over a four year period and it was quickly abandoned after the end of the program.

Looking at the NRHP criteria, Facility 1500B-Launch Stand and Ramp (8BR3154) does not meet the criteria for listing in the NRHP. It played a very minor role in the Cold War through a very limited association with the development of the *Titan* ICBMs and it was quickly abandoned after the end of the program. This style of construction is considered typical of those launch complexes along ICBM Road. Better examples remain at LCs 14, 19 and 34 which are

Figure 43. Wide view to the southwest of Facility 15500B.

Figure 44. View to the southwest of the main section of Facility 15500B.

Figure 45. Interior photograph of Facility 15500B showing current conditions.

Figure 46. Interior photograph of Facility 15500B showing current conditions and electrical components from the *Red Tigress* program.

components of the Man in Space NHL district. Finally, there is very little of the facility left intact.

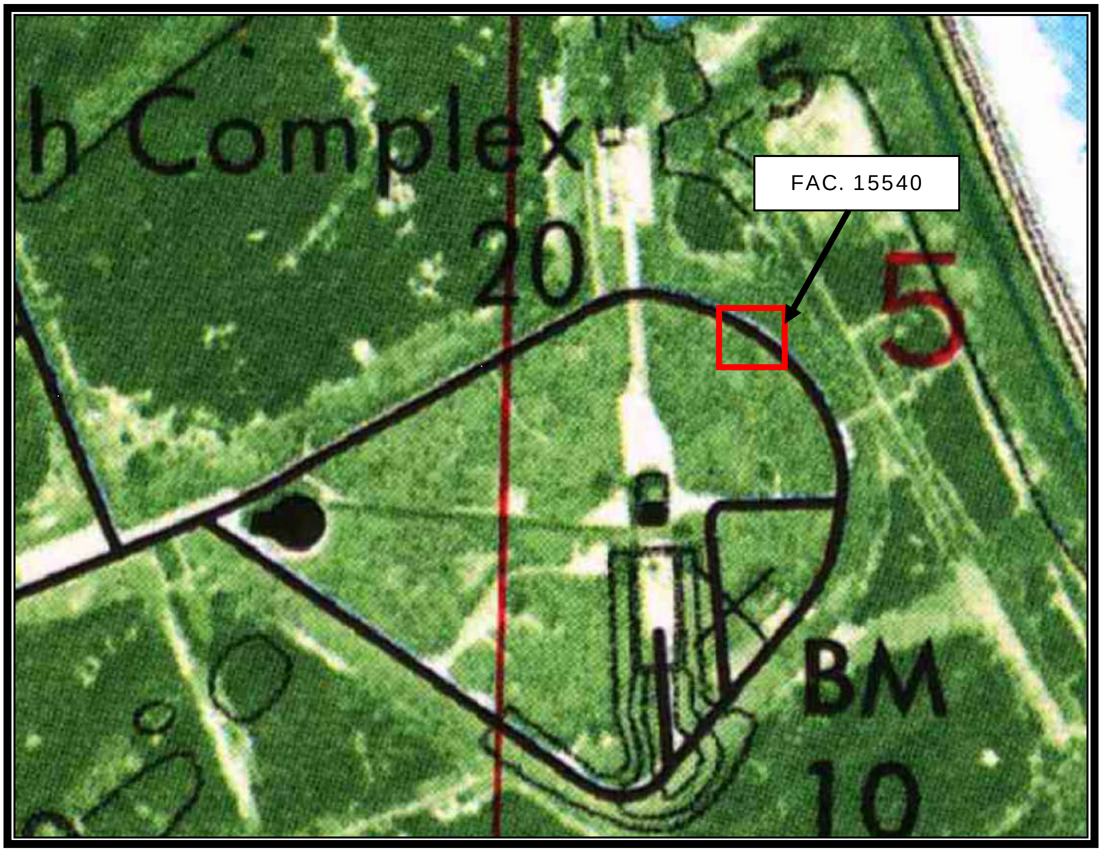

Figure 47. USGS map showing the location of Facility 15540- Launch Pad A-BMDO (USGS 1984).

5.5.5 Facility 15540-Launch Pad A-BMDO

5.5.5.1 Location

Facility 15540-Launch Pad A-BMDO is located at the northeast corner of the complex. It is the SW¼ of Section 5 in Township 23 South and Range 38 East of the *False Cape* United States Geological Survey (USGS 1976) Quadrangle Map (Figure 47).

5.5.5.2 History

Considering the recent nature of the construction of this facility it was assumed there would be a wealth of information. However, this was not the case. Facility 15540 was constructed in 1989 for the *Starbird* rocket program on top of the *Titan* program LOX Holding Pond (Figure 47). When constructed it consisted of a rectangular shaped poured concrete launch pad measuring 2.3 x 2.3 m (25 x 25 ft) with a 15 x 24-m (50 x 80 ft) work apron, four lightning protection masts, metal launch rail, and a launch equipment building (Facility 15541) (Figures 48 and 49). The

Figure 48. Photograph from 1989 showing Facility 15540-Launch Pad A-BMDO under construction (Bionetics Corp. 1989a).

Figure 49. Photograph from 1993 showing Facility 15540-Launch Pad A-BMDO (Bionetics Corp. 1993a).

rocket was launched by raising the rocket via rail to the selected trajectory.

According to the 45 SW Real Property records and BIGs Facility 15540 was originally identified as Facility 15540-Launch Pad A: Starbird and two years later the name was changed to its current designation. The facility was also used for the *Prospector-I/Joust-I* mission and the *Red Tigress* program. It was abandoned in place by 1995 (InDyne Inc. 2010; JCWS 1993, 1995, 1997; PanAm 1960, 1963, 1965, 1967, 1969, 1971, 1973, 1975, 1977; SGS 1998, 2000, 2003, 2005, 2008; 45 SW Real Property 2014).

Figure 50. View to the east of Facility 15540-Launch Pad A-BMDO

5.5.5.3 Description

Today the facility remains abandoned in place and essentially unchanged. The launch rail has been removed and only the mounting ring remains (Figure 50).

5.5.5.4 Integrity

The facility's setting remains and retains its original design. The original materials that make up the facility are still intact except the most important component, the launch rail has been removed.. The standardized military workmanship is intact.

75.5.5.5 NRHP Eligibility

Facility 15540-Launch Pad A-BMDO was constructed in 1989. It is less than 50 years old and served as a launch complex to a series of very short lived rocket programs in 1993. It does not meet any of the criteria for listing in the NRHP.

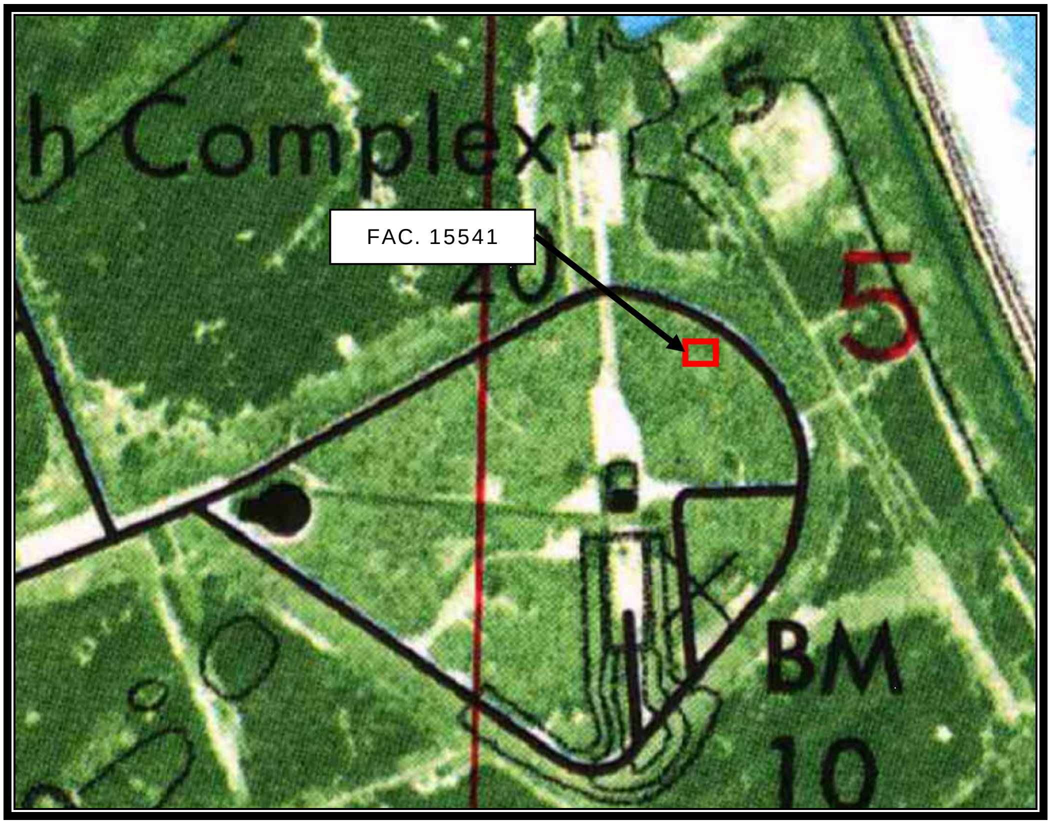

Figure 51. USGS map showing the location of Facility 15541-Equipment Building (USGS 1984).

<u>5.5.6 Facility 15541-Equipment Building</u>

5.5.6.1 Location

Facility 15541-Equipment Building is located at the northeast corner of the complex within Facility 15540-Launch Pad A-BMDO. It is the SW¼ of Section 5 in Township 23 South and Range 38 East of the *False Cape* United States Geological Survey (USGS 1984) Quadrangle Map (Figure 51).

5.5.6.2 History

Facility 15541 was part of the *Starbird* rocket program built on top of the *Titan* program LOX Holding Pond in 1989. It was used to house electrical equipment associated with launch operations at the pad. According to the 45 SW Real Property records and BIGs it was originally

Figure 52. View to the northeast of Facility 15541-Equipment Building.

Figure 53. View to the west of Facility 15541-Equipment Building.

identified as Facility 15541-Equipment Building: Pad A and two years later the name was changed to its current designation. The facility was also used for the *Prospector-1/Joust-1* mission and the *Red Tigress* program. It was abandoned in place by 1995 (InDyne Inc. 2010; JCWS 1993, 1995, 1997; SGS 1998, 2000, 2003, 2005, 2008; 45 SW Real Property 2014).

5.5.6.3 Description

Today the facility remains abandoned in place and essentially unchanged. Facility 15541 is a rectangular-shaped building totaling 103.9 sq m (341 sq ft). The building sits on top of the launch pad slab which serves as the floor and foundation. The walls and roof are constructed of poured concrete slabs. On the east side are two curved metal vents. On the south side are two metal doors which open into two separate rooms. Over the doors is a cantilevered metal shed-style roof (Figures 52 and 53).

5.5.6.4 Integrity

The facility's setting remains and retains its original design. The original materials that make up the facility are still intact. The standardized military workmanship is intact.

5.5.6.5 NRHP Eligibility

This facility was constructed in 1989. It is less than 50 years old and served as a launch complex to a series of very short lived rocket programs in the 1990s. It does not meet any of the criteria for listing in the NRHP.

<u>5.5.7 Facilities 15608-Power Center and 15609-Control Center</u>

5.5.7.1 Location

The two facilities are located within the south central portion of the complex at the site of Facility 15531. They are found in the SW¼ of Section 5 and SE ¼ of Section 6 in Township 23 South and Range 38 East of the *False Cape* (USGS 1984) Quadrangle Map (Figure 54).

5.5.7.2 History

Both facilities were constructed in 2003 when the Facility 15531 was used to process chemicals and have always been identified by the current nomenclature. They have always served as instrumentation facilities from 2003 until 2010 when abandoned in place (InDyne Inc. 2010; SGS 2003, 2005, 2008; 45 SW Real Property 2014).

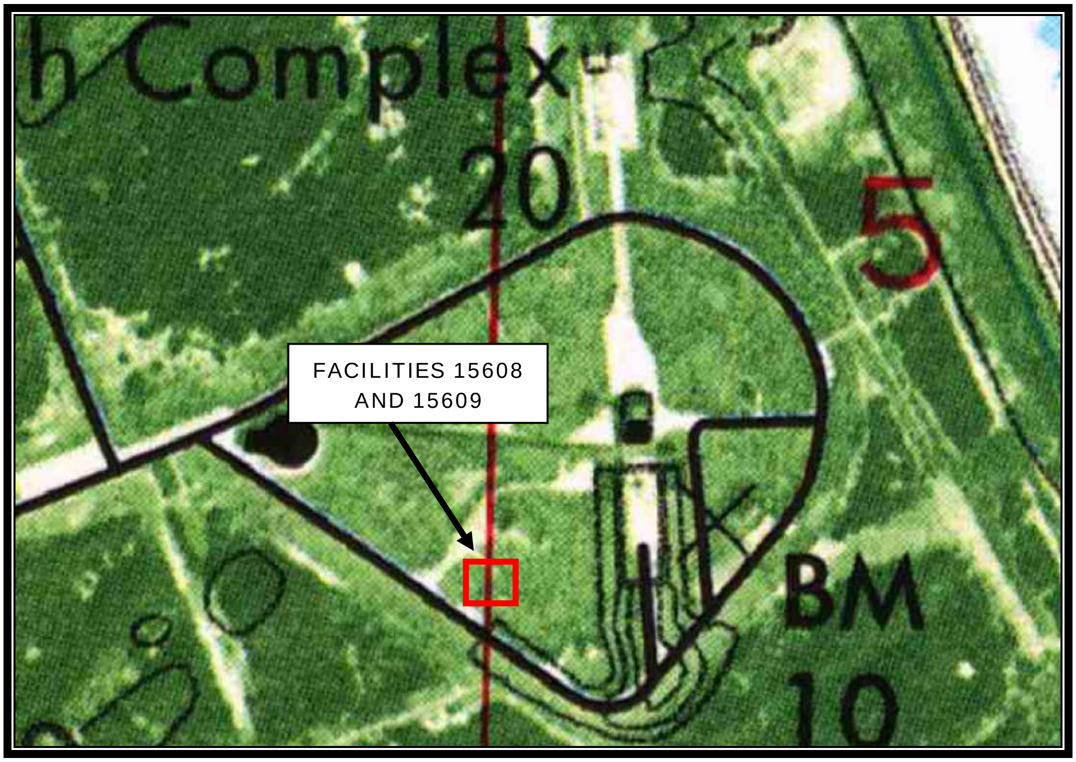

Figure 54. USGS map showing the location of Facilities 15608-Power Center and 15609-Control Center(USGS 1984).

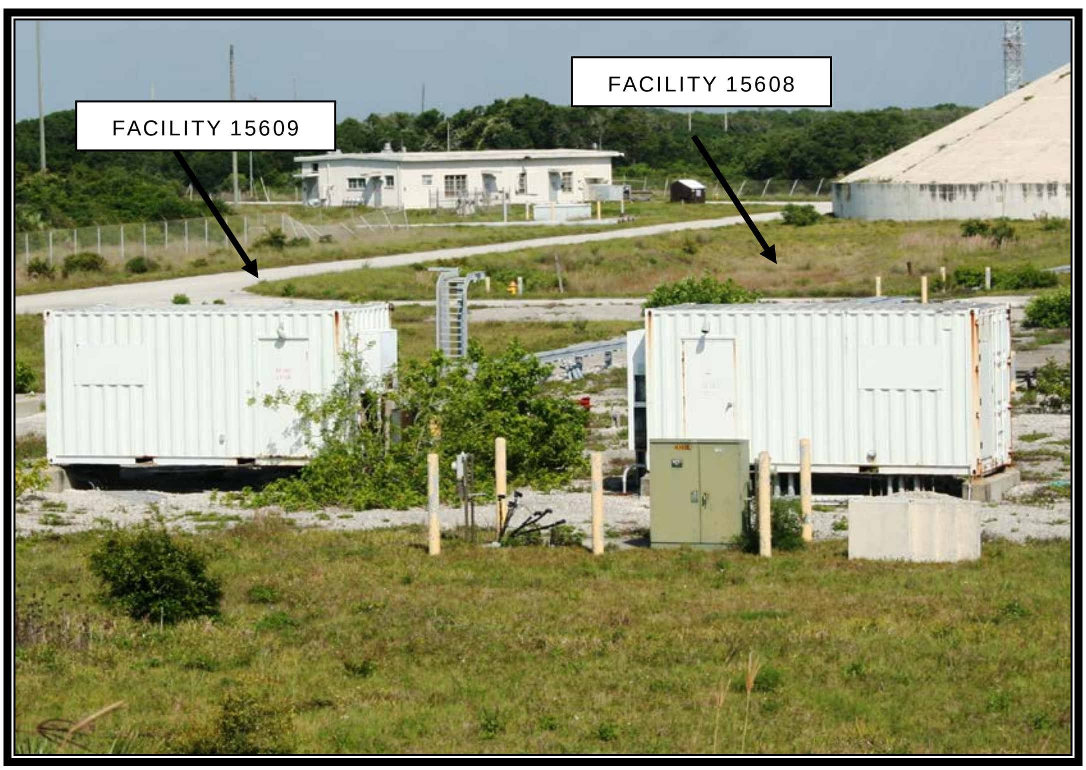

Figure 55. View to the west of Facilities 155608 and 15609.

5.5.7.3 Description

The two structures are identical. They are rectangular modular structures with all four walls and roof constructed of steel frames covered with metal panels. Each measures 36.6 sq m (120 sq ft) in size. They set on poured concrete piers. Access is via poured concrete steps leading to metal panel doors. At one end of each is an air conditioning unit and both structures appear to once have contained a single rectangular-shaped window that have been sealed with a metal panel (Figure 55).

5.5.7.4 Integrity

The facilities settings remain and retain their original design. The original materials that make up the facility are still intact.

5.5.7.5 NRHP Eligibility

These structures were moved to the site in 2003 and served as instrumentation facilities for approximately seven years. They do not meet any of the criteria for listing in the NRHP.

<u>5.5.8 Facility 15640-Launch Pad B-BMDO</u>

5.5.8.1 Location

Facility 15640-Launch Pad B-BMDO is located at the southeast corner of the complex. It is the SW¼ of Section 5 in Township 23 South and Range 38 East of the *False Cape* United States Geological Survey (USGS 1984) Quadrangle Map (Figure 56).

5.5.8.2 History

Facility 15640 was constructed in 1989 for the *Starbird* rocket program at the same time as facility 15540 (Figure 57). When constructed it consisted of a rectangular shaped poured concrete launch pad measuring 2.3 x 2.3 m (25 x 25 ft) with a 15 x 24-m (50 x 80 ft) work apron, four lightning protection masts, metal launch rail, and a launch equipment building (Facility 15641). The rocket was launched by raising the rocket via rail to the selected trajectory. However it does not appear that it was actually used to launch rockets.

According to the 45 SW Real Property records and BIGs, Facility 15640 was originally identified as Facility 15640-Launch Pad B: *Starbird* and two years later the name was changed to its current designation. The facility was also used for the *Prospector-I/Joust-I* mission and the

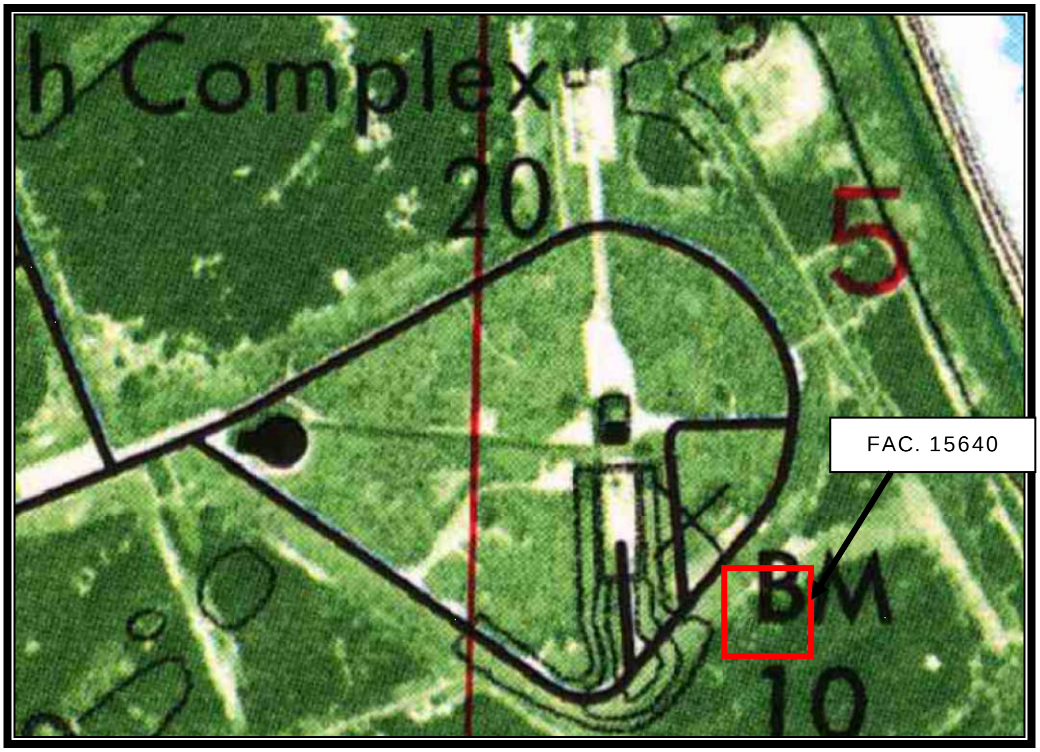

Figure 56. USGS map showing the location of Facility 15640- Launch Pad B-BMDO (USGS 1984).

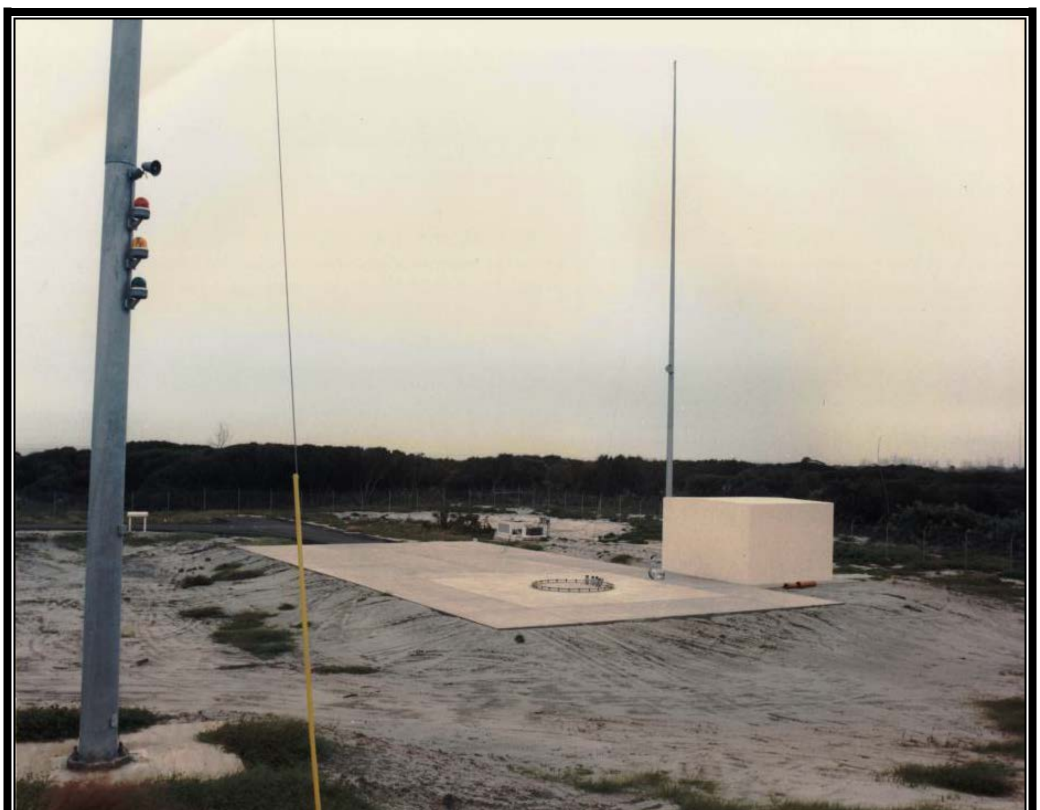

Figure 57. Photograph from 1989 showing Facility 15640-Launch Pad B-BMDO under construction (Bionetics Corp. 1989b).

Figure 58. View to the southwest of Facility 15640-Launch Pad B-BMDO.

Red Tigress program. It was abandoned in place by 1995 (InDyne Inc. 2010; JCWS 1993, 1995, 1997; SGS 1998, 2000, 2003, 2005, 2008; 45 SW Real Property 2014).

5.5.8.3 Description

Today the facility remains abandoned in place and essentially unchanged. The launch rail has been removed and only the mounting ring remains. Metal parts and a square-shaped metal structure of unknown function were observed on the pad (Figure 58).

5.5.8.4 Integrity

The facility's setting remains and retains its original design. The original materials that make up the facility are still intact except the most important component, the launch rail has been removed.. The standardized military workmanship is intact.

5.5.8.5 NRHP Eligibility

Facility 15640-Launch Pad B-BMDO was constructed in 1989. It is less than 50 years old and served as a launch complex to a series of very short lived rocket programs in 1993. It does not meet any of the criteria for listing in the NRHP.

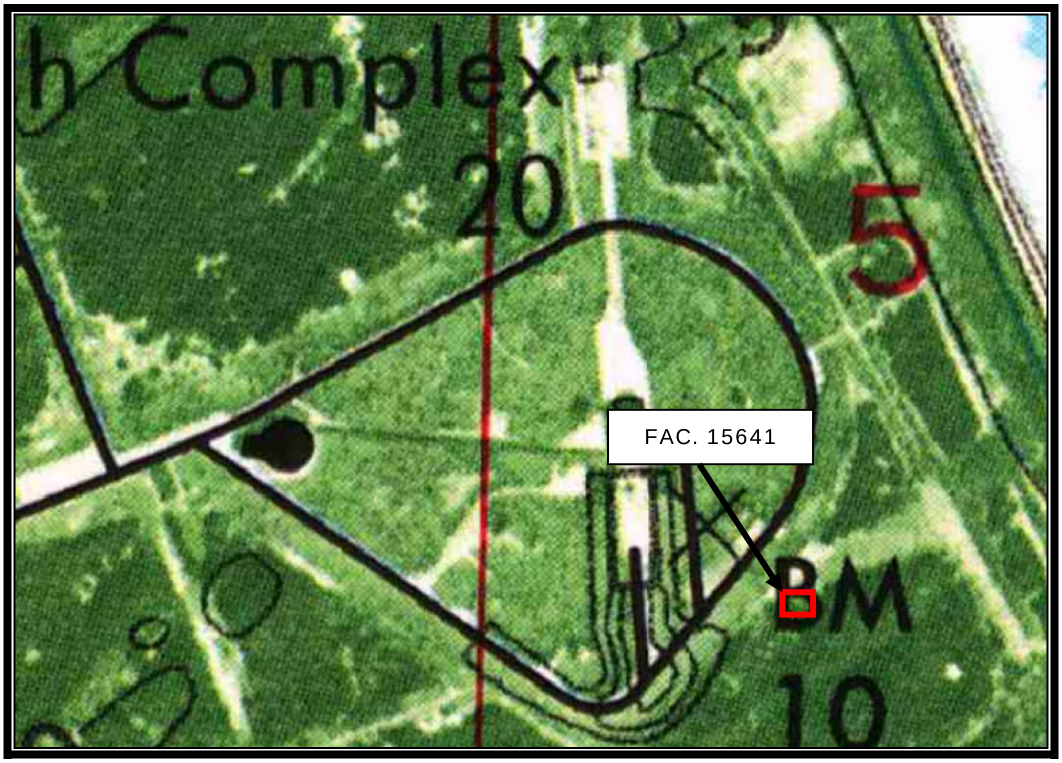

Figure 59. USGS map showing the location of Facility 15641-Equipment Building (USGS 1984).

5.5.9 Facility 15641-Equipment Building

5.5.9.1 Location

Facility 15641-Equipment Building is located at the southeast corner of the complex within Facility 15640-Launch Pad B-BMDO. It is the SW¼ of Section 5 in Township 23 South and Range 38 East of the *False Cape* United States Geological Survey (USGS 1984) Quadrangle Map (Figure 59).

5.5.9.2 History

Facility 15641 was constructed in 1989 to house electrical equipment associated with launch operations at the pad. According to the 45 SW Real Property records and BIGs the structure was originally identified as Facility 15641-Equipment Building: Pad B and two years later the name was changed to its current designation. The facility was also used for the *Prospector-I/Joust-I* mission and the *Red Tigress* program. It was abandoned in place by 1995(InDyne Inc. 2010; JCWS 1993, 1995, 1997; SGS 1998, 2000, 2003, 2005, 2008; 45 SW Real Property 2014).

Figure 60. View to the northeast of Facility 15641-Equipment Building.

Figure 61. View to the west of Facility 15641-Equipment Building.

5.5.9.3 Description

Today the facility remains abandoned in place and essentially unchanged. Facility 15541 is a rectangular-shaped building totaling 103.9 sq m (341 sq ft). The building sits on top of the launch pad slab which serves as the floor and foundation. The walls and roof are constructed of poured concrete slabs. On the east side are two curved metal vents. On the south side are two metal doors which open into two separate rooms. Over the doors is a cantilevered metal shed-style roof (Figures 60 and 61).

5.5.9.4 Integrity

The facility's setting remains and retains its original design. The original materials that make up the facility are still intact. The standardized military workmanship is intact.

5.5.9.5 NRHP Eligibility

This facility was constructed in 1989. It is less than 50 years old and served as a launch complex to a series of very short lived rocket programs in the 1990s. It does not meet any of the criteria for listing in the NRHP.

5.5.10 Facility 18705-Warehouse

5.5.10.1 Location

Facility 18705-Warehouse is located within the north-central portion of the complex. It is the SW¼ of Section 5 in Township 23 South, Range 38 East of the *False Cape*, United States Geological Survey (USGS 1976) Quadrangle Map (Figure 62).

5.5.10.2 History

Facility 18705 was constructed in 1999 by Space Florida when they were leased the launch complex. According to the records the facility was identified as the Quick Reaction Program Horizontal Processing Facility and was under NASA ownership. In 2003, it was identified as the Horizontal Processing Facility, and from 2005 to present it has been known as Facility 18705-Warehouse. It has been under USAF ownership since 2012 (InDyne Inc. 2010; SGS 2000, 2003, 2005, 2008; 45 SW Real Property 2014).

Based on its original name it appears to have been used as a highbay facility to process some type of aerospace component. However, if this was a rocket, missile or some other launch vehicle is unknown. Attempts to identify the ca. 2000 Quick Reaction Program were unsuccessful.

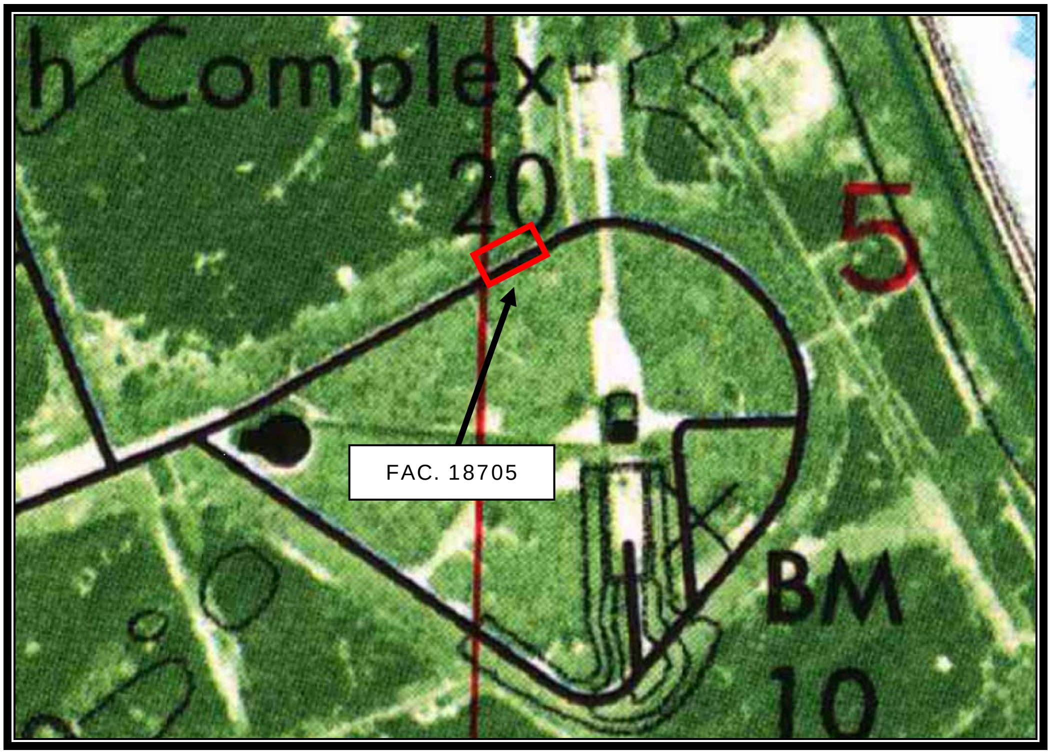

Figure 62. USGS map showing the location of Facility 18705-Warehouse (USGS 1984).

Figure 63. View to the northeast at Facility 18705.

5.5.10.3 Description

Facility 18705 is a 1938.5 sq m (6360 sq ft) building constructed of a steel frame covered with metal panels set on a poured concrete foundation. The central mass is two-stories in height with 1-1/2 story roll up doors on the east and west elevations. The roof is built-up asphalt and pea gravel and has a slight gable. There are single story masses on the north and south side. The north mass is covered with a shed-style, built-up asphalt and pea gravel roof. There are no windows. The south mass is also covered with a shed-style, built-up asphalt and pea gravel roof. There are several windows set in a metal frame. The main entrance to the building is via this mass and it is located on the west side (Figure 63).

5.5.10.4 Integrity

The facility's setting remains and retains its original design. The original materials that make up the facility are still intact. The standardized military workmanship is intact.

5.5.10.5 NRHP Eligibility

This facility was constructed in 1999. It is less than 50 years old and served as nothing more than a warehouse. It does not meet any of the criteria for listing in the NRHP.

<u>5.5.11 Fac.18000-Blockhouse (8BR3155)</u>

5.5.11.1 Location

Facility 18000-Blockhouse (8BR3155) is located within the western portion of the complex. It is the SE¼ of Section 6 in Township 23 South and Range 38 East of the *Cape Canaveral*, United States Geological Survey (USGS 1984) Quadrangle Map (Figure 64).

5.5.11.2 History

The Launch Control Center, also known as the blockhouse, was constructed in 1959 (Figures 65-67) and served as the command center for controlling *Titan I* launch vehicles. All of the blockhouses along ICBM Rd are almost identical in construction and configuration. Those located within LCs 15, 16, 19 and 20 were all constructed with the same set of drawings. The 7936.4 sq m (26,038 sq ft) blockhouse is a reinforced concrete dome approximately 47.5 m (156 ft) in diameter at the base and 15.2 m (50 ft) tall. Construction consisted of a 1.5 m (5 ft) layer of reinforced concrete covered by 2.1 to 5.2 m (7-17 ft) of sand and an additional 10.2 cm (4 in) of shotcrete (a concrete mortar to hold the sand in place). A 20.3-cm (8-in) thick reinforced concrete retaining wall encircled the base of the blockhouse. Located on the west side of the blockhouse

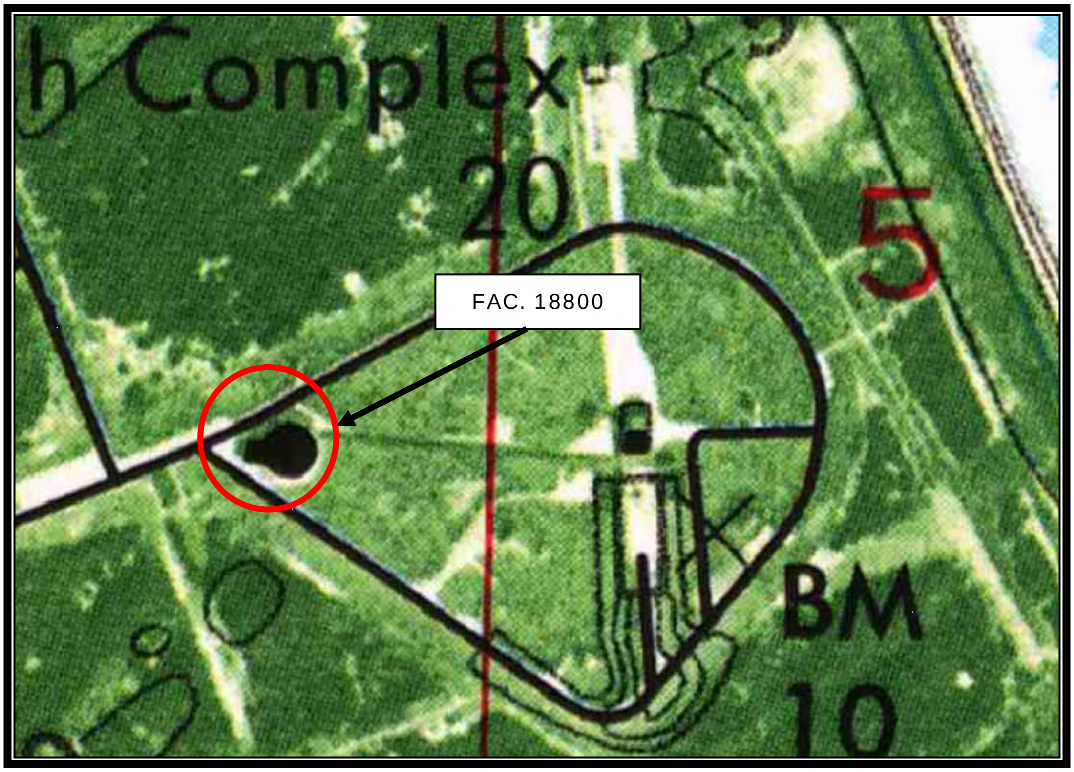

Figure 64. USGS map showing the location of Facility 18800-Blockhouse (8BR3155) (USGS 1984).

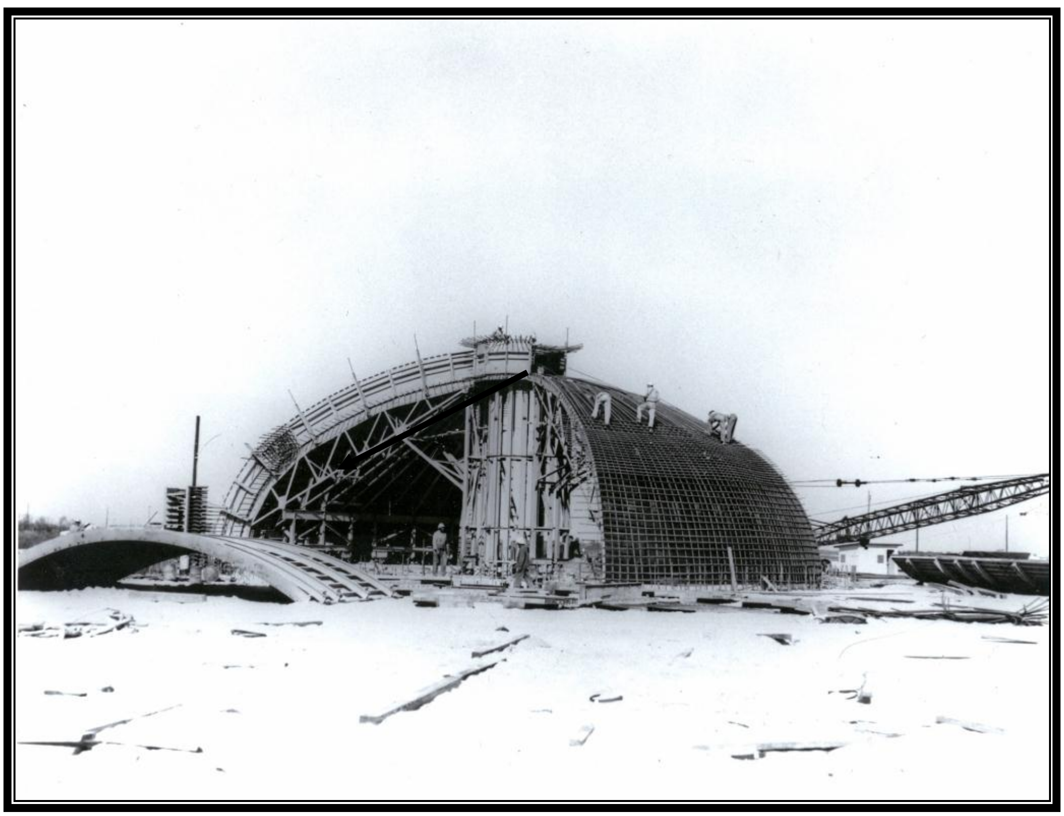

Figure 65. Photograph showing Facility 18800-Blockhouse (8BR3155) under construction (USAF 1959).

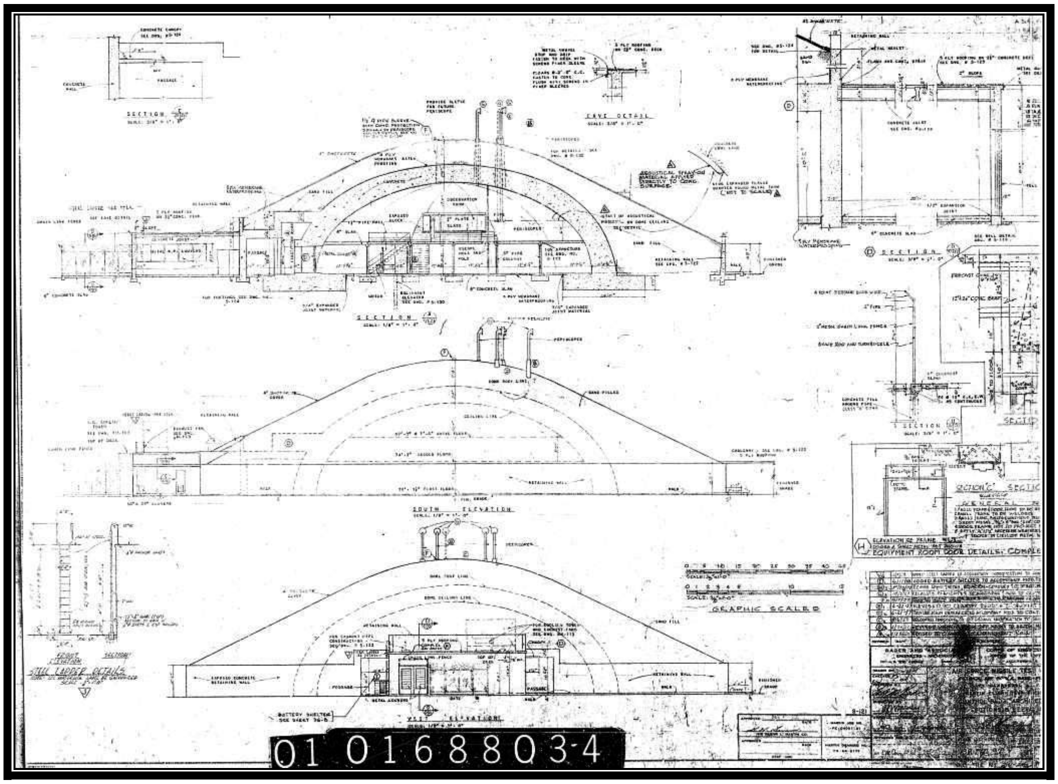

Figure 66. As-built drawing showing the blockhouse at LC-20 (Rader and Associates 1956).

Figure 67. Photograph from 1961 of the LC-20 Blockhouse (USAF 1961b).

was the entrance into the building. A reinforced concrete U-shaped passage, formed by the junction of the blockhouse and the west side utility room, protects the entrance from the launch blast and gases. The equipment room, a flat-roof non-reinforced building, contained a diesel generator and a cooling tower to support the numerous systems in the blockhouse. An octagonal steel-grate viewing stand, located on the roof of the blockhouse, was used by launch personnel to monitor launch proceedings before each launch. At approximately T-20 minutes, terminal count, excess personnel evacuated the complex and a drive mechanism closed and locked the steel security doors. Terminal count was the time at which the potential for an explosion or detonation existed (Figures 65 through 67).

From 1959 to 1965 it was identified as Facility 15500A-Blockhouse from 1959 to 1963 the name was annotated with LC 20. In 1965, the annotation was changed to Launching Test Fac., Complex 20. From 1966 to 1970 the blockhouse was identified as Facility 15500A-Launch Control Bldg. In 1967 and 1969 it was annotated as being deactivated. This suggests that the blockhouse stayed in use through the conversion to the *Titan III* program and launches of the missile. In 1971 the facility had its name and number changed to facility 18800-Data Storage and annotated with the nomenclature MSL/Space RSCH Bldg. It appears to have retained the name and function until 1975 when the name was changed a again to Facility 18800-Blockhouse. The name has not changed from that time (InDyne Inc. 2010; JCWS 1993, 1995, 1997; Maurice H. Connell and Associates 1958; PanAm 1960, 1963, 1965, 1967, 1969, 1971, 1973, 1975, 1977; SGS 1998, 2000, 2003, 2005, 2008; 45 SW Real Property 2014).

While not shown in all the records we do know that the function of the blockhouse never changed after 1975 when it appears to have returned to use as a launch control center. However, it remained unoccupied until 1987-1989 when the pad was modified for the Starbird Program (Figure 68), again in 1991-1993, and again in 2003 with various follow-on launch programs (InDyne Inc. 2010; JCWS 1993, 1995, 1997; PanAm 1965, 1967, 1969, 1971, 1973, 1975, 1977; SGS 1998, 2000, 2003, 2005, 2008; 45 SW Real Property 2014).

The 24.4 m (80 ft) interior diameter of the igloo-shaped blockhouse contained two floors. The first floor was used for general operations, repair, and communications while the second floor contained the actual launch control systems. A protected vestibule gave access to the general work area, a ready room, operations room, instrumentation repair room, communication pit, two escape pits and access to the cableway are also located on the first floor. Equipment

Figure 68. View to the west of the LC-20 Blockhouse during the *Starbird* program (Bionetics Corp. 1990).

supporting first floor operations included range sequencing and control area instrumentation, power systems, and control racks for cables extending out to the launch area. Two reinforced concrete escape pits, one on the north and south sides of the building, provided emergency egress for blockhouse personnel in case of explosion.

The second floor of the Blockhouse contained the actual operations center. Equipment and operations included safety systems, countdown indicators, the flight control and propulsion system, the facilities console, instrumentation racks, test conductor consoles and TV monitors. To permit viewing of the launch stand and pad by personnel within the launch control room, four periscopes, similar to submarine periscopes, extended through the roof of the blockhouse. In addition to the launch support equipment located on the second floor, a glass observation room was included for visiting VIPS. The launch crew consisted of the lead engineer, assistant engineers and the Test Conductor.

The exterior structure of the blockhouse did not require modification to support the follow-

Figure 69. Photograph of the launch control center during the *Titan III* program (USAF 1964c).

Figure 70. Photograph of the launch control center during the *Titan III* program (USAF 1964d).

Figure 71. Photograph of the launch control center during its use in 1993 (Bionetics Corp. 1993b).

Figure 72. Photograph of the first floor office area during its use in 1993 (Bionetics Corp. 1993c).

on launch programs. Numerous instrumentation, communications, power and range sequencing racks and consoles, however, were removed and updated to support the programs. New equipment and operations included the Launch Vehicle (LV) safety system, countdown indicators, a LV test conductor console, the LV flight control and propulsion console, LV facilities console, LV instrumentation racks, spacecraft auxiliary racks, numerous spacecraft test conductor consoles and TV monitors. Additional tracking equipment needed to support the missile programs included pulse radar as well as assorted optical instruments. The changes to the interior between 1964 and 1993 can be seen in Figures 69 through 72

5.5.11.3 Description

Facility 18800-Blockhouse (8BR3155) looks much the same as it did when constructed in 1959. Except for changes in cables access ports and updating the viewing platform on the roof very little has changed. The condition is slowly degrading but the years of use have resulted in maintaining basic upkeep. Since being abandoned in place in 2012 vegetation is beginning to grow out of the surfaces of the dome and corrosion is becoming an issue on the exterior metal (Figures 73 and 74). The interior is empty. All the previous launch related equipment was removed on 2010-2012.

5.5.11.4 Integrity

Facility 18000-Launch Complex 20 Blockhouse (8BR3155) retains its integrity. It has never been moved and still sits at the same location where it was constructed LC-20. The building's setting remains intact and illustrates the military industrial character of CCAFS and its launch complexes. The blockhouse retains its original design. The original concrete block and poured materials that make up the building are still intact. The standardized military workmanship is intact. The building retains its integrity of feeling or its ability to evoke the sense of its historic past and period of significance. All of the above characteristics convey the building's integrity of association between the building and the events associated with its historic context.

5.5.11.5 NRHP Eligibility

Looking at the three methods of determining significance and NRHP eligibility, the LC-20 Blockhouse has no association with the Man in Space thematic study.

Figure 73. View to the east of the LC-20 Blockhouse.

Figure 74. View to the northwest of the LC-20 Blockhouse.

Using the criteria established by Lewis et al. (1995), the blockhouse had a minor relationship in the Cold War through a brief association with the development of the *Titan I and III* missiles. Only a few missiles were launched over a five year period. While the complex was modified for the Titan III missile only 4 were launched from here in 1964. All Titan III operations moved to LCs 40 and 41 in 1965 and the complex was abandoned.

Looking at the NRHP criteria, Facility 18800-Launch Complex 20 Blockhouse (8BR3155) could meet Criterion C the blockhouse for its construction. However, it is almost identical in configuration to LCs 11-16, 19 and 34 with some variations. It is identical to those at LCs 15, 16, and 19. The blockhouse never played a major role in any of the missile programs tested at CCAFS and has sat largely vacant over its 55 year history.

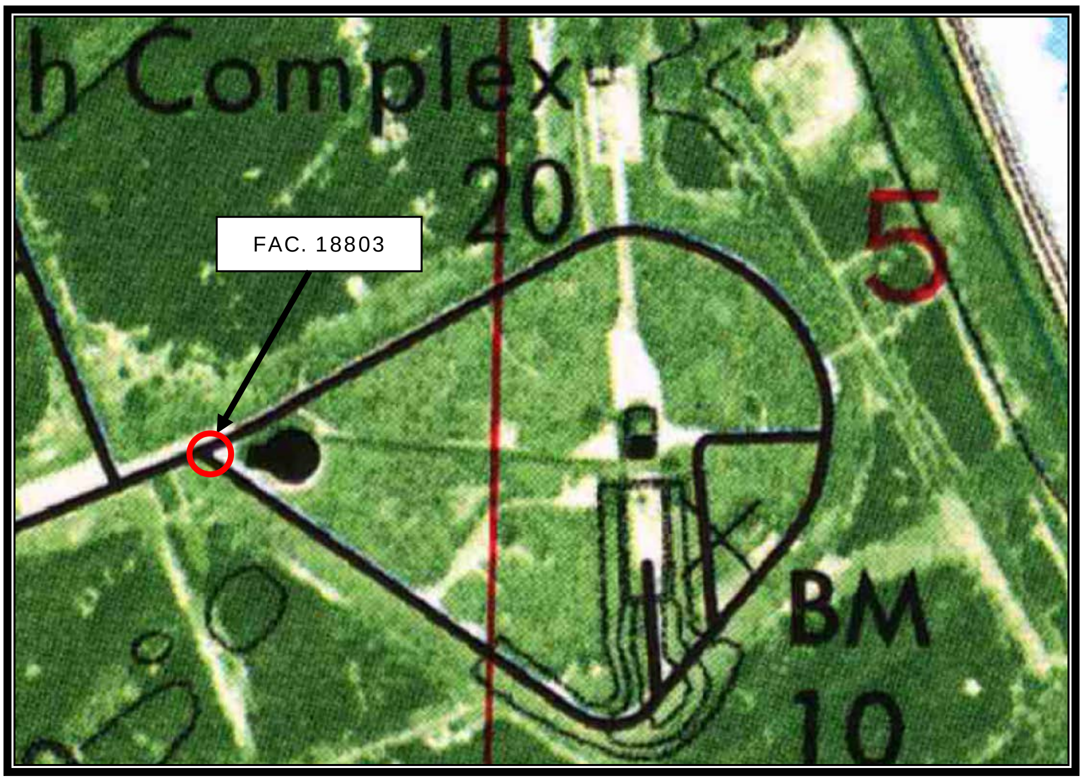

Figure 75. USGS map showing the location of Facility 18003-Guard House (USGS 1984).

5.5.12 Fac.18003-Guard House

5.5.12.1 Location

Facility 18003-Guard House is located within the western portion of the complex. It is the SE¼ of Section 6 in Township 23 South and Range 38 East of the *False Cape*, United States Geological Survey (USGS 1984) Quadrangle Map (Figure 75).

Figure 76. View to the southwest of Facility 18803 (note incorrect facility number on bldg).

Figure 77. View to the southeast of Facility 18803.

5.5.12.2 History

The small wooden building, at the entrance of the complex, was used to monitor all personnel and deliveries entering the complex. However, it is not the original guard shack at LC-20. According to the 45 SW Real Property records (2014) it was moved to its present location in 1990 after the original structure was demolished. The original location is unknown.

5.5.12.3 Description

The 12.2 sq m (40 sq ft) building was built on a 3.6 sq m (12 sq ft) poured concrete slab foundation. Three of the four walls contained double-hung wood windows while the fourth wall contained the wood and glass entrance door. The built-up shed roof extended three feet over the entrance door. It is in very poor condition and on the verge of collapse (Figures 76 and 77). It is designated for demolition in FY 2016.

5.5.12.4 Integrity

Facility 18003-Guard House does not have its integrity. It was moved to the site from another unknown location. While the BIGs and Real Property records indicate it was built in 1990 that may not necessarily be accurate. It has been found at other areas of CCAFS that temporary buildings such as guard shacks may have been built earlier but shown at their new location as being built the day they were moved. The building is in a ruinous state.

5.5.12.5 NRHP Eligibility

Facility 18003-Guard House does not meet any of the criteria for listing in the NRHP. It was been moved to its present location in 1990, the date of construction cannot be determined, and it is typical of guard shacks or sentry houses found in military and industrial settings.

<u>5.5.13 Facility 18806-Payload Assembly Building (8BR3156)</u>

5.5.13.1 Location

Facility 18806-Payload Assembly Building (8BR3156) is located within the western portion of the complex. It is the SE¼ of Section 6 in Township 23 South and Range 38 East of the *Cape Canaveral*, United States Geological Survey (USGS 1984) Quadrangle Map (Figure 78).

5.5.13.2 History

Facility 18806-Payload Assembly Building, originally known as the Ready Building was constructed in 1959 and was used by facility engineers and contractors for prelaunch

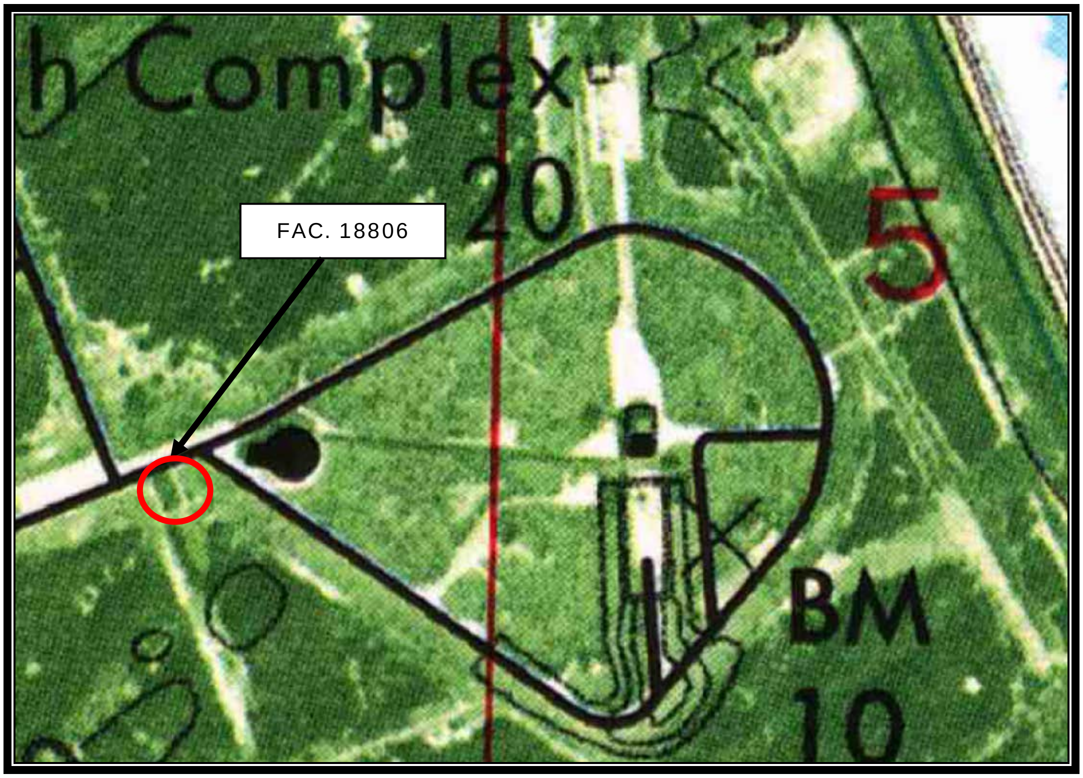

Figure 78. USGS map showing the location of Facility 18806- Payload Assembly Building (8BR3156) (USGS 1984).

administration and briefings. In the 1959 BIG the facility was identified by the map key number 241 and as Ready Building. Annotations indicated it was under construction. The following year it was identified as Facility 15500C-Ready Building and retained that designation until 1971. From 1971 to 1974 it was known as Facility 18806-Data Storage Building with an annotation of MSL/Space RSCH ENG. Suggesting it was used for storage of files and hard copies of documents. In 1975 The name was changed again to Storage Bldg-CX 20 and maintained both the facility number and annotation. From 1979 to 1987, it was known as Security Police Training Building and used by the security contractor for administrative functions. It appears with the introduction of missile programs in the 1990s the building returned to being used for launch related activities. From 1991 through 1999, it was renamed the Payload Assembly Building and used for processing missiles. Three years later it still retained the name but was annotated as Traffic Check HSE. In 2005 the building was identified as being owned by NASA and it retained the same name. In 2012, the building was returned to the USAF from NASA (InDyne Inc. 2010; JCWS 1993, 1995, 1997; Maurice H. Connell and Associates 1958; PanAm 1960, 1963, 1965, 1967, 1969, 1971, 1973, 1975, 1977; SGS 1998, 2000, 2003, 2005, 2008; 45 SW Real Property 2014).

Figure 79. Aerial photograph from 1965 of Facility 18806 (USAF 1965).

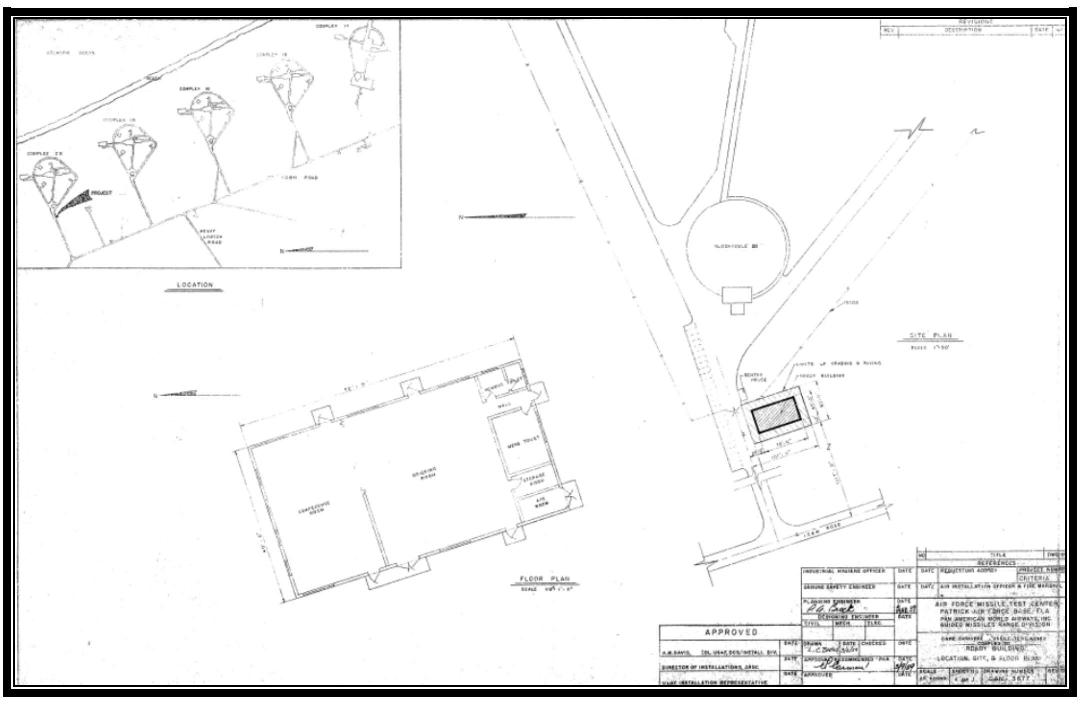

Figure 80. As-built drawing of the LC-20 Ready Building (PanAm 1959).

The original function of the building was to provide office space for the test conductor, lead engineers, and complex manager. Daily test conductor and contractor meetings were also held i n the Ready Room. Before each launch "ready-to-launch" meetings were held. In the 1990s the function of the building changed to processing rockets and their payloads.

Set on a concrete foundation, the 878 sq m (2880 sq ft), rectangular-shaped Ready Building was constructed in 1959 of wood frame clad with corrugated asbestos cement siding and topped by a flat roof. The floor plan for the building incorporated a Briefing Room, Workshop, Test Conductor's office, Office, Conference Room, Heater Room, Storage, and a Men's and Women's Restroom. The public rooms had an asphalt tile floor, walls clad with wood and gypsum board, and an acoustic board ceiling. Windows were four and eight light windows (Figures 79 and 80). In 1990 the building was modified with the installation of a roll-up garage door within the north elevation. The interior was reconfigured to create a large room for processing the smaller rockets launched from the site.

5.5.13.3 Description

Facility 18806 is abandoned in place and in a state of disrepair. It has remained essentially unchanged from its original construction. As previously stated the windows were replaced and a roll up garage door was installed in the north elevation. Entry to the building is via one of several metal slab doors with fixed pane windows set in a metal frame. Over the doors are cantilevered overhangs. The original windows remain in place. The roof contains metal ventilators (Figures 81 and 82).

5.5.13.4 Integrity

Facility 18806-Payload Assembly Building (8BR3156) retains its integrity. It has never been moved and still sits at the same location where it was constructed LC-20. The building's setting remains intact and illustrates the military industrial character of CCAFS and its launch complexes. Facility 18806 retains its original design and materials used for its construction. The standardized military workmanship is intact. Facility 18806 retains its integrity of feeling or its ability to evoke the sense of its historic past and period of significance. All of the above characteristics convey the building's integrity of association between the building and the events associated with its historic context.

Figure 81. View to the southeast of Facility 18806.

Figure 82. View to the northwest of Facility 18806.

5.5.13.5 NRHP Eligibility

Looking at the three methods of determining significance and NRHP eligibility, the Facility 18806 Blockhouse has no association with the Man in Space thematic study.

Using the criteria established by Lewis et al. (1995), Facility 18806-Payload Assembly Building had a minor relationship in the Cold War through a brief association with the development of the *Titan I and III* missiles. Only a few missiles were launched from this complex over a five year period. While the complex was modified for the *Titan III* missile only 4 were launched from here in 1964. All *Titan III* operations moved to LCs 40 and 41 in 1965 and the complex was abandoned. During this period, Facility 18806 served as an administrative center for the complex

Looking at the NRHP criteria, Facility 18806-Payload Assembly Building (8BR3156) does not meet any of the criteria for listing in the NRHP. It is almost identical in configuration to LCs 11-16, 17, 19, 34, 36, 37, 40 and 41 with some variations. It is identical to those at LCs 15, 16, and 19. It is not unique in construction or design and never served a significant function at the complex. Facility 18806 never played a major role in any of the missile programs tested at CCAFS and has sat largely vacant over its 55 year history.

6.0 SUMMARY AND CONCLUSIONS

6.1 Summary

Launch Complex 20 (LC-20) has never been adequately assessed to determine if the complex and the individual facilities within are eligible for listing in the NRHP. The 45 SW CRM conducted a historic properties survey in October and November 2014 to determine if the complex and its individual buildings and structures were eligible for listing in the NRHP.

6.2 Conclusions

Launch Complex 20 (LC-20) consists of 14 facilities, of these a total of four date to its original construction in 1959, two date to the period of use for *Titan-III* launches and the remainder of the date to 1989s or later. The original function of LC-20 was as a R&D facility of the Cold War-era *Titan* ICBM which was a vital component of our nation’s missile defense. However, its contribution to the *Titan I* and *III* missile programs was negligible. Most of the Titan I testing was conducted at LC-19 and only four *Titan III* missiles were launched from the complex before the program was moved to LCs 40 and 41. It later played a minor R&D role in short-lived missile programs R&D in the 1990s. Based on the criteria established by Lewis et al. (1995), LC-20 has a minor Cold War relationship as well as a low rating for identifying the base's role within the national Cold War context. It also has minor importance with respect to science, theories or ideas.

Using the NRHP criteria, the Launch Complex 20 Historic District and its components are not eligible due to the lack of integrity and the fact that it played only a minor role in our nation's defense and missile development history. Also, its eligibility is questionable due to its redundant design and characteristics.

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APPENDIX A

PHOTOGRAPHS

Figure A-1. View to the south of the former flume and basin.

Figure A-2. View of the Launch Stand and Ramp and Facility and Warehouse.

Figure A-3. View to the northeast of the Cableway.

Figure A-4. View to the west of Facility 15500AD.

Figure A-5. View to the southeast of Facility 15531.

Figure A-6. View to the southwest of Facility 15531.

Figure A-7. Top of the Launch Stand and Ramp looking north.

APPENDIX B

AS-BUILT DRAWINGS

APPENDIX C

FMSF FORMS

APPENDIX G

Transportation Concurrence Correspondence

Re: Re-Issue of permit #072919-1 with correct route

Gaddis, Gregory (KSC-SII10) <gregory.gaddis-1@nasa.gov>

Wed 7/31/2019 6:56 PM

To: Priyanka Valletta <pprakash@brph.com>; Huff, Patrick D. (KSC-BOSS-4240)[PAE - SGT Partners LCC] <patrick.d.huff@nasa.gov>

Good Evening Pri...!

The permit isn't a requirement for the EA... and it was me that questioned the use of that specific bridge.

Given the answer Patrick worked up for us, I'm confident there will be no issues with the route...

The specific permit can be worked when the customer is actually within a few weeks of the actual transport...

Hope that helps...!

THANKS!

Greg "Tremendously Awesome" Gaddis
**** It's an attitude... not a self-assessment ****
KSC Master Integrator
Customer Service & Integration Branch
321-861-9556 (Office)

Sent from my iPhone

On: 31 July 2019 18:31, "Priyanka Valletta" <pprakash@brph.com> wrote:

Hi Greg, hi Patrick,

I promise to quit bugging you guys on this one soon. ☺
Can we get a revised permit with the updated vehicle dimensions (12' wide, 14' high)?

So no issues with using the Roy Bridges bridge from a weight limit perspective?

Just wanted to make sure so we're covered for the EA.

Thanks!
Pri

Priyanka Valletta PE
Civil Engineer

EMAIL pvalletta@brph.com
DIRECT 321-751-3095
CELL 321-243-2584
FAX 321-259-4703

BRPH | 5700 North Harbor City Boulevard, Suite 400 | Melbourne, Florida 32940 | **BRPH.com**

Engineering News-Record Top 500 Design Firms - 2018

From: Priyanka Valle a <pprakash@brph.com>
Sent: Tuesday, July 30, 2019 9:41 AM
To: Gaddis, Gregory (KSC-SII10) <gregory.gaddis-1@nasa.gov>
Subject: Re: Re-Issue of permit #072919-1 with correct route

Most likely not until after Jan 2021. Initial launches are targeted for the start of 2021, but the manufacturing may not begin in Florida until later in the year 2021.

Priyanka Valletta PE
Civil Engineer

EMAIL pvalletta@brph.com
DIRECT 321-751-3095
CELL 321-243-2584
FAX 321-259-4703

BRPH | 5700 North Harbor City Boulevard, Suite 400 | Melbourne, Florida 32940 | **BRPH.com**

Engineering News-Record Top 500 Design Firms - 2018

From: Gaddis, Gregory (KSC-SII10) <gregory.gaddis-1@nasa.gov>
Sent: Tuesday, July 30, 2019 8:26 AM
To: Priyanka Valle a <pprakash@brph.com>
Subject: RE: Re-Issue of permit #072919-1 with correct route

You bet… even more of a requirement for the escort…!

When might the customer start moving hardware…???

THANKS!

Greg "Tremendously Awesome" Gaddis
**** It's an attitude...not a self-assessment ****
KSC Master Integrator
Customer Service & Integration Branch (SI-I1)
321-861-9556 (Office)

cid:image001.png@01D0E619.6E408F40

From: Priyanka Valle a <pprakash@brph.com>
Sent: Tuesday, July 30, 2019 8:24 AM
To: Gaddis, Gregory (KSC-SII10) <gregory.gaddis-1@nasa.gov>
Subject: [EXTERNAL] Re: Re-Issue of permit #072919-1 with correct route

Hi Greg!

Thanks for following up on this one. Yes, I think when we get closer to operations, the customer would prefer to have an escort.

One note on the updated permit--can we modify the height and width to the 12' wide and 14' height?

Thanks!
Pri

Priyanka Valletta PE
Civil Engineer

EMAIL pvalletta@brph.com
DIRECT 321-751-3095
CELL 321-243-2584
FAX 321-259-4703

BRPH | 5700 North Harbor City Boulevard, Suite 400 | Melbourne, Florida 32940 | **BRPH.com**

Engineering News-Record Top 500 Design Firms - 2018

FW: Re-Issue of permit #072919-1 with correct route

Gaddis, Gregory (KSC-SII10) <gregory.gaddis-1@nasa.gov>

Tue 7/30/2019 7:55 AM

To: Priyanka Valletta <pprakash@brph.com>

1 attachments (57 KB)

072919-1.pdf;

Good Morning Pri…!

As we discussed earlier… When we get close to doing these operations, I believe you'll find that CCAFS Security will be escorting you across KSC to SLC-20… this is STRONGLY recommended…especially with flight hardware.

Let me know how I may facilitate your success in the future…!

THANKS!

Greg "Tremendously Awesome" Gaddis
*** It's an attitude...not a self-assessment ***
KSC Master Integrator
Customer Service & Integration Branch (SI-I1)
321-861-9556 (Office)

SPACEPORT INTEGRATION & SERVICES

From: Huff, Patrick D. (KSC-BOSS-4240)[PAE - SGT Partners LCC] <patrick.d.huff@nasa.gov>
Sent: Tuesday, July 30, 2019 7:52 AM
To: Pri Valletta (KSC)[BRPH ARCHITECTS ENGINEERS INC] <pprakash@brph.com>; KSC-Boss-DUTYOFFICE <KSC-BOSS-DUTYOFFICE@mail.nasa.gov>
Cc: KSC-DL-BOSS-MISSION-COORDINATORS <KSC-DL-BOSS-MISSION-COORDINATORS@mail.nasa.gov>; Gaddis, Gregory (KSC-SII10) <gregory.gaddis-1@nasa.gov>; Mullen, Brian J. (KSC-BOSS-4240)[PAE - SGT Partners LCC] <brian.j.mullen@nasa.gov>
Subject: Re-Issue of permit #072919-1 with correct route

This is a Self-Escort permit. If KSC Escorts are desired, contact BOSS Duty Office.

PATRICK D. HUFF, P.E.
Team Lead Civil & Structural Design Engineering
Base Operations & Spaceport Services (BOSS)
Bldg. K6-1096 | Room 2303-R2
Kennedy Space Center, Florida 32899
o: 321-861-4664
e: patrick.d.huff@nasa.gov

PERMIT FOR OVERWEIGHT/OVERSIZE ROADWAY VEHICLE AT KSC
PERMIT MUST BE IN VEHICLE AT ALL TIMES

DATE OF ISSUE: **7/29/2019**	EXPIRATION DATE: **9/29/2019**	ROUTE: **Space Commerce Way/NASA Parkway/Gate 3/Banana River Bridge/CCAFS**

PERMIT #: **072919-1**	OPERATOR / POINT OF CONTACT: Priyanka Valletta	PHONE #: 321-243-2584

VEHICLE: **Truck Semi-Trailer hauling Flight Hardware**	HEIGHT: **13'-6"**	WIDTH: **8'-0"**	LENGTH: **80'-0"**

NO. OF AXLES: **4** AXLE WEIGHTS: **Legal (80K GVWR)**	☒ ATTACHMENT A: ROUTE ☐ ATTACHMENT B: AXLES AND DIMENSIONS ☐ ATTACHMENT C: LOAD PLATES

☒ Prior permits Void- Route is limited to: same as above	☐ Transit under Kennedy Parkway overpass prohibited.
☐ Load distribution plates are required per Attachment C for Pad A/B Bypass Road culverts. All hardware is to be provided by Permittee.	☐ Movement against oncoming traffic requires traffic be blocked.
☐ Maximum Speed on bridges is 5 mph. ***Convoy commander will review speed requirements with permit vehicle operator. Lead escort vehicle will maintain maximum speed and remain in front of escorted vehicle at all times.***	☐ Requester must submit a request for route approval and or escort support from Support Operations Center (853-5211) and contact BOSS Duty Office @ 321-861-5050 on KSC. If using CCAFS, contact the Air Force watch commander (853-2159) prior to movement. Verify bridges & facilities are in-service prior to scheduled move.
☐ Vehicle centered on all bridge spans. ***No stopping, no accelerating. Convoy commander will use the lead escort vehicle as a point of reference for permit vehicle driver and maintain the escort vehicle in the center of the bridge spans.***	☐ KSC Security Escort, operations, route preparation, and flagging required per OMI-Q-3745. ☒ Permittee self-escort, operations, route preparation, and flagging required per OMI-Q-3745.
☐ Wind speed shall be 25 mph or less on bridge.	

The requestor is responsible for ensuring that all operations comply with the requirements in the current KNPR 6000.1. This authorization / permit prescribes equipment configuration for the movement of overweight / oversize equipment on KSC & CCAFS. For further information, contact BOSS Design Engineering at 861-4664. This authorization permits the movement of the equipment in the configuration as described above in accordance with the noted restrictions / requirements. If the configuration changes at any time this permit becomes invalid.

NOTE: This is a multiple vehicle configuration permit. The operator is to perform route survey to verify no obstructions prior to transit.

Approvals:

7/30/2019 X Patrick D. Huff Signed by: Patrick Huff (affiliate) **Name/Title:** Patrick Huff, P.E.	7/30/2019 X Brian Mullen Signed by: Brian Mullen (affiliate) **Name/Title:** Brian Mullen, Engineer 2

RE: Firefly Transportation Route for EA

WALLACE, BRIAN K GS-12 USAF AFSPC 45 CES/CENMP <brian.wallace.1@us.af.mil>

Wed 7/24/2019 11:04 AM

To: Priyanka Valletta <pprakash@brph.com>
Cc: DEAL, GREGORY A GS-12 USAF AFSPC 45 CES/CEZL <gregory.deal.1@us.af.mil>; LONG, EVA M CIV USAF AFSPC 45 CES/CEIE <eva.long@us.af.mil>; Pete Eggert <PEggert@spaceflorida.gov>; Jaculin Watkins <jwatkins@brph.com>; Steve Berry <saberry@lg2es.com>; Benjamin (BJ) Bukata <BBukata@jonesedmunds.com>

Pri,

Your message below provides all the information required for a route study. The information documents that there are no issues with the transportation route relative to the planned transport and cargo. The vehicle weight and type is within the design parameters of the roadway, and in general the vehicle and cargo is typical to those of FDOT roadways.
Given this, I concur that providing the information below in the transportation route section of the EA will serve as the route study in lieu of providing a standalone route study document. One caveat, as you noted, the Roy Bridges bridge is still under review. If NASA finds the bridge can accommodate the planned transport and cargo, then the route will be acceptable to all parties. If not, an alternate route to CX20 will have to be submitted and approved.
However, for the proposed route, it appears all objectives of the route study for CCAFS have been met, and with that, the meeting schedule for 1430 today can be canceled.

Thank you so much for providing the information below.

Very Respectfully,

Brian K. Wallace, PE
45 CES/CENMP
PHN: 321-853-0922
DSN: 467-0922

From: Priyanka Valletta <pprakash@brph.com>
Sent: Tuesday, July 23, 2019 6:04 PM
To: WALLACE, BRIAN K GS-12 USAF AFSPC 45 CES/CENMP <brian.wallace.1@us.af.mil>
Cc: DEAL, GREGORY A GS-12 USAF AFSPC 45 CES/CEZL <gregory.deal.1@us.af.mil>; LONG, EVA M CIV USAF AFSPC 45 CES/CEIE <eva.long@us.af.mil>; Pete Eggert <PEggert@spaceflorida.gov>; Jaculin Watkins <jwatkins@brph.com>; Steve Berry <saberry@lg2es.com>; Benjamin (BJ) Bukata <BBukata@jonesedmunds.com>
Subject: [Non-DoD Source] Re: Firefly Transportation Route for EA

Hi Brian!

Thanks for your time today on the phone. Below are my notes--feel free to add/adjust anything I may have missed. I think we have a pretty clear idea of what needs to be done moving forward to address the transportation route requirements for the EA. Let me know if you still would like to have a call tomorrow to discuss.

We are following up with similar conversations with the NASA POC's, particularly regarding use of the Roy Bridges bridge.

Thanks,

Pri

- NASA will need to determine the suitability for the route & Roy Bridges bridge for the proposed vehicle and loads on the KSC side.
- On the CCAFS side of the route:
    - **Vehicle loads/weight:**
        - The CCAFS roads were designed to FDOT specifications to accommodate an HS-20 traffic loading.
        - Firefly will be using a standard tractor trailer and will stay within FDOT maximum weights for an HS-20 vehicle loading (8 kips on front axle, 32 kips for rear axles), for a maximum allowable weight of 80,000 lbs.
        - ***As the weights will be within FDOT standard weight limits, no additional improvements to the route are anticipated to accommodate the vehicle weight.***
    - **Vehicle dimensions and maneuvering:**
        - Firefly will be using a standard tractor trailer with an extension for a maximum length of 80'. This is comparable to (and slightly smaller than) the overall length of an AASHTO WB-96 or WB-114 vehicle. These vehicles require a minimum of 21', and 17' inside turning radius measured from the inside wheel, and 50' and 60' turning radius measured from the outside wheel respectively.
        - The four main intersections on CCAFS where these turning maneuvers will occur are:
            - **NASA Parkway/Samuel C. Phillips Parkway.** The inside radius of the pavement appears to be at least 40'. This intersection will also be receiving additional pavement as part of the EDTPF project. The roadway width of each road is at least 24', so this should accommodate the required outside wheel turning radii as well.
            - **Samuel C Phillips Parkway and Heavy Launch Road.** This maneuver does not require a sharp turn (approx. 20 degree change in alignment) and the radius of the turn in the existing pavement is very large (100' feet).
            - **Heavy Launch Road and ICBM Road.** The inside radius of the pavement appears to be at least 60'.
            - **ICBM Road and SLC-20.** The inside radius of the pavement appears to be at least 90'.
        - These inside radii are greater than the minimum required inside radii for the comparable AASHTO vehicles.
        - ***Based on the observations above, no additional improvements to the route are anticipated to accommodate the vehicle dimensions and turning maneuvers.***
    - Hazardous material:
        - Firefly will not be transporting ordnance along the proposed route.
    - General:
        - The information above will be summarized in the transportation route section of the EA in lieu of providing a standalone route study document.
        - We will include a note in the EA that oversized loads utilizing this route will be coordinated with Cape Support prior to artifact delivery.

- It is recommended that the customer inspect the route prior to delivery. We discussed that the customer may place steel plates over any culverts along the route at their discretion; however, given that the weights will not exceed FDOT weight restrictions, it is not anticipated that these will be needed.

Priyanka Valletta PE

Civil Engineer

EMAIL pvalletta@brph.com

DIRECT 321-751-3095

CELL 321-243-2584

FAX 321-259-4703

BRPH | 5700 North Harbor City Boulevard, Suite 400 | Melbourne, Florida 32940 | **BRPH.com**

Engineering News-Record Top 500 Design Firms - 2018

From: Priyanka Valletta
Sent: Monday, July 22, 2019 1:00 PM
To: WALLACE, BRIAN K GS-12 USAF AFSPC 45 CES/CENMP <brian.wallace.1@us.af.mil>
Cc: DEAL, GREGORY A GS-12 USAF AFSPC 45 CES/CEZL <gregory.deal.1@us.af.mil>; LONG, EVA M CIV USAF AFSPC 45 CES/CEIE <eva.long@us.af.mil>; Pete Eggert <PEggert@spaceflorida.gov>; Jaculin Watkins <jwatkins@brph.com>
Subject: Firefly Transportation Route for EA

Hi Brian,

Eva suggested I reach out to you directly to discuss this possibly in lieu of the meeting on Wednesday. Attached is the language and description we are including in the SLC-20 EA for the travel route.

Upon further discussions with Firefly, they will be using a standard tractor trailer with an extension for a total length no longer than 80', and that the transported stages would meet FDOT weight limits (80,000 lbs max, HS-20 axle loadings). The stages will be transported from Exploration Park to the SLC-20 facility for assembly, with about 2 trips for each Alpha vehicle and 2-3 trips for each Beta vehicle. Given that these are standard loadings, would a route evaluation study still be necessary? If so, does this need to be done prior to release of the EA, or can this be done prior to using the route for delivery?

We're trying to determine how to best address this subject in the EA. Could you please give me a call on my cell below when you get a chance?

Thank you!
Pri

Priyanka Valletta PE

Civil Engineer

EMAIL pvalletta@brph.com

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Engineering News-Record Top 500 Design Firms - 2018

APPENDIX H

Florida State Clearinghouse Correspondence

LONG, EVA M CIV USSF SPOC 45 CES/CEIE

From:	Stahl, Chris <Chris.Stahl@dep.state.fl.us>
Sent:	Wednesday, July 1, 2020 4:14 PM
To:	LONG, EVA M CIV USSF SPOC 45 CES/CEIE
Cc:	State_Clearinghouse
Subject:	[Non-DoD Source] State Clearance Letter for FL202005128941C- Environmental Assessment For The Reconstitution And Enhancement Of Space Launch Complex 20 Multi-User Launch Operations At Cape Canaveral Air Force Station, Brevard County, Florida
Attachments:	2020 3034 - Clearinghouse - SCH 106 USAF CCAFS.pdf

July 1, 2020

Eva Long
U.S. Air Force
45 CES/CEI
Samuel C Phillips Pkwy,
Cape Canaveral Air Force Station, Florida 32925

RE: Department of Defense, Department of the Air Force, U.S. Air Force, Environmental Assessment For The Reconstitution And Enhancement Of Space Launch Complex 20 Multi-User Launch Operations At Cape Canaveral Air Force Station, Brevard County, Florida
SAI # FL202005128941C

Dear Eva:

Florida State Clearinghouse staff has reviewed the proposal under the following authorities: Presidential Executive Order 12372; § 403.061(42), Florida Statutes; the Coastal Zone Management Act, 16 U.S.C. §§ 1451-1464, as amended; and the National Environmental Policy Act, 42 U.S.C. §§ 4321-4347, as amended.

The proposed project has been reviewed by the Department of Environmental Protection's Central District and it has determined that it may require a DEP Drinking Water Main Extension Permit, NPDES Stormwater Permit, a Dewatering permit, an Industrial Wastewater Permit and a possibly an Environmental Resource Permit (ERP): • The activities may require a Conceptual ERP Permit and/or an Individual ERP Permit pursuant to 373, F.S. for wetland impacts and stormwater control requirements. If required, the project will be reviewed under the Environmental Resource Permit Applicant's Handbook I and II (Chapter 62-330, F.A.C.). • If wetlands and other surface waters are proposed to be impacted by the project, a demonstration of the elimination and reduction of wetland and surface water impacts will be required and any unavoidable impacts will require mitigation pursuant to Chapter 10.3 A.H. Vol I. • Any portion of the project that crosses sovereign, submerged lands will require a public easement through the Department's Division of State Lands (Chapter 18-21.005, F.A.C.).

The Florida Department of State has reviewed the proposed action and submitted comments. As a courtesy, these have been attached to this letter and are incorporated hereto.

Based on the information submitted and minimal project impacts, the state has no objections to allocation of federal funds for the subject project and, therefore, the funding award is consistent with the Florida Coastal Management

Program (FCMP). The state's final concurrence of the project's consistency with the FCMP will be determined during any environmental permitting processes, in accordance with Section 373.428, Florida Statutes, if applicable.

Thank you for the opportunity to review the proposed plan. If you have any questions or need further assistance, please don't hesitate to contact me at (850) 717-9076.

Sincerely,

Chris Stahl

Chris Stahl, Coordinator
Florida State Clearinghouse
Florida Department of Environmental Protection
3800 Commonwealth Blvd., M.S. 47
Tallahassee, FL 32399-2400
ph. (850) 717-9076
State.Clearinghouse@floridadep.gov