DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration
Office of Commercial Space Transportation

Adoption of the Environmental Assessment
and
Finding of No Significant Impact
for
Boost-back and Landing of Falcon Heavy Boosters at Landing Zone-1, Cape Canaveral Air Force Station, Florida

Summary

The U.S. Air Force (USAF) acted as the lead agency, and the Federal Aviation Administration (FAA) was a cooperating agency, in the preparation of the February 2017 *Supplemental Environmental Assessment to the December 2014 EA for Space Exploration Technologies Vertical Landing of the Falcon Vehicle and Construction at Launch Complex 13 at Cape Canaveral Air Force Station, Florida* (2017 SEA), which analyzed the potential environmental impacts of Space Exploration Technologies Corp. (SpaceX) conducting boost-backs and landings of up to three Falcon Heavy boosters at Landing Zone 1 (LZ-1) at Cape Canaveral Air Force Station (CCAFS), Florida during the same mission. LZ-1 is also known as Launch Complex 13 (LC-13). The scope of the action analyzed in the 2017 SEA also included the option of landing one or two Falcon Heavy boosters on SpaceX's autonomous droneship in the Atlantic Ocean. The 2017 SEA also addressed construction of two landing pads as well as construction and operation of a processing and testing facility for SpaceX's Dragon spacecraft. The National Aeronautics and Space Administration (NASA) also participated as a cooperating agency in the preparation of the 2017 SEA. The 2017 SEA was prepared in accordance with the National Environmental Policy Act of 1969, as amended (NEPA; 42 United States Code [U.S.C.] § 4321 et seq.); Council on Environmental Quality NEPA implementing regulations (40 Code of Federal Regulations [CFR] parts 1500 to 1508); the USAF's Environmental Impact Analysis Process (32 CFR 989); and FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*.

In October 2014, the USAF issued the *Environmental Assessment for the Space Exploration Technologies Vertical Landing of the Falcon Vehicle and Construction at Launch Complex 13 at Cape Canaveral Air Force Station, Florida* (2014 EA), which analyzed the potential environmental impacts of SpaceX conducting boost-backs and landings of a Falcon 9 launch vehicle first stage/booster (or a single Falcon Heavy booster) at LZ-1 or in the Atlantic Ocean. Boost-backs are when the launch vehicle operator (i.e., SpaceX) command the first stage/booster to return to Earth after separating from the second stage and land in the ocean or on land. The 2014 EA also addressed related land clearing and construction of a main landing pad, four contingency landing pads, and supporting infrastructure at LZ-1. Since publication of the 2014 EA, SpaceX has constructed the main landing pad and none of the contingency landing pads. SpaceX no longer has plans to construct the four contingency landing pads discussed in the 2014 EA. SpaceX is now proposing to construct two additional main landing pads and the Dragon processing and testing facility.

Launches (takeoffs) of the Falcon Heavy launch vehicle would occur from LC-39A located at Kennedy Space Center (KSC). Launch operations, including Falcon Heavy launches, at LC-39A were assessed in NASA's 2013 *Environmental Assessment for Multi-Use of Launch Complexes 39A and 39B, John F. Kennedy Space Center, FL*. The FAA was a cooperating agency in the preparation of NASA's EA. NASA and the FAA issued Findings of No Significant Impact (FONSIs) for launch operations at LC-39A. Thus, the scope of launch operations analyzed in the 2017 SEA was limited to the return and landing of the Falcon Heavy boosters at LZ-1. The 2017 SEA assumes a normal launch mission of a Falcon Heavy launch vehicle continues forward with the successful separation of the second stage and payload, while the boosters (i.e., the two side boosters and core booster) begin their boost-back and landing sequence for landing at LZ-1.

As the Proposed Action would require Federal actions (as defined in 40 CFR § 1508.18) involving the USAF and FAA, the EA was prepared to satisfy the NEPA obligations of both agencies. The FAA's Federal action in this matter pertains to its role in issuing licenses for the operation of commercial launch and reentry vehicles at launch sites. The USAF's action is issuing a five-year real property license to SpaceX to allow SpaceX to operate LZ-1 as a landing facility. The USAF issued a FONSI on March 13, 2017, which stated the potential environmental impacts associated with the Proposed Action would not individually or cumulatively result in a significant impact on the quality of the human environment, and therefore, the preparation of an environmental impact statement (EIS) was not required.

SpaceX is required to obtain a license from the FAA for Falcon Heavy launch operations, to include boost-backs and landings. Based on its independent review and consideration of the 2017 SEA, the FAA issues this FONSI concurring with, and formally adopting, the analysis of impacts and findings in the 2017 SEA, supporting the FAA's issuance of licenses to SpaceX for Falcon Heavy launch operations to include boost-backs and landings at LZ-1 or on a droneship in the Atlantic Ocean. If, in their license application to the FAA, SpaceX makes changes to their operations which fall outside the scope of the 2017 SEA, additional environmental review would be required prior to the FAA issuing a license associated with such an application.

After reviewing and analyzing available data and information on existing conditions and potential impacts, including the 2017 SEA, the FAA has determined the issuance of licenses to SpaceX to conduct Falcon Heavy boost-backs and landings at LZ-1 or in the Atlantic Ocean would not significantly affect the quality of the human environment within the meaning of NEPA. Therefore, the preparation of an EIS is not required, and the FAA is independently issuing this FONSI. The FAA has made this determination in accordance with applicable environmental laws and FAA orders and regulations. The 2017 SEA is incorporated by reference into this FONSI.

For any questions or to request a copy of the 2017 SEA, contact:

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Purpose and Need

The purpose of SpaceX's proposal is to provide a Falcon booster landing area by constructing landing pads and associated supporting infrastructure for landing operations of the Falcon Heavy boosters in order to reuse the boosters for future launches. The purpose of SpaceX's proposal is also to temporarily process (refurbish) the Dragon and conduct Dragon engine testing. This purpose supports SpaceX's overall missions for NASA and the USAF. The action continues to fulfill the United States' expectation that space transportation costs are reduced to make continued exploration, development, and use of space more affordable. The National Space Transportation Policy of 2013 addressed the commercial launch sector, stating that "assuring reliable and affordable access to space through U.S. space

transportation capabilities is fundamental to achieving National Space Policy goals." SpaceX's proposal is needed to increase the effective, cost-efficient operation of space flight. This would be accomplished by reusing the boosters instead of developing entirely new boosters. The proposal aids SpaceX in fulfilling its mission of supporting the International Space Station and other commercial enterprises.

The purpose of FAA's Proposed Action is to fulfill the FAA's responsibilities as authorized by Executive Order 12465, *Commercial Expendable Launch Vehicle Activities* (49 FR 7099, 3 CFR, 1984 Comp., p. 163), and the U.S. Commercial Space Launch Competitiveness Act of 2015 (Public Law 114-90) for oversight of commercial space launch activities, including licensing launch activities. The need for FAA's Proposed Action results from the statutory direction from Congress under the U.S. Commercial Space Launch Competitiveness Act of 2015 to, in part, "promote commercial space launches and reentries by the private sector; facilitate Government, State, and private sector involvement in enhancing U.S. launch sites and facilities; and protect public health and safety, safety of property, national security interests, and foreign policy interests of the United States." Additionally, Congress has determined the Federal Government is to "facilitate the strengthening and expansion of the United States space transportation infrastructure, including the enhancement of United States launch sites and launch-site support facilities, and development of reentry sites, with Government, State, and private sector involvement, to support the full range of United States space-related activities" (51 U.S.C., subtitle V, ch. 509, §50901).

Proposed Action

The FAA's Proposed Action is to issue licenses to SpaceX for Falcon Heavy launch operations that include boost-backs and landings of three Falcon Heavy boosters (i.e., the two side boosters and core booster) at LZ-1 and/or on an autonomous drone ship in the Atlantic Ocean.[1] The action analyzed in the 2017 SEA consisted of SpaceX conducting Falcon Heavy booster landings at LZ-1, as well as construction of two landing pads and associated supporting infrastructure, and a processing and testing facility for the Dragon (refer to Figure 1-5 in the 2017 SEA). Under the Proposed Action, Falcon Heavy launches including boost-backs and landings at LZ-1 would occur up to six times per year. That is, there could be up to six annual Falcon Heavy missions, and each mission could involve up to three booster landings, for a total of 18 annual booster landings. The Proposed Action would not change the number of launches (takeoffs) of the Falcon Heavy launch vehicle. While the FAA has no Federal action associated with the

[1] Because the 2014 EA addressed booster landing in the Atlantic Ocean, the 2017 SEA's impact analysis focused on three booster landings at LZ-1.

proposed construction and Dragon processing and testing, potential impacts related to both the issuance of launch licenses and the proposed construction are addressed below.

Construction

Construction activities include constructing two concrete landing pads, each with an approximate diameter of 282 feet surrounded by an approximate 50 foot-wide hard-packed soil "apron," which would bring the diameter of each pad area to approximately 400 feet (refer to Figure 2-4 in the 2017 SEA for a depiction of the proposed landing pads). The landing pads would be approximately 18 inches thick and designed to support the weight and thrust energy of the Falcon Heavy boosters. Like the existing landing pad, the new pads would comply with all CCAFS and other relevant construction requirements. These new pads would be constructed on previously undisturbed land. Two short access paths would be constructed so a crane would have access to the landing pads following a landing event. Pedestals, similar to what was constructed for the existing pad, might be constructed at the new pads. Additionally, construction activities would include building a Dragon processing and testing facility, including a main building and related utilities. The building would be approximately 130 feet long, 100 feet wide, and 30 feet tall. Approximately 23 acres of land would be cleared for construction of the landing pads, crane paths, Dragon processing and testing facility, and supporting infrastructure.

Construction of the pad in the northern area of LZ-1 (see Figure 2-4 in the 2017 SEA) would require clearing approximately 11 acres of vegetation and roller-chopping approximately two acres of vegetation. Clearing is needed for proper operation of the landing navigational systems. The northern area would avoid the wetlands to the west and northeast of the landing pad (see Figure 2-5 in the 2017 SEA). Construction of the other pad in the southern area of LZ-1 would require clearing approximately 10 acres of vegetation. Wetlands further to the south, and an existing drainage ditch to the west, would be avoided (see Figure 2-6 in the 2017 SEA). The removed vegetation would be either taken off site to an approved burn or burial area, or burned onsite with appropriate coordination/permissions. Site grading would be required in order to provide a flat, compacted area to construct the two landing pads, aprons, and crane paths.

Existing power distribution infrastructure discussed in the 2014 EA would be extended to support the two new pads and Dragon processing and testing facility. These utilities, along with water, video camera, and nitrogen gas lines would be contained within buried conduit in the immediate vicinity of the pads and traverse above ground throughout the rest of the site. Up to four additional lattice towers,

approximately 20 feet high, would be installed at LZ-1. The towers would contain equipment needed to ensure adequate wireless internet service for the site, and would be integrated into the system being installed for the original/existing landing pad.

A FireX system[2] similar to one installed for the existing landing pad would be constructed at each new pad with three or four remote controlled water cannons mounted on posts above ground to allow for remote firefighting capabilities. An additional above-ground 12,000-gallon water storage tank would be placed on the western side of LZ-1. The tank would be pressurized with nitrogen and provide water for fire-fighting equipment. Nitrogen would be supplied to the tank using a mobile trailer. The water tank would be filled using the existing water supply.

SpaceX would continue to use portable sanitary facilities at LZ-1. The landing pads would be constructed to control all stormwater runoff from the pads. All stormwater flowing off the landing pads would be directed to a retention basin, swale, or similar infiltration feature according to Federal, State, and local stormwater run-off regulations. The exact location and size of the stormwater management infrastructure would be determined during final site design, and would consider avoiding or minimizing potential effects to wetlands and protected species.

Operations

Boost-back and Landing

Following a nominal (i.e., according to plan or within accepted parameters) launch of the Falcon Heavy from LC-39A, the three boosters (two side boosters and core booster) would separate from the second stage and return to LZ-1 for potential reuse. All three boosters are designed with landing legs to support landing. SpaceX may decide to land one or two of the boosters on the autonomous drone ship in the Atlantic Ocean in addition to or in place of landing a booster(s) on land.

Each of the boosters has carbon overwrapped pressure vessels filled with either nitrogen or helium, and are used to orient the position of the booster. After the side boosters separate and engine cutoff occurs, the center engine in each booster would burn to control the booster's trajectory safely away from the rocket. The core booster would continue to fire until second stage separation. Cold gas thrusters would be triggered to flip each of the boosters into position for retrograde burn. Three of the nine engines of each booster would be restarted to conduct the retrograde burn in order to reduce the velocity of the

[2] A FireX system is a water deluge system that can be used to help extinguish any fire that might develop.

booster and place it at the correct angle and course to return to LZ-1. As each of the three boosters are in position and approaching its own landing target, two of the three engines would be shut down to end the boost-back burn, and landings would occur using one to three engines per booster, on the three separate landing pads.

The three boosters would begin to return to LZ-1 (and/or the autonomous drone ship) approximately 10 minutes after lift-off. Each of the three boosters would be controlled separately so their approach and landing at LZ-1 (and/or the drone ship) would be managed independently. During the boost-back phase, each returning booster is predicted to produce two sonic booms (one louder than the other), for a total of up to six booms per Falcon Heavy mission. While the noise (pressure waves) are initiated when the booster reaches sub-sonic speeds, the boom would not be heard until close to or upon landing. The landing legs on each booster would deploy in preparation for a final one to three-engine burn that would slow each booster to a velocity of zero before landing.

Although most of the on-board propellant would be expended during flight, there is a potential for a relatively small amount of propellants—liquid oxygen (LOX) (less than 5,840 lbs) and rocket propellant-1 (RP-1) (less than 2,160 lbs)—to remain in the boosters upon landing. A small amount of ordnance, such as small explosive bolts and on-board batteries typically would be onboard each booster. Any hazardous materials would be handled in accordance with Federal, State, and local laws and regulations. SpaceX has an established emergency response team and any unexpected spills would be contained and cleaned up per the procedures identified in the SpaceX Emergency Action Plan and the Spill Prevention Control and Countermeasures Plan.

Operations at LZ-1 would support preparations for, and the landing of, up to three boosters as well as post-flight landing and safing. Should one or two of the boosters land on the droneship, each would be safed (i.e., returned to a safe condition, for example, by venting gases or propellants) at sea, and then the droneship would be towed to either the Port of Jacksonville, Florida or Port Canaveral. Safing activities would begin upon completion of all landing activities, and engine shutdowns would be the same as for a single booster landing. The oxidizer systems would be purged, and any excess fuel would be drained into a suitable truck-mounted container or tanker. Any remaining pressurants (i.e., helium or nitrogen) would be vented, and any Flight Termination System explosives would also be rendered "inert" prior to declaring the boosters safe. After the landing legs are removed or folded back into place, each booster would be lowered into a horizontal position, placed on a transport vehicle, and taken to a SpaceX facility. A ground crew would perform and supervise all landing operations.

The 2014 EA estimated that 12 booster landings would take place per year for the initial five-year FAA launch license. SpaceX estimates there may be up to six annual Falcon Heavy missions involving three booster landings each mission. Therefore, each year, there could be up to 30 individual booster landings at LZ-1. SpaceX prefers to conduct all launch operations during daylight hours, but, based on mission needs, there is a possibility that some of the landing events could be performed during the night. Accordingly, up to two Falcon Heavy night landings (three boosters each time) were assumed for the 2017 SEA.

Dragon Processing and Static Engine Firings

LZ-1 provides a location to perform propellant servicing operations and post-flight refurbishment for Dragon missions. Following a Dragon mission (e.g., service to and from the International Space Station), the Dragon would be transported to the processing facility at LZ-1 for post-flight processing and refurbishment. In order to support pre- and post-flight operations, the Dragon would require a processing facility to perform various vehicle checkouts, final flight closeouts, propellant load, propellant unload, and propellant servicing operations.

The Dragon also requires a location to perform periodic vehicle static fires in order to test the SuperDraco launch abort and landing system. The Dragon would be fastened to a portable mechanical stand that can be configured to varying heights. This mobile static fire stand would be integrated to the proposed landing pad in the northern section of LZ-1, and would not be permanently installed. Test firings of the SuperDraco launch abort and landing system would be less than two seconds.

Alternatives

Alternatives analyzed in the 2017 SEA and this FONSI include (1) the Proposed Action and (2) the No Action Alternative. Under the No Action Alternative, the proposed two landing pads, additional support infrastructure, and the Dragon processing and testing facility would not be built, and the controlled landing of three Falcon Heavy boosters would not occur at LZ-1. The Falcon family of rockets would continue to be launched from LC-40 (CCAFS) and LC-39A (KSC); however, only a single Falcon booster would conduct boost-back and landing operations at LZ-1 (as analyzed in the 2014 EA). During a Falcon Heavy launch, the other two boosters would fall into the Atlantic Ocean. Thus, under the No Action Alternative, the FAA would not issue any launch licenses to SpaceX to conduct Falcon Heavy triple core landings at LZ-1. The No Action Alternative would not meet the purpose of and need for SpaceX's proposal.

Environmental Impacts

The following presents a brief summary of the potential environmental impacts considered in the 2017 SEA.[3] This FONSI incorporates the 2017 SEA by reference and is based on the potential impacts discussed therein. The FAA has determined the analysis of impacts presented in the 2017 SEA represents the best available information regarding the potential impacts associated with the FAA's regulatory responsibilities described in this FONSI. Although not required by FAA Order 1050.1F, this FONSI includes the following additional impact categories because they are addressed in the 2017 SEA by the lead agency (USAF) in the 2017 SEA: geology and soils, health and safety, and transportation.

Air Quality

CCAFS and Brevard County are classified as attainment areas with respect to the National Ambient Air Quality Standards and Florida Ambient Air Quality Standards for all pollutants. During construction and operational activities, emissions from construction equipment, ground support operations, and Falcon landings would cause adverse air quality impacts. The majority of emissions during boost-back would occur above the mixing height (approximately 3,000 feet above ground level) and would not have the potential to affect ambient air quality. All project emissions would represent an extremely small percentage of the Brevard County regional emissions and would not exceed any thresholds established under the Clean Air Act. Though emissions from Falcon landings would increase the yearly levels of greenhouse gases (GHGs) at CCAFS, the emissions would still be well below the U.S. Environmental Protection Agency (EPA) mandatory reporting threshold for stationary sources of 25,000 metric tons of carbon dioxide equivalent, and would represent a negligible fraction of GHG emissions from CCAFS, the United States, or the world.

Loading of Dragon hypergolic propellants would be performed at the LZ-1 facility in a manner similar to previous operations with the Dragon at LC-40. Each loading or unloading operation would be independent, sequential, and conducted using a closed-loop system. During the operation, all propellant and vapors are contained. Although nitrogen tetroxide (NTO) and hydrazine are classified as hazardous air pollutants, regulations under Title III of the Clean Air Act have not yet established control standards. The scrubber systems usually used are considered Best Available Control Technology and would be considered acceptable when regulations are promulgated. SpaceX would comply with applicable State

[3] Because the 2014 EA addressed booster landing in the Atlantic Ocean, the 2017 SEA's impact analysis focused on three booster landings at LZ-1.

and Federal regulations. SpaceX safety procedures ensure minimal risk for any potential spills. In conclusion, the Proposed Action is not expected to result in significant air quality impacts [SEA 4.5 at 4-23, 4-24].

Biological Resources (Fish, Wildlife, and Plants)

The Proposed Action would result in the clearing of approximately 21 acres of vegetation and roller-chopping approximately two acres of vegetation for a total of 23 acres of vegetation impacts. Both native and invasive species would be cleared. Conversion of the vegetative community in this area from scrub (Florida scrub-jay habitat) to open grass area would be offset through the restoration, at a 2:1 ratio, of overgrown scrub-jay habitat located elsewhere on CCAFS. If construction occurred during the migratory bird nesting season, pre-construction surveys for migratory birds would occur. Additional construction-related impacts would include temporary noise disturbance to individual species in the vicinity of LZ-1.

Wildlife species in the vicinity of LZ-1 could be affected by launch operations, mainly by launch noise. Wildlife exposed to the landing noise would likely have a startle response. Temporary noise impacts to wildlife are not expected to affect local or regional populations of wildlife, especially since this area is accustomed to launch operations. In addition to engine noise, wildlife would be exposed to sonic booms during landing. According to USAF sonic boom modeling, a loud sonic boom could be expected during Falcon Heavy booster landings, peaking at approximately 5-7 pounds per square foot (psf) in the near-field (on CCAFS property) and reaching dozens of miles beyond with over 0.5 psf. Animals exposed to the sonic booms on land would likely have a startle response. No significant impacts on terrestrial animal populations from sonic booms are expected. Due to the infrequency of the sonic booms and the low density of marine species in the surface waters of the ocean, sonic booms would not adversely affect marine species.

Construction activities would have the potential to result in the “take” of species listed under the Endangered Species Act (ESA). In accordance with section 7 of the ESA, the USAF prepared a Biological Assessment and submitted it to the U.S. Fish and Wildlife Service (USFWS). The USAF determined the proposed project “may affect and is likely to adversely affect” the Florida scrub-jay and the eastern indigo snake. The USAF also determined the proposed project “may affect, but is not likely to adversely affect” the loggerhead, green, leatherback, hawksbill, and Kemp’s ridley sea turtles; the American alligator; the red knot; and the piping plover. The USFWS concurred with the USAF’s determinations and

issued an amended Biological Opinion on February 12, 2016, stating the proposed project is not likely to jeopardize the continued existence of any federally listed species. In its Biological Opinion, the USFWS listed terms and conditions for which the USAF must comply (see Appendix D of the 2017 SEA).

During informal discussions between the USAF and National Marine Fisheries Service (NMFS) during preparation of the 2014 EA, the USAF received concurrence from NMFS that Falcon boost-back and landing at LZ-1 or on a drone ship in the Atlantic Ocean would have no effect on federally listed species under NMFS jurisdiction and no effect on essential fish habitat. Since the Proposed Action is essentially the same with respect to species under NMFS jurisdiction, the USAF determined the Proposed Action would have no effect on federally listed species under NMFS jurisdiction and no effect on essential fish habitat. The FAA agrees with this determination.

In conclusion, the Proposed Action would not result in significant impacts on biological resources [SEA 4.3 at 4-14, 4-16, and 4-18].

Climate

The majority of GHG emissions associated with the Proposed Action include those from boost-back and landing of the Falcon Heavy boosters. The 2017 SEA conservatively estimated that 12 annual Falcon Heavy boost-backs and landings (three boosters each time) would emit approximately 1,533 metric tons of carbon dioxide equivalent (CO_2e). Though emissions from construction and Falcon Heavy landings would increase the yearly levels of GHGs at CCAFS, the emissions would be well below the EPA mandatory reporting threshold for stationary sources of 25,000 metric tons of CO_2e, and would represent a negligible fraction of local (CCAFS), national, or global GHG emissions.

In addition to assessing the Proposed Action's impacts on climate, the 2017 SEA assessed the potential impacts of climate change on the project. SpaceX considered sea level rise when designing the landing pads and Dragon processing facility. The existing and proposed landing pads are several feet higher than existing terrain, and the processing facility floors would be several feet above the 100-year flood stage. Climate change (including sea level rise) is not expected to affect the project.

In conclusion, the Proposed Action would not result in significant impacts related to climate or climate change [SEA 4.6 at 4-26].

Coastal Resources

No adverse effects to the coastal zone, as defined by the Coastal Zone Management Act, are anticipated. The Florida Department of Environmental Protection determined the Proposed Action is consistent with the Florida Coastal Management Program. Therefore, the Proposed Action would not affect coastal resources [SEA 4.1 at 4-9].

Department of Transportation Act, Section 4(f)

No designated Section 4(f) properties, including public parks, recreation areas, or wildlife/waterfowl refuges, exist within the boundaries of CCAFS; therefore, no physical use or temporary occupancy of a Section 4(f) property would occur. Section 4(f) properties located within approximately a 15-mile radius of LZ-1 include Merritt Island National Wildlife Refuge, Cape Canaveral National Seashore, Jetty Park, Kelly Park, Kars Park, Kings Park, and Manatee Cove Park. Additionally, the St. John's National Wildlife Refuge and Tosohatchee State Game Preserve are located west of LZ-1. Due to their proximity to LZ-1, these properties may experience noise from proposed Falcon Heavy booster landings. Noise levels at these 4(f) properties may increase slightly and temporarily during booster landings, but any impact would only last a few seconds and is expected to occur only once a month under the Proposed Action.

For decades, the 4(f) properties have been experiencing increased noise levels during launches taking place at CCAFS and adjacent Kennedy Space Center (KSC). Due to the long history of these Section 4(f) properties experiencing noise from launches at CCAFS and KSC, and because of the infrequent proposed booster landings at LZ-1, the FAA has determined the Proposed Action would not substantially diminish 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 and would not invoke Section 4(f) of the Department of Transportation Act [SEA 4.15 at 4-36, 4-37].

Farmlands

There is no farmland at CCAFS. The Proposed Action would not convert prime agricultural land to other uses or result in a decrease in the land's productivity. Therefore, the Proposed Action would not affect farmlands [SEA 3.1 at 3-2; SEA 4.1 at 4-9].

Geology and Soils

No unique geologic features of exceptional interest or mineral resources occur in the project area. Prior to and during construction, best management practices (e.g., erosion and sediment control measures) would be required to retain sediment on-site and to prevent potential violations of State water quality standards. Thus, the Proposed Action would not result in significant impacts on geology or soils [SEA 4.9 at 4-31].

Hazardous Materials, Pollution Prevention, and Solid Waste

Construction activities may require or generate small quantities of hazardous materials or hazardous wastes. Since demolition is not part of the proposed project, asbestos and lead-based paint waste is not a concern. Management of hazardous materials would be completed in accordance with 40 CFR Parts 260–279. All hazardous materials would continue to be handled and disposed of per the requirements established by the Occupational Safety and Health Administration (OSHA) and per the Hazardous Materials Contingency Plan developed for the Falcon Launch Vehicle Program at CCAFS. Since all applicable Federal, State, county, and USAF rules and regulations would continue to be followed for the proper storage, handling, and use of hazardous materials (including propellants) under the Falcon Launch Vehicle Program, no significant impacts related to hazardous materials are expected. Landing of the Falcon Heavy boosters is expected to generate less solid waste than a Falcon launch/takeoff. Examples of solid waste may include cardboard packaging, wood, rag material, plastic, and aluminum bottles and cans. All solid waste would be disposed of according to local, state, and CCAFS solid waste management rules and regulations. In conclusion, the Proposed Action would not result in significant impacts related to hazardous materials, pollution prevention, or solid waste [SEA 4.7 at 4-27, 4-28].

Historical, Architectural, Archeological, and Cultural Resources

LZ-1 is not considered a historic property, and there are no identified historic properties located within the LZ-1 boundary or in the immediate vicinity. Three previously unrecorded archaeological sites were identified during an archaeological survey conducted by the USAF between June and August 2014. The USAF determined the sites are ineligible for listing on the National Register of Historic Places and the State Historic Preservation Officer concurred with that determination. Disturbance to these sites would be avoided. Thus, the Proposed Action would have no effects on historical, architectural, archaeological, or cultural resources [SEA 4.4 at 4-23].

Health and Safety

Safety hazards are inherently associated with heavy equipment operation and construction activities. All appropriate regulations, including OSHA regulations (29 CFR Part 1926, Safety and Health Regulations for Construction) and local USAF health and safety regulations would be followed. SpaceX would have an on-site safety manager who would conduct safety meetings and ensure proper safety procedures are followed. Therefore, construction activities are not expected to result in a significant impact related to health and safety [SEA 4.12 at 4-33].

CCAFS safety regulations ensure the general public, launch area personnel, and affected land area are provided an acceptable level of safety, and that all aspects of pre-launch and launch operations adhere to public laws. The range safety organizations[4] at CCAFS use models to predict launch hazards to the public and on-site personnel prior to every launch. These models calculate the risk of injury resulting from toxic gases, debris, and blast overpressure both from nominal launches and launch failures. Launches are postponed if predicted risk of injury exceeds acceptable limits. Furthermore, the FAA would conduct its own public safety review in accordance with 14 CFR Part 400 prior to issuing a license.

Dragon processing would involve the handling of toxic and hazardous propellants, including monomethylhydrazine (MMH) and NTO. MMH is a strong irritant and may damage eyes and cause respiratory tract damage. Exposure to high vapor concentrations can cause convulsions and possibly death. Repeated exposures to lower concentrations may cause toxic damage to liver and kidneys as well as anemia. The EPA classifies MMH as a probable human carcinogen. It is flammable and could spontaneously ignite when exposed to an oxidizer. NTO is a corrosive oxidizing agent; contact with the skin and eyes can result in severe burns. Inhalation of vapors can damage the respiratory system. NTO would ignite when combined with fuels and may promote ignition of other combustible materials. Fires involving NTO burn vigorously and produce toxic fumes.

Potential health and safety impacts to personnel involved in the propellant loading and unloading operations in the processing facility would be minimized by adherence to OSHA and USAF Occupational Safety and Health regulations, just as they are currently used for similar operations at LC-40. These regulations require use of appropriate protective clothing and breathing protection. Toxic vapor detectors are used in the facilities to monitor for leaks and unsafe atmospheres.

[4] The 45th Space Wing safety organizations include ground safety, mission flight control and analysis, and systems safety.

Spills, fires, and explosions would be possible outcomes from accidents during Dragon processing. A violent fire or an explosion could produce severe injuries or even death. A catastrophic accident of this type during payload processing would be unlikely. Most propellant spills would be contained within the processing facility with no health impacts to personnel. The most likely consequences of a severe accident during processing would be some level of damage to the spacecraft and the immediate liquid propellant transfer area. Facility design would limit damage to the spacecraft and the transfer area.

In conclusion, the Proposed Action is not expected to result in significant impacts related to health and safety [SEA 4.12 at 4-32 to 4-34].

Land Use

The Proposed Action would not change land use or affect land use planning at CCAFS. The Proposed Action would occur at LZ-1, which is designated for space launch activities. Thus, the Proposed Action would not result in significant impacts related to land use [SEA 4.1 at 4-9].

Light Emissions and Visual Impacts

Construction and installation of launch-related infrastructure would result in light emissions and visual impacts. The presence of the proposed infrastructure would not affect the visual integrity of the area, as this type of infrastructure is well established at CCAFS and considered part of the local landscape. There may be a short-term visible contrail during booster landings. The contrail would be similar in visual impact (though smaller in size) to the plume generated during takeoff and would dissipate quickly as wind and air turbulence affect the trail. Landing operations would not substantially degrade the existing visual character or quality of the site and its surroundings. Thus, the Proposed Action would not have significant impacts related to light emissions and visual resources [SEA 4.1 at 4-9].

Natural Resources and Energy Supply

The current potable and non-potable water supply, which could be available for Falcon Heavy booster landings, was originally designed to support Atlas launches. Since the Proposed Action involves landing up to three boosters, typical launch deluge water would not be used. The Proposed Action's reliance on the water supply would be relatively small; two pressurized 12,000 gallon tanks (one for each new pad) would be filled via the fire-main system and used to supply water cannon nozzles in the event of a fire. The Proposed Action would not have a significant impact on CCAFS water supply [SEA 4.11 at 4-32].

The electrical power capabilities for operations at LZ-1 were designed to support the Atlas launch program. If needed, electrical demand for construction activities would be satisfied by small propane or diesel-driven electrical generators. Electrical needs during landing events would be minimal and would include lights, small pumps, communications equipment, and site cameras. Electrical power requirements would be provided by tie-ins to existing power cables. The Proposed Action would not have a significant impact on electrical power demand or supply [SEA 4.11 at 4-32]. In conclusion, the Proposed Action would not result in significant impacts related to natural resources and energy supply.

Noise and Noise-Compatible Land Use

Low to moderate levels of noise would be generated by heavy equipment, work vehicles, and other construction equipment during land clearing and construction. The relative isolation of LZ-1 reduces the potential for noise to affect noise sensitive areas (e.g., residential areas, schools, hospitals, etc.). The closest noise sensitive area to CCAFS are about seven miles to the south, in the cities of Cape Canaveral and Cocoa Beach. Therefore, construction noise would not result in significant noise impacts [SEA 4.2 at 4-10].

Operational noise would occur from the booster engines as the boosters descend and land at LZ-1, and from sonic booms during descent. Because the approved models identified in FAA's NEPA-implementing order for modeling noise levels of proposed actions are not suitable for predicting rocket launch noise, USAF implemented a non-standard noise methodology to predict noise levels of Falcon Heavy booster landings. On September 1, 2017, the FAA Office of Environment and Energy approved the methodology. A copy of the approval is attached.

Launch noise levels at a launch site are directly correlated to the thrust of the launch vehicle at lift-off or landing. The Falcon Heavy boosters would land at LZ-1 with one to three engines operating, representing approximately one-third (or less) of the total thrust energy of each booster at liftoff. The closest noise sensitive area (residential areas of Cape Canaveral) is approximately seven miles away. Given a maximum of six annual Falcon Heavy booster return missions (with each mission including three booster landings), significant noise impacts in the residential areas of Cape Canaveral are not expected. That is, 18 booster landings per year would not result in an increase in noise of day-night average sound level (DNL) 1.5 dBA or more at or above DNL 65 dBA noise exposure for the closest noise sensitive area [SEA 4.2 at 4-11].

Regarding sonic booms, SpaceX used the FAA-approved model, PCBOOM, to predict overpressures generated during Falcon 9 booster landings in the 2014 EA. The 2014 EA discussed the occurrence of a maximum sonic boom of 3 psf that would occur over the Atlantic Ocean, approximately 30 miles from the coast, during a booster landing. For the 2017 SEA, the USAF supplemented the PCBOOM results using their own modeling. According to USAF modeling, a loud sonic boom could be expected during Falcon Heavy booster landings, peaking at approximately 5-7 psf in the near-field (on CCAFS property) and reaching dozens of miles beyond with over 0.5 psf. These peak values (5-7 psf) exceed the historical sonic booms generated in the area from previous vehicles (e.g., Space Shuttle, Concorde, Apollo capsule, etc.), which produced sonic booms typically below 2 psf. Public reaction can be expected between 1.5 and 2 psf. Rare, minor structure damage may occur with 2 to 5 psf of overpressure. SpaceX has measured sonic booms from their recent landing events at CCAFS. There is no evidence the overpressures of up to 5.48 psf at CCAFS (CRS-9 landing July 18, 2016) caused any structural or biological damage or impacts. However, the noise caused by the overpressures between that value and 1.45 psf at 10 miles, and possibly 0.5 psf at 60 miles, startled a large number of people. Therefore, SpaceX has developed a notification plan to educate the public and announce when a landing event would take place. The plan would involve issuing statements to news outlets and law enforcement so that when a sonic boom is heard, the public would understand what has occurred [SEA 4.2 at 4-11].

Two sonic boom events may occur for each returning stage, for a total of up to six booms. It is possible the pressure waves from the returning boosters could interact and cause localized regions of increased sonic boom overpressures down track. These local interactions would change the signature of the pressure waves in small regions on the ground affected by the coalesced waves; however, those small areas are not expected to significantly increase in overpressure magnitudes. In summary, sonic booms generated during Falcon Heavy booster returns are not expected to result in significant impacts [SEA 4.2 at 4-12].

The total thrust for Dragon engine testing would be approximately 131,000 pounds of force, which is approximately 13 percent of the thrust generated during a Falcon 9 (Block 1) launch. Falcon 9 launches at CCAFS have been shown not to result in significant noise impacts. Dragon test firings would be less than 2 seconds. Thus, noise generated during test firings would not result in significant noise impacts [SEA 4.2 at 4-11].

In conclusion, the Proposed Action is not expected to result in significant impacts. That is, the Proposed Action would not 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.

Socioeconomics, Environmental Justice, and Children's Environmental Health and Safety

SpaceX would use its current workforce for land clearing and construction activities but would hire up to 50 additional temporary workers and local consultants. The addition of these workers at CCAFS would not represent a significant increase in the population or growth rate of the region. During landing events and long-term operations, SpaceX would continue to use its current workforce. Landing operations would be expected to attract tourists who travel to the area specifically to view a landing event. Spending by tourists would generate revenue for local businesses, particularly in the hospitality industry, resulting in a small beneficial impact on the local economy.

Because operations would occur within CCAFS boundaries, and because most of the potential environmental impacts would occur at and within the vicinity of LZ-1, the Proposed Action would not affect low-income or minority populations within the region. Similarly, the Proposed Action would not have high and disproportionate effects on children. Thus, the Proposed Action is not expected to result in significant impacts related to socioeconomics, environmental justice, or children's environmental health and safety [SEA 4.13 at 4-35; SEA 4.14 at 4-36; SEA 3.1 at 3-2].

Transportation

Minor short-term interruptions to traffic flow or utilities may occur during construction activities. Since Falcon Heavy landing operations would occur up to six times a year, on-base traffic near LZ-1 would not change appreciably. Continuing to operate LZ-1 as a landing facility for up to three returning Falcon Heavy boosters is not expected change operation of the CCAFS roadways during a launch at LC-40 or LC-39A. Operating the Dragon processing and testing facility is not expected to require the closure of ICBM Road. Operation of roadways outside CCAFS would not be impacted.

Launch viewing traffic per year has declined substantially since the Shuttle program was terminated in 2011. Traffic volume has increased for a Falcon launch but has been less than that of a Shuttle launch. There may be a slight increase in viewing traffic for a Falcon Heavy landing event, since it would be a novelty. Any increased visitation would cause less than a significant impact on CCAFS and local traffic patterns. There might be a slight positive impact on traffic since the boosters would be transported to a

local SpaceX facility for reuse rather than transporting new boosters from Texas to CCAFS. In conclusion, the Proposed Action is not expected to result in significant impacts related to transportation [SEA 4.10 at 4-31].

Water Resources (Wetlands, Floodplains, Surface Waters, Groundwater, and Wild and Scenic Rivers)

Construction of the landing pads would require a storm water management system to address the impervious surface added at LZ-1. The design would be developed and a modification to the existing Environmental Resource Permit would be reviewed and approved by the St. Johns River Water Management District (SJRWMD). Any stormwater runoff during construction would be managed according to a Stormwater Pollution Prevention Plan approved by the SJRWMD. Under the Proposed Action, a typical deluge water system would not be used; therefore, there would be no wastewater generated booster landings. In the case of an unsuccessful booster landing, if remaining propellant was not consumed during combustion, there could be potential impacts (short term decline in water quality) to surface waters (Banana River Lagoon or the Atlantic Ocean) near LZ-1. SpaceX has an established emergency response team and any unexpected spills would be contained and cleaned up per the procedures identified in the SpaceX Emergency Action Plan and the Spill Prevention Control and Countermeasures Plan.

Wetlands were surveyed and delineated at LZ-1. Construction activities would avoid wetlands. Additionally, a 25-foot buffer zone has been established, as required by SJRWMD, to ensure adequate separation between construction activities and wetlands. This buffer would protect wetlands from potential direct or indirect impacts.

Construction of the southern-most proposed landing pad would occur in the 100-year floodplain (see Appendix F of the 2017 SEA). Based on the expected adverse impacts on one of the natural and beneficial floodplain values (i.e., wildlife), the FAA has determined the Proposed Action would result in a floodplain encroachment per Department of Transportation Order 5650.2. The USAF formally consulted the USFWS per section 7 of the ESA to minimize potential impacts on federally listed species. With the mitigation identified in the USFWS's Biological Opinion, no significant impacts on wildlife within the floodplain are expected. The required site plan affords no other practicable alternative that would meet the requirements of the project. The public was informed of this floodplain encroachment through

SpaceX's public notice in the Florida Today newspaper by a notice published on July 3, 4, and 5, 2016. No significant impacts on wetlands or floodplains are expected.

There are no wild or scenic rivers present at or near CCAFS; thus, there would be no impact on wild and scenic rivers. In summary, the Proposed Action would not have a significant impact on water resources [SEA 4.8 at 4-29, 4-30].

Cumulative Impacts

This FONSI incorporates by reference the 2017 SEA, which addresses the potential impacts of past, present, and reasonably foreseeable future activities at and within the vicinity of CCAFS that would affect the resources impacted by the Proposed Action. Due to the nature of the Proposed Action and its location on the coast within CCAFS, only launch-related actions (construction and operation) occurring at CCAFS would meaningfully interact in time and space with the Proposed Action such that potential cumulative impacts could result. Past, present, and reasonably foreseeable actions near LZ-1 include vehicle launches, landings, and construction activities, including land clearing. This section presents a brief summary of the potential cumulative environmental impacts considered in the 2017 SEA. As noted above, the Proposed Action would not affect coastal resources; farmlands; historical, architectural, archaeological, and cultural resources; land use; environmental justice and children's environmental health and safety; wetlands; and wild and scenic rivers. Thus, the Proposed Action would not result in cumulative impacts to these resources. The following summary focuses on those resources with the greatest potential of experiencing cumulative impacts: air quality; biological resources (fish, wildlife, and plants); hazardous materials, pollution prevention, and solid waste; and noise and noise-compatible land use.

Air Quality

The cumulative emissions from the Proposed Action and past, present, and reasonably foreseeable future projects at CCAFS would not exceed any thresholds established under the Clean Air Act or jeopardize the attainment status of the region. All government and commercial launches at CCAFS occur individually, i.e., no launch overlaps in time or space with another launch. This avoids the potential for simultaneously combining impacts associated with exhaust plumes from multiple vehicles. Individuals at and around the launch sites are unlikely to be exposed to concentrations of any launch vehicle emission that exceeds the allowable public exposure limits adopted by the range safety organizations. Also, USAF's compliance with Executive Order 13514, *Federal Leadership in Environmental, Energy, and*

Economic Performance, for activities taking place at CCAFS helps minimize emissions of GHGs. Therefore, no significant cumulative impacts to the region's air quality are expected to occur [SEA 5.2 at 5-10].

Biological Resources (Fish, Wildlife, and Plants)

Potential cumulative impacts on biological resources from the Proposed Action and other past, present, and reasonably foreseeable future projects at CCAFS include those types of direct and indirect impacts discussed above. Cumulative adverse impacts would occur to the Florida scrub-jay and eastern indigo snake. When evaluated with other projects occurring or proposed at CCAFS, KSC, or the Port of Canaveral area, the proposed removal of approximately 23 acres of habitat would result in a reduction of available breeding habitat in the area, as well as a reduction in the availability of scrub-jay habitat for restoration. The restoration of approximately 46 acres of habitat (proposed mitigation for the Proposed Action) would result in habitat that could support additional scrub-jay territories.

Cumulative impacts on sea turtles have the potential to occur. The new facilities and additional operations would result in more exterior lighting than is currently present at LZ-1. Adherence to the Light Management Plan and USAF lighting policies would minimize these impacts. Amber LED lighting would be used to minimize potential adverse impacts on nesting turtles and their young.

Potential cumulative impacts on biological resources would be minimized with implementation of measures identified during consultation with the USFWS (as applicable for the Proposed Action), measures identified in environmental documents completed for other projects, measures to be incorporated in environmental documents currently under development for future actions, and measures identified in the USAF's Integrated Natural Resources Management Plan and Light Management Plan for CCAFS. Therefore, no significant cumulative impacts to biological resources are expected to occur [SEA 5.2 at 5-9, 5-10].

Hazardous Materials, Pollution Prevention, and Solid Waste

Launch operations and other activities conducted at CCAFS use products containing hazardous materials. Implementation of existing handling and management procedures for hazardous materials, hazardous waste, and solid waste limits the potential for impacts. Each organization or entity conducting activities at CCAFS is responsible for compliance with applicable regulatory requirements (e.g., Resource Conservation and Recovery Act; Executive Order 12088, *Federal Compliance with Pollution Control*

Standards). Therefore, significant cumulative impacts related to hazardous materials, pollution prevention, and solid waste are not expected to occur [SEA 5.2 at 5-12].

Noise and Noise-Compatible Land Use

When combined with other past, present, and reasonably foreseeable future projects at CCAFS, short-term increases in noise levels in the area surrounding CCAFS from the Proposed Action are not anticipated to be significant. Long-term cumulative noise levels would not be expected to exceed the FAA's noise significance threshold. Each launch at CCAFS would and has occurred separately, avoiding combined noise impacts from more than one launch at a time. Thus, significant cumulative impacts related to noise and compatible land use are not expected to occur [SEA 5.2 at 5-9].

Agency Finding and Statement

The FAA has determined that no significant impacts would occur as a result of the Proposed Action and, therefore, that preparation of an Environmental Impact Statement is not warranted and a FONSI in accordance with 40 CFR Section 1501.4(e) is appropriate.

After careful and thorough consideration of the facts contained herein, the undersigned finds that the proposed Federal action is consistent with existing national environmental policies and objectives as set forth in Section 101 of NEPA and other applicable environmental requirements and will not significantly affect the quality of the human environment or otherwise include any condition requiring consultation pursuant to Section 102(2)(C) of NEPA.

APPROVED: _____ DATE: 11/28/17

Dr. George C. Nield
Associate Administrator for
Commercial Space Transportation