ENVIRONMENTAL IMPACT STATEMENT

SPACEX STARSHIP-SUPER HEAVY LAUNCH VEHICLE AT LAUNCH COMPLEX 39A

at the Kennedy Space Center, Merritt Island, Florida

Final, Volume II, Appendix B.1, Part 4

January 2026

Federal Aviation Administration

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B.1.5 Addendum to the May 2025 USFWS Biological and Conference Assessment

Addendum to the May 2025 Biological and Conference Assessment for SpaceX Starship-Super Heavy Launch and Landing Operations at Launch Complex 39A at Kennedy Space Center, Merritt Island, Florida, Addressing an Expanded Range of Starship Return to Launch Site Trajectories

June 12, 2025

Action

Background

On March 20, 2025, the National Aeronautics and Space Administration (NASA) submitted to the United States Fish and Wildlife Service (USFWS) the *Final Biological and Conference Assessment* [BCA] *for SpaceX Starship-Super Heavy Launch and Landing Operations at Launch Complex-39A at the Kennedy Space Center* [KSC]*, Merritt Island, Florida* (Fish and Wildlife Service [FWS] Log Number 2024-0058364) (NASA, 2025a). On May 1, 2025, NASA submitted the *Revised Final Biological and Conference Assessment for SpaceX Starship-Super Heavy Launch and Landing Operations at Launch Complex-39A at the Kennedy Space Center, Merritt Island, Florida* to the USFWS to address the addition of a Starship Atlantic Ocean contingency landing area and items in the Request for Additional Information received from the USFWS on April 11, 2025; this revised BCA is hereafter referred to as the Starship-Super Heavy LC-39A Revised BCA (NASA, 2025b). In this *Addendum to the May 2025 Biological and Conference Assessment for SpaceX Starship-Super Heavy Launch and Landing Operations at Launch Complex 39A at Kennedy Space Center, Merritt Island, Florida*, comparisons to previous analyses refer exclusively to the Starship-Super Heavy LC-39A Revised BCA, as it superseded the original BCA submitted on March 20, 2025. The Starship-Super Heavy LC-39A Revised BCA and this addendum support Endangered Species Act Section 7 interagency consultation between the USFWS and NASA.

The Starship-Super Heavy LC-39A Revised BCA evaluated the effects to Endangered Species Act-listed species and critical habitat (designated and proposed) under USFWS jurisdiction caused by operation of the Starship-Super Heavy at LC-39A at KSC. The Proposed Action included infrastructure construction, static fire tests, launches, landings, and daily operations at LC-39A; transport of supplies, personnel, and launch vehicles to LC-39A; expenditure of vehicles and components in the ocean; landings on droneships in the ocean; and transport of supplies and vehicles via barge. SpaceX must obtain a vehicle operator license from the Federal Aviation Administration (FAA) for Starship-Super Heavy launch and landing operations at LC-39A. The FAA action is the issuance of the vehicle operator license and subsequent renewals or modifications that are within the scope of this BCA and addendum.

Update to Action

In June 2025, NASA developed this addendum to the Starship-Super Heavy LC-39A Revised BCA to evaluate an expanded range of Starship return to launch site (RTLS) trajectories (Figure 1). This addendum also updates the Action Area map, clarifies the range of trajectories for launches and Super Heavy RTLS landings, and makes corrections to select portions of the Starship-Super Heavy LC-39A Revised BCA (NASA, 2025b).

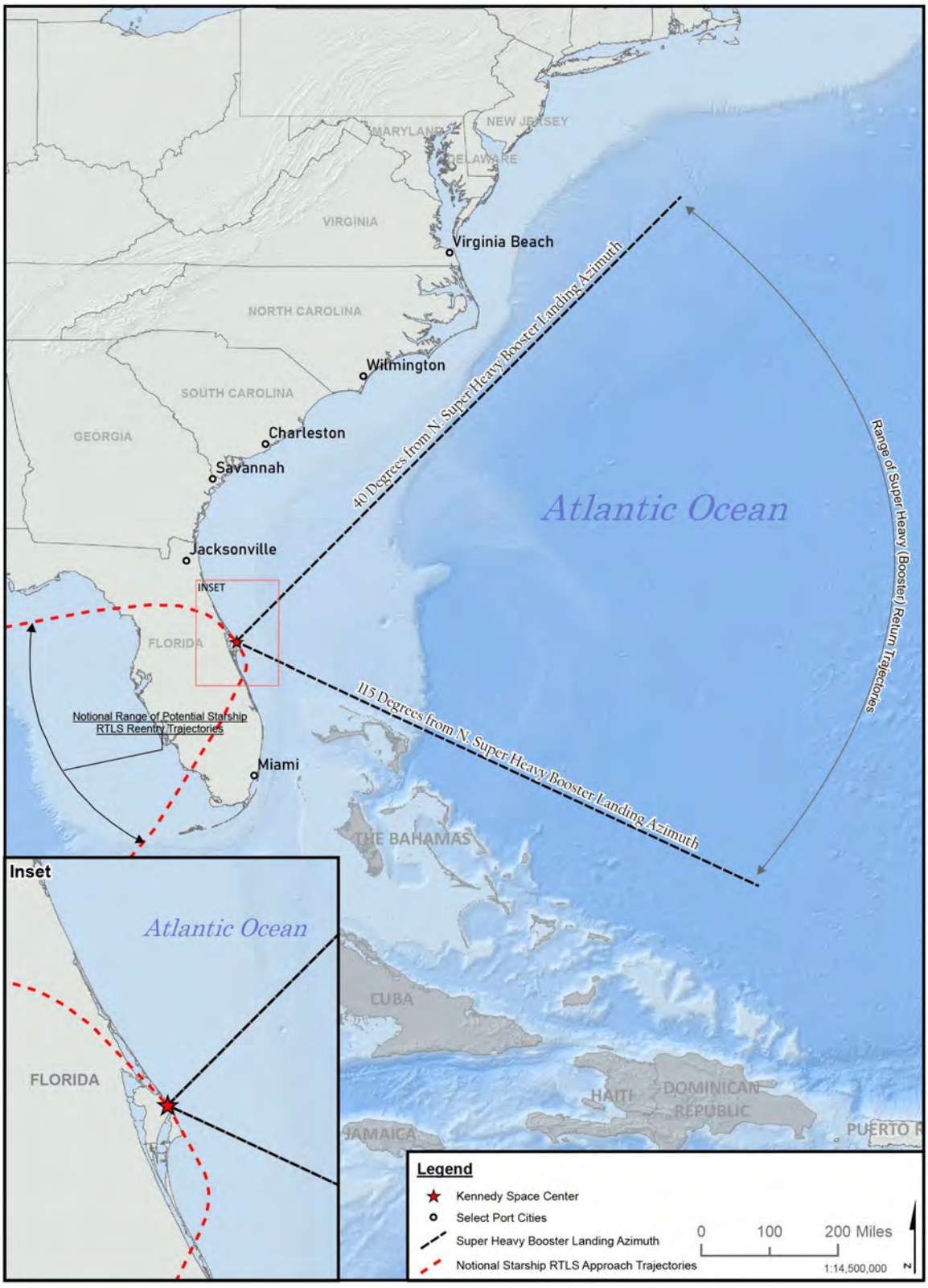

Figure 1. Range of RTLS Landing Trajectories for Starship and Super Heavy

Range of Starship RTLS Trajectories and Sonic Boom Footprints

Ground areas affected by sonic booms differ widely depending on the trajectory being followed, reflecting widely varying locations and headings of the supersonic portions of these trajectories. However, landing trajectory altitude, speed, and distance profiles are similar regardless of the horizontal flight path being followed, resulting in the size and shape of the sonic boom footprint also being similar for various inbound routings. In the Starship-Super Heavy LC-39A Revised BCA, the only proposed trajectory for Starship RTLS landings was the nominal heading. Figure 2 depicts the modeled sonic boom overpressure contours calculated for the Starship RTLS nominal trajectory. This addendum additionally examines effects associated with an expanded range of Starship RTLS landing trajectories (153 to 320 degrees).

For the purposes of analysis, the sonic boom footprints for launches on various trajectories are assumed to differ only in orientation relative to the landing pad. To reflect the entire Action Area for Starship RTLS landing overpressures exceeding 1 pound per square foot (psf), the modeled 1-psf contour for a Starship RTLS landing on the nominal heading was rotated clockwise and counterclockwise to 153- and 320-degree headings, respectively, using LC-39A as the pivot point. This is reflected in Figure 3. To evaluate potential sonic boom effects associated with the expanded range of Starship landing trajectories, a map of overpressure zones was created by rotating the 1-, 1.25-, 1.5-, and to 1.7-psf contours for Starship RTLS landings on the nominal heading clockwise and counterclockwise to 153- and 320-degree headings, respectively. This is reflected in Figure 2. These zones of overpressures from 1 psf to 1.7 psf would vary based upon the approach trajectory of the Starship.

Range of Super Heavy RTLS Trajectories and Sonic Boom Footprints

The Proposed Action in the Starship-Super Heavy LC-39A Revised BCA included Super Heavy RTLS trajectories from 40 to 115 degrees, with sonic boom modeling conducted for Super Heavy landings at nominal, 40-degree, and 115-degree trajectories. To reflect the entire Action Area for Super Heavy RTLS landing overpressures exceeding 1 psf, the 1-psf footprints for each of the three modeled headings (40 degrees, nominal, and 115 degrees) were connected as follows: the modeled 40-degree and 115-degree 1-psf footprints were rotated clockwise and counterclockwise, respectively, toward the nominal heading footprint, using LC-39A as the pivot point. This is reflected in Figure 3. The creation of overpressure zones was not necessary for Super Heavy landings since exact modeling results for the various psf levels at the outer extremes (40- and 115-degree headings) and the nominal heading were already available and used in calculations for Florida scrub-jays, southeastern beach mice, and sea turtles in Sections 5.3.5, 5.3.15, and 5.3.20, respectively, of the Starship-Super Heavy LC-39A Revised BCA (see Table 5-6, Table 5-10, and Table 5-13 in the Starship-Super Heavy LC-39A Revised BCA).

Range of Launch Trajectories and Sonic Boom Footprints

The Proposed Action in the Starship-Super Heavy LC-39A Revised BCA included launch trajectories from 40 to 115 degrees, but sonic boom modeling was only conducted for launches at the nominal trajectory. To reflect the entire Action Area for launch overpressures exceeding 1 psf, the modeled 1-psf footprint for launches on the nominal heading was rotated clockwise to the 115-degree heading and counterclockwise to the 40-degree heading, using LC-39A as the pivot point. This is reflected in Figure 3. None of the trajectories within the permitted range for launches (40 to 115 degrees) would result in sonic boom overpressures in excess of 1 psf on land, so the creation of launch overpressure zones was not necessary, and no new analyses were conducted for launches in this addendum.

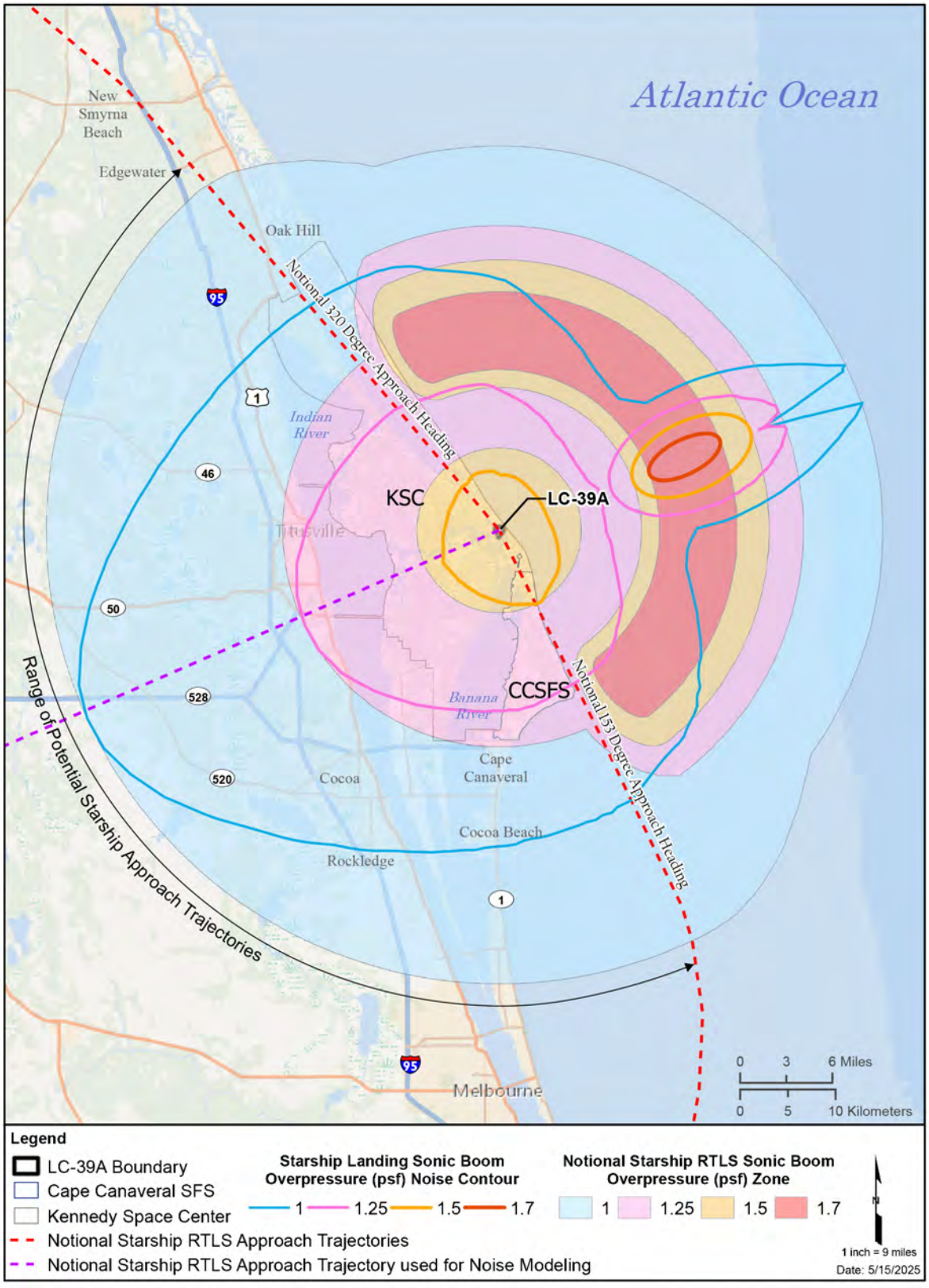

Figure 2. Notional Starship RTLS Approach Trajectories and Sonic Boom Overpressure Zones

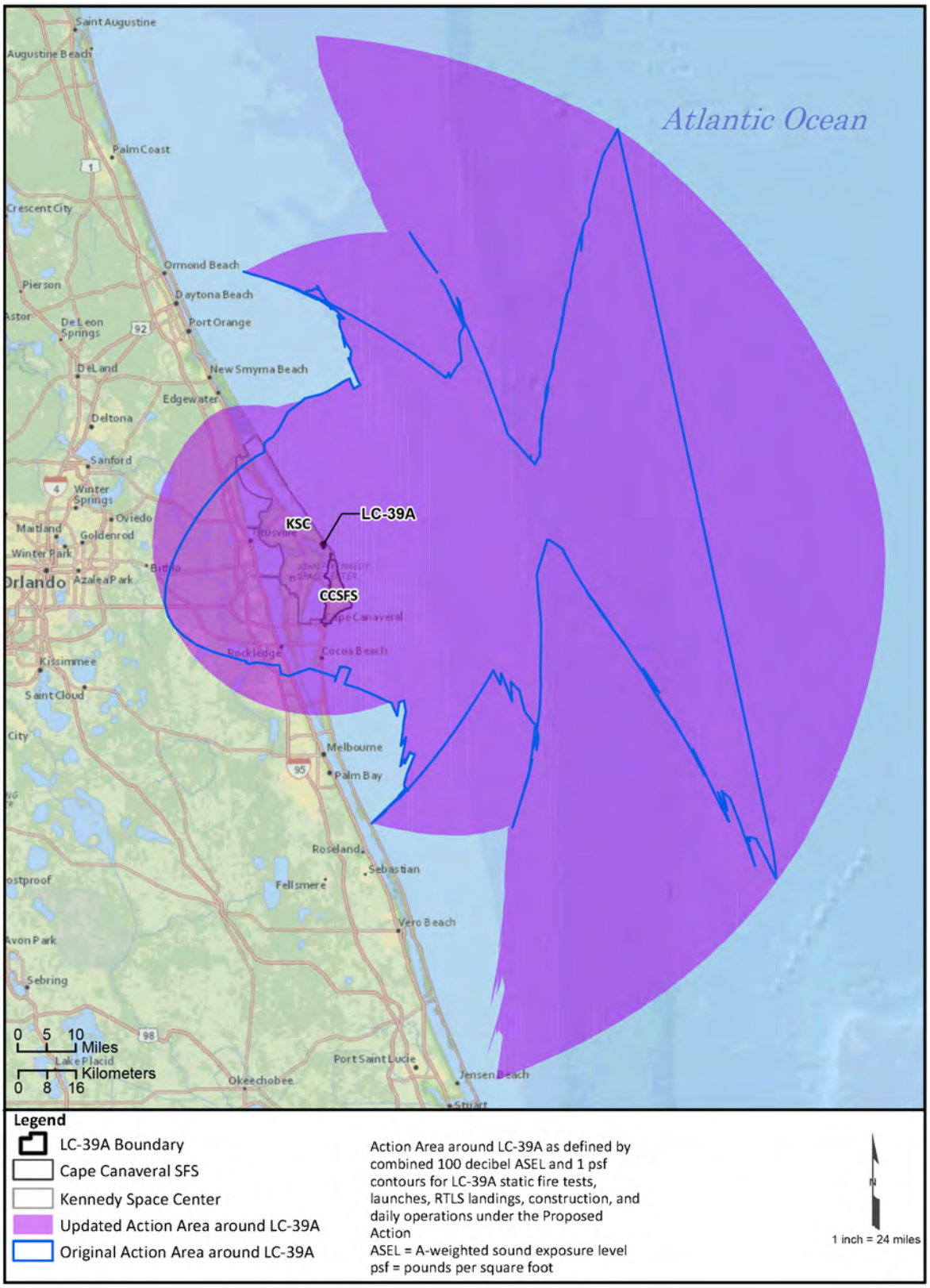

Figure 3. LC-39A and Surrounding Area: Original and Updated Combined 1 psf/100 dB ASEL Contour for the Proposed Action

Noise, Plume, and Light Extent

As discussed in the Starship-Super Heavy LC-39A Revised BCA, both launch and landing propulsion noise levels (e.g., A-weighted sound exposure level [ASEL]) would be highest when the vehicle is nearly vertical; this occurs during the initial portion of a launch when the vehicle is close to the ground and climbing or during the final portion of a landing when the vehicle is descending along a nearly vertical flight path. Propulsion noise levels are affected primarily by distance to the launch pad and whether the noise propagates over land or water.

The heading of a launch or landing has minimal effect on the propulsion ASEL noise levels. Thus, in the Starship-Super Heavy LC-39A Revised BCA, the ASEL noise contours for launches (Figure 5-3), Super Heavy RTLS landings (Figure 5-6), and Starship RTLS landings (Figure 5-7) on their respective nominal trajectories are considered representative of ASEL noise contours for the full range of permitted trajectories for launches, Super Heavy landings, and Starship landings, respectively. Therefore, propulsion ASEL noise is not discussed further in this addendum.

Additionally, variations in launch and Super Heavy and Starship RTLS landing trajectories would have a minimal effect on plume size and light extent due to the vertical nature of these events. The launch and landing plume areas in Figure 2-1 of the Starship-Super Heavy LC-39A Revised BCA are considered representative for all permitted launch and Super Heavy and Starship RTLS landing trajectories, respectively. Therefore, plume size and light extent are not discussed further in this addendum.

Summary

Table 1 summarizes and compares the range of trajectories and related consequences. Figure 3 shows the original Action Area for LC-39A and the surrounding area, as well as the updated Action Area reflecting the entirety of the area around LC-39A affected by the combined 1 psf/100 decibel (dB) ASEL (or sometimes denoted as "dBA SEL") contour associated with static fire tests, launches (40- to 115-degree trajectories), Super Heavy RTLS landings (40- to 115-degree trajectories), and Starship RTLS landings (153- to 320-degree trajectories).

Table 1. Summary and Comparison of Range of Trajectories and Related Consequences

Activity	Starship-Super Heavy LC-39A Revised BCA (May 1, 2025)	BCA Addendum (June 12, 2025)	Comparison of Consequences
Starship RTLS	Proposed Action includes only nominal trajectory.	Proposed Action includes expanded range of Starship RTLS trajectories (153 to 320 degrees).	Map of Area around LC-39A Affected by 1 psf/100 dB ASEL: Added 1-psf footprints associated with continuously variable Starship approaches ranging from 153 to 320 degrees Analysis: Additionally examined areas affected by new Starship approach trajectories
Super Heavy RTLS	Proposed Action includes trajectories ranging from 40 to 115 degrees.	No change.	Map of Area around LC-39A Affected by 1 psf/100 dB ASEL: Corrected map to show 1-psf footprints associated with continuously variable Super Heavy approaches ranging from 40 to 115 degrees

Table 1. Summary and Comparison of Range of Trajectories and Related Consequences

Activity	Starship-Super Heavy LC-39A Revised BCA (May 1, 2025)	BCA Addendum (June 12, 2025)	Comparison of Consequences
Launches	Proposed Action includes trajectories ranging from 40 to 115 degrees.	No change.	Map of Area around LC-39A Affected by 1 psf/100 dB ASEL: Corrected map to show 1-psf footprints associated with continuously variable launch trajectories ranging from 40 to 115 degrees

Notes: ASEL = A-weighted sound exposure level; BCA = Biological and Conference Assessment; dB = decibel(s); LC= Launch Complex; psf = pounds per square foot; RTLS = return to launch site.

Considered Species and Critical Habitat Areas

Official Species List and Effect Determinations Summary

The species and critical habitats previously considered in the Starship-Super Heavy LC-39A Revised BCA are listed in Table 2. For this addendum, NASA requested a new official species list on June 4, 2025, from the USFWS Information for Planning and Conservation (IPaC) database for the updated Action Area around LC-39A, which includes the areas affected by up to 1 psf and/or 100 dB ASEL from static fire tests, launches, and RTLS landings for Starships and Super Heavy boosters as shown in Figure 3. The official species list for the addendum identified the same species and critical habitats as the Starship-Super Heavy LC-39A Revised BCA, with the addition of the Kemp's ridley sea turtle (*Lepidochelys kempii*) (Attachment 1). Although not in the original IPaC list, the Kemp's ridley sea turtle was analyzed in the Starship-Super Heavy LC-39A Revised BCA. This addendum does not include any changes to Starship contingency ocean landings or to other landings in the Atlantic, Pacific, and Indian Oceans, so no other new IPaC reports were run. However, for completeness, all species considered in the Starship-Super Heavy LC-39A BCA are listed in Table 2. The analyses and rationale for the addendum effect determinations are provided in the following sections.

Table 2. Species and Critical Habitats: Effect Determinations

Species or Critical Habitat Area	Endangered Species Act Status	June 2025 Addendum: *Expanded Range of Starship RTLS Trajectories*	May 2025 Starship-Super Heavy LC-39A Revised BCA: *Construction and Original Mission Profile with Contingency Landings*	Updated Overall Effect Determination: *Construction and Updated Mission Profile (with Contingency Landings and Range of Starship RTLS Trajectories)*
Birds				
Audubon's crested caracara (*Caracara plancus audubonii*) [Florida DPS]	Threatened	Not Likely to Adversely Affect		
Band-rumped storm-petrel (*Hydrobates castro*) [Hawaii DPS]	Endangered	Not Present[1]	Not Likely to Adversely Affect	

Table 2. Species and Critical Habitats: Effect Determinations

Species or Critical Habitat Area	Endangered Species Act Status	June 2025 Addendum: *Expanded Range of Starship RTLS Trajectories*	May 2025 Starship-Super Heavy LC-39A Revised BCA: *Construction and Original Mission Profile with Contingency Landings*	Updated Overall Effect Determination: *Construction and Updated Mission Profile (with Contingency Landings and Range of Starship RTLS Trajectories)*
Bermuda petrel (*Pterodroma cahow*)	Endangered	Not Present[1]	Not Likely to Adversely Affect	
Black-capped petrel (*Pterodroma hasitata*)	Endangered	Not Likely to Adversely Affect		
Eastern black rail (*Laterallus jamaicensis jamaicensis*)	Threatened	Not Likely to Adversely Affect		
Everglade snail kite (*Rostrhamus sociabilis plumbeus*)	Endangered	Not Likely to Adversely Affect		
Florida grasshopper sparrow (*Ammodramus savannarum floridanus*)	Endangered	Not Present[1]	Not Likely to Adversely Affect	
Florida scrub-jay (*Aphelocoma coerulescens*)	Threatened	*Insignificant effects* - Not Likely to Adversely Affect	Likely to Adversely Affect	
Hawaiian petrel (*Pterodroma sandwhichensis*)	Endangered	Not Present[1]	Not Likely to Adversely Affect	
Newell's shearwater (*Puffinus newelli*)	Threatened	Not Present[1]	Not Likely to Adversely Affect	
Piping plover (*Charadrius melodus*)	Threatened	Not Likely to Adversely Affect		
Red-cockaded woodpecker (*Dryobates borealis)*	Threatened	Not Likely to Adversely Affect		
Roseate tern (*Sterna dougallii dougallii*)	Endangered	Not Present[1]	Not Likely to Adversely Affect	
Rufa red knot (*Calidris canutus rufa*)	Threatened	Not Likely to Adversely Affect		
Short-tailed albatross (*Phoebastria albatross*)	Endangered	Not Present[1]	Not Likely to Adversely Affect	
Whooping crane (*Grus americana*)	Threatened (NEP)	No Effect		
Wood stork (*Mycteria americana*)	Threatened (delisting proposed)	Not Likely to Adversely Affect		
Crustaceans				
Black Creek crayfish (*Procambarus pictus*)	Proposed Endangered	Not Present[1]	Not Likely to Adversely Affect	
Insects				
Monarch butterfly (*Danaus plexippus*)	Proposed Threatened	Not Likely to Jeopardize		

Table 2. Species and Critical Habitats: Effect Determinations

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Mammals				
Anastasia Island beach mouse (*Peromyscus polionotus phasma*)	Endangered	Not Present[1]	Not Likely to Adversely Affect	
Florida bonneted bat (*Eumops floridanus*)	Endangered	Not Present[1]	Not Likely to Adversely Affect	
Florida panther (*Puma [= Felis] concolor coryi*)	Endangered	No Effect		
Puma (*Puma [= Felis] concolor,* all subspecies except *coryi*)	Threatened (S/A)	No Effect		
Southeastern beach mouse (*Peromyscus polionotus niveiventris*)	Threatened	*Insignificant effects* - Not Likely to Adversely Affect	Likely to Adversely Affect	
Tricolored bat (*Perimyotis sublavus*)	Proposed Endangered	Not Likely to Jeopardize		
West Indian manatee (*Trichechus manatus*)	Threatened	Not Likely to Adversely Affect		
Reptiles				
American alligator (*Alligator mississippiensis*)	Threatened (S/A)	No Effect		
American crocodile (*Crocodylus acutus*)	Threatened	No Effect		
Atlantic salt marsh snake (*Nerodia clarkia taeniata*)	Threatened	Not Likely to Adversely Affect		
Eastern indigo snake (*Drymarchon couperi*)	Threatened	*Insignificant effects* - Not Likely to Adversely Affect	Likely to Adversely Affect	
Green sea turtle (*Chelonia mydas*) [North Atlantic Ocean DPS]	Threatened	*Insignificant effects* - Not Likely to Adversely Affect	Likely to Adversely Affect	
Hawksbill sea turtle (*Eretmochelys imbricata*)	Endangered	*Insignificant effects* - Not Likely to Adversely Affect	Likely to Adversely Affect	
Kemp's ridley sea turtle (*Lepidochelys kempii*)	Endangered	*Insignificant effects* - Not Likely to Adversely Affect	Likely to Adversely Affect	
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered	*Insignificant effects* - Not Likely to Adversely Affect	Likely to Adversely Affect	

Table 2. Species and Critical Habitats: Effect Determinations

Species or Critical Habitat Area	Endangered Species Act Status	June 2025 Addendum: *Expanded Range of Starship RTLS Trajectories*	May 2025 Starship-Super Heavy LC-39A Revised BCA: *Construction and Original Mission Profile with Contingency Landings*	Updated Overall Effect Determination: *Construction and Updated Mission Profile (with Contingency Landings and Range of Starship RTLS Trajectories)*
Loggerhead sea turtle (*Caretta caretta*) [Northwest Atlantic Ocean DPS]	Threatened	*Insignificant effects* - Not Likely to Adversely Affect	Likely to Adversely Affect	
Critical Habitat				
Piping plover	Final	Not Present[1]	Not Likely to Adversely Affect	
Rufa red knot	Proposed	No Effect		
Florida bonneted bat	Final	Not Present[1]	Not Likely to Adversely Affect	
West Indian manatee	Final and Proposed	No Effect		
Green sea turtle	Proposed	No Destruction or Adverse Modification		
Loggerhead sea turtle	Final	Not Likely to Adversely Affect	Likely to Adversely Affect	
Plants				
Plants (Starship-Super Heavy LC-39A Revised BCA provides full list of IPaC plants)	Threatened, Endangered	No Effect		

Notes: ASEL = A-weighted sound exposure level; BCA = Biological and Conference Assessment; dB = decibels; DPS = Distinct Population Segment; LC = Launch Complex; IPaC = Information for Planning and Consultation; NEP = non-essential experimental population; psf = pounds per square foot; RTLS = return to launch site; S/A = Similarity of Appearance; USFWS = United States Fish and Wildlife Service.

[1.] Species labeled as Not Present were not identified in the official species list obtained from the USFWS IPaC system on June 4, 2025, for the updated 1 psf/100 dB ASEL contour, which includes the expanded range of trajectories.

No Effect Determinations

The following species and critical habitats were not present on the updated IPaC list run for this addendum and are not expected to occur within the updated Action Area for the 1 psf/100 dB ASEL contour: band-rumped storm-petrel, Bermuda petrel, Hawaiian petrel, Newell's shearwater, roseate tern, short-tailed albatross, Black Creek crayfish, Florida grasshopper sparrow, Anastasia Island beach mouse, Florida bonneted bat, Florida bonneted bat critical habitat, and piping plover critical habitat (see Table 2 and Attachment 1). Therefore, the expanded range of trajectories would have no effect on them, and their overall effect determinations remain the same as those listed in the Starship-Super Heavy LC-39A Revised BCA.

Although identified in the updated IPaC list as potentially occurring within the updated Action Area for the 1 psf/100 dB ASEL contour, there have been no changes in listing status for the following species and the updated range of trajectories would have no effect on them: whooping crane, puma, Florida panther, American alligator, American crocodile, rufa red knot proposed critical habitat, and West Indian manatee

critical habitat (proposed and designated) (see Table 2 and Attachment 1). Thus, the overall determinations for these animal species and critical habitats remain the same as those listed in the Starship-Super Heavy LC-39A Revised BCA (i.e., **No Effect**). The effect determination for all listed plants identified in the IPaC reports also remains as **No Effect**.

Species Assessments

Commonalities Across Species

Environmental Baseline

Since the completion of the Starship-Super Heavy LC-39A Revised BCA on May 1, 2025, there has been no change in the listing status of any of the species considered in the BCA, and there have been no new USFWS assessments, reviews, recovery plans, Federal Register publications, or published updates in the literature regarding the distribution, habitat needs, or biology of any of these species.

Effects of the Action

The types and spatial extents of relevant effects are based on the analyses in the Starship-Super Heavy LC-39A Revised BCA; they have been updated where appropriate with new information. Potential effects from plumes, light, and noise were adequately addressed by analyses conducted in the Starship-Super Heavy LC-39A Revised BCA, as summarized previously in the Update to Action section. The Species Assessments section focuses on potential effects on federally listed species and proposed and designated critical habitat from sonic boom overpressures associated with the expanded range of Starship landing trajectories.

Overpressures associated with the expanded range of Starship RTLS trajectories would affect additional portions of the Atlantic Ocean; KSC; Merritt Island National Wildlife Refuge (MINWR); Canaveral National Seashore (CANA); Cape Canaveral Space Force Station (CCSFS); and Brevard, Volusia, Seminole, Orange, and Osceola Counties compared to the areas affected by the Starship nominal approach that was modeled and analyzed in the Starship-Super Heavy LC-39A Revised BCA (Figure 2). However, the highest overpressures of 1.7 psf are expected to be limited to the Atlantic Ocean (Figure 2). While there would be an increase in the area affected by sonic booms from Starship RTLS landings, there would be fewer exposures in any one area due to the range of trajectories. At a predicted maximum of 1.7 psf, the sonic booms generated by Starship landings would be much less intense than booms generated by Super Heavy booster landings (up to over 20 psf).

Cumulative Effects

No projects were identified that meet the criteria of being both reasonably foreseeable and exclusively a State or private activity that did not require any type of Federal permit. Therefore, according to the definition of cumulative effects in 50 Code of Federal Regulations §402.02, there would be no cumulative effects to the Florida scrub-jay, southeastern beach mouse, eastern indigo snake, or any sea turtle species within the Action Area beyond those analyzed in the Starship-Super Heavy LC-39A Revised BCA and this addendum.

Audubon's Crested Caracara, Black-Capped Petrel, Eastern Black Rail, Everglade Snail Kite, Red-Cockaded Woodpecker, and Wood Stork

The expanded range of Starship RTLS trajectories would expose additional areas to sonic booms of up to 1.7 psf where these bird species may occur. As discussed in the Starship-Super Heavy LC-39A Revised BCA, such events may cause temporary disturbance and stress due to interrupted foraging, roosting, or breeding. Breeding activity has not been documented in the Action Area for the caracara, black rail, Everglade snail kite, or red-cockaded woodpecker, and no wood stork colonies are present within the Action Area. It is unknown how various overpressure levels may affect the hearing ability of these bird species, but NASA expects that any individuals in the vicinity would exhibit a startle response (e.g., take flight), returning to normal behavior shortly thereafter. The effort required for a disturbed bird to fly to another area to forage or rest would be minimal, and any effects associated with dispersal are expected to be insignificant.

Although individuals present at the time of a landing could be disturbed by the sonic boom depending on their proximity, any temporary alterations in feeding and sheltering would not significantly disrupt normal behavioral patterns. Overall effects to the crested caracara, black-capped petrel, eastern black rail, Everglade snail kite, red-cockaded woodpecker, and wood stork from the Proposed Action would be considered insignificant. Thus, NASA has made the determination of **may affect, not likely to adversely affect,** for the Proposed Action and the overall Proposed Action (as described in the Starship-Super Heavy LC-39A Revised BCA) with respect to the crested caracara, black-capped petrel, eastern black rail, Everglade snail kite, red-cockaded woodpecker, and wood stork.

Florida Scrub-Jay

The overpressures associated with the expanded range of Starship RTLS trajectories would affect small additional portions of Brevard, Volusia, Seminole, Orange, and Osceola Counties where Florida scrub-jays may occur. The Florida scrub-jay has been documented nesting, foraging, and roosting within the Action Area, with core habitat located 1.3 miles from the landing pad at LC-39A. As discussed in the Starship-Super Heavy LC-39A Revised BCA, sonic booms may startle birds, potentially resulting in interruption of foraging, breeding, nesting, or roosting, or could cause a Florida scrub-jay to flush from the nest, leaving eggs or young vulnerable to predation or dehydration. In some cases, adults may damage eggs during their startle response. Individuals that flush from a protected or concealed area may be more vulnerable to predation. However, Florida scrub-jays in these areas likely already experience low-level overpressures from other landings at KSC and CCSFS. With the use of varied trajectories, there would be fewer exposures in any one area, and overpressures greater than 1.7 psf would not be expected to reach land. Effects from Starship landing sonic booms are expected to be insignificant.

Table 5-6 in the Starship-Super Heavy LC-39A Revised BCA presented the acres of core Florida scrub-jay habitat at KSC, MINWR, CANA, and CCSFS exposed to sonic boom overpressures associated with Starship RTLS landings at the nominal heading; this was the only trajectory modeled for Starship RTLS

landings. With the expansion of the range of Starship RTLS landings, additional analyses were conducted for the acres of core habitat within the predicted overpressure contours for Starship RTLS landings at the outermost trajectories of 153 degrees and 320 degrees. Table 3 now includes the acres of core Florida scrub-jay habitat exposed to Starship landing overpressures for each of the three approach trajectories. Using the Starship landing at 320 degrees as the representative trajectory, up to 29,609 acres of core Florida scrub-jay habitat at KSC, MINWR, CANA, and CCSFS may be exposed to overpressures of 1 to 1.7 psf.

Table 3. Updated Florida Scrub-Jay Core Habitat at KSC, MINWR, CANA, and CCSFS Exposed to Greater than 1 psf Overpressure from the Proposed Action at LC-39A

Events at LC-39A	Acres affected[1]					
	1-2 psf	2-4 psf	4-6 psf	6-10 psf	10-20 psf	>20 psf
Starship-Super Heavy launch	Sonic boom over the Atlantic Ocean does not affect land.					
Starship static fire test	No sonic boom occurs.					
Super Heavy static fire test						
Super Heavy landing: 40 degrees	21	2,420	7,304	8,303	4,519	167
Super Heavy landing: nominal	0	1,220	7,562	10,342	2,761	94
Super Heavy landing: 115 degrees	0	24	6,437	9,927	5,461	131
Starship landing: 153 degrees	27,387	0	0	0	0	0
Starship landing: nominal	23,954	0	0	0	0	0
Starship landing: 320 degrees	29,609	0	0	0	0	0

Notes: > = greater than; BCA = Biological and Conference Assessment; CANA = Canaveral National Seashore; CCSFS = Cape Canaveral Space Force Station; KSC = Kennedy Space Center; LC = Launch Complex; MINWR = Merritt Island National Wildlife Refuge; psf = pounds per square foot.

[1.] Data for Florida scrub-jay core habitat outside of KSC, MINWR, CANA, and CCSFS were not available at the time of BCA development.

Figure 4 shows the notional Starship RTLS sonic boom overpressure zone in relation to core Florida scrub-jay habitat at KSC, MINWR, CANA, and CCSFS. Individuals present at the time of landings could be disturbed by sonic booms depending on their proximity, with potential for alterations in breeding, feeding, and sheltering. Such disturbance from low overpressure sonic booms is not reasonably certain to cause a substantial reduction in the fitness of individual Florida scrub-jays on a daily or annual basis, and effects are considered insignificant. Thus, NASA has made the determination of **may affect, not likely to adversely affect**, for the Florida scrub-jay for Starship RTLS landing sonic booms. For the overall Proposed Action, NASA maintains the determination of **may affect, likely to adversely affect**, for the Florida scrub-jay, as described in the Starship-Super Heavy LC-39A Revised BCA.

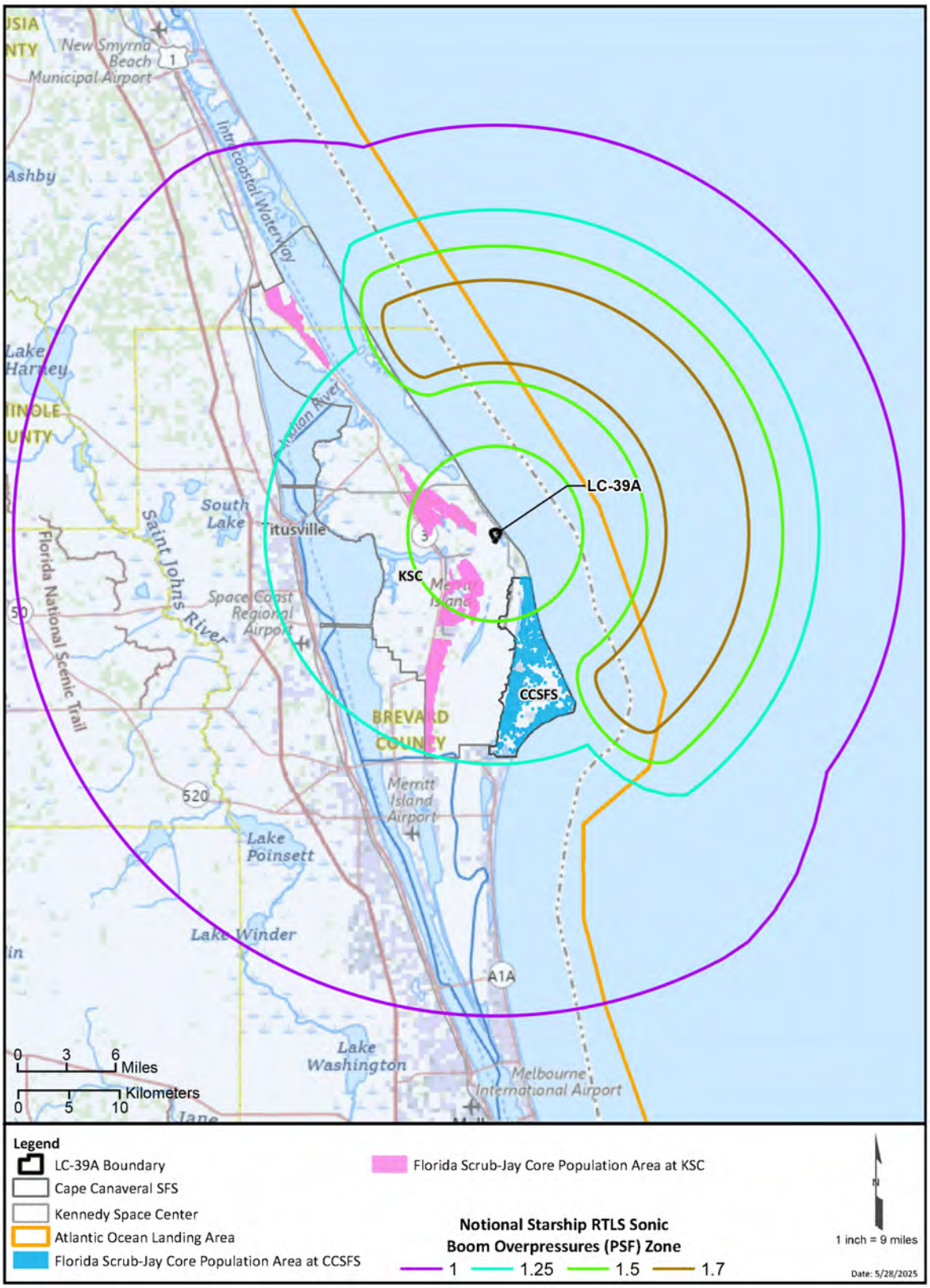

Figure 4. Florida Scrub-Jay Core Habitat in Relation to Notional Starship RTLS Sonic Boom Overpressure Zones

Piping Plover and Rufa Red Knot

The expanded range of Starship RTLS approaches would expose additional areas to sonic booms of up to 1.7 psf where piping plovers and red knots are known to overwinter; these species do not breed within the Action Area. As discussed in the previous section for crested caracaras and other bird species, such events may cause temporary disturbance and stress due to interrupted foraging and roosting. It is unknown how various overpressure levels may affect their hearing ability, but NASA expects that any individuals in the vicinity would exhibit a startle response, returning to normal behavior shortly thereafter. The effort required for a disturbed bird to fly to another area to forage or rest would be minimal, and any effects associated with dispersal are expected to be insignificant.

Overwintering red knots and the occasional piping plover have been documented in the Action Area. Although individuals present at the time of a landing could be disturbed by the sonic boom depending on their proximity, any temporary alterations in feeding and sheltering would not significantly disrupt normal behavioral patterns. Overall effects to the red knot and piping plover from the Proposed Action would be considered insignificant. Thus, NASA has made the determination of **may affect, not likely to adversely affect**, for Starship RTLS landing sonic booms and for the overall Proposed Action (as described in the Starship-Super Heavy LC-39A Revised BCA) with respect to the piping plover and rufa red knot.

Monarch Butterfly

The monarch butterfly is present within the Action Area and may be exposed to sonic booms from landings. The potential effects to butterflies from sonic booms are unknown, but activity in their proximity may cause them to move to other areas for feeding, breeding, or sheltering. Such movements would not significantly disrupt normal monarch behavioral patterns. Overall effects to monarch butterflies from the Proposed Action would be considered insignificant. NASA has made the determination of **not likely to jeopardize** for Starship landings and the overall Proposed Action (as described in the Starship-Super Heavy LC-39A Revised BCA) with respect to the proposed monarch butterfly.

Southeastern Beach Mouse

The southeastern beach mouse has been documented within the Action Area, and the overpressures associated with the expanded range of Starship RTLS trajectories (less than 1.7 psf) would affect small additional portions of Brevard and Volusia Counties with potential beach mouse habitat. As discussed in the Starship-Super Heavy LC-39A Revised BCA, sonic booms associated with landings may disturb southeastern beach mice, and in some cases may make them more vulnerable to predation. Although retreat to their burrows may reduce exposure to sonic booms, such retreat may reduce breeding success, foraging efficiency, and rest and feeding time, particularly when the disturbances are at night, since the southeastern beach mouse is nocturnal. However, southeastern beach mice in these areas likely already experience low-level overpressures from other landings at KSC and CCSFS. With the use of varied Starship landing trajectories, there would be fewer exposures in any one area, and overpressures greater than 1.7 psf from Starship landings would not be expected to reach land. Effects from Starship landing sonic booms are expected to be insignificant.

Table 5-10 in the Starship-Super Heavy LC-39A Revised BCA presented the acres of potential southeastern beach mouse habitat at KSC, MINWR, CANA, and CCSFS exposed to sonic boom overpressures associated

with Starship RTLS landings at the nominal heading; this was the only trajectory modeled for Starship RTLS landings. With the expansion of the range of Starship RTLS landings, additional analyses were conducted for the acres of potential habitat within the overpressure contours for Starship RTLS landings at the outermost trajectories of 153 degrees and 320 degrees. Table 4 now includes the acres of potential southeastern beach mouse habitat exposed to Starship landing overpressures for each of the three approach trajectories. Figure 5 shows the notional Starship RTLS sonic boom overpressure zone in relation to southeastern beach mouse potential habitat at KSC, MINWR, CANA, and CCSFS.

Table 4. Updated Southeastern Beach Mouse Potential Habitat at KSC, MINWR, CANA, and CCSFS Exposed to Greater than 1 psf Overpressure from the Proposed Action at LC-39A

Events at LC-39A	Acres affected[1]					
	1-2 psf	2-4 psf	4-6 psf	6-10 psf	10-20 psf	>20 psf
Starship-Super Heavy launch	Sonic boom over the Atlantic Ocean does not affect land					
Starship static fire test	No sonic boom occurs.					
Super Heavy static fire test						
Super Heavy landing: 40 degrees	5	1,728	8,098	4,868	870	100
Super Heavy landing: nominal	6	236	9,036	5,423	733	82
Super Heavy landing: 115 degrees	76	325	6,843	6,948	1,244	137
Starship landing: 153 degrees	15,827	0	0	0	0	0
Starship landing: nominal	15,655	0	0	0	0	0
Starship landing: 320 degrees	14,851	0	0	0	0	0

Notes: > = greater than; BCA = Biological and Conference Assessment; CANA = Canaveral National Seashore; CCSFS = Cape Canaveral Space Force Station; KSC = Kennedy Space Center; LC = Launch Complex; MINWR = Merritt Island National Wildlife Refuge; psf = pounds per square foot.

[1.] Data for potential southeastern beach mouse habitat outside of KSC, MINWR, CANA, and CCSFS were not available at the time of BCA development.

Table 5-11 in the Starship-Super Heavy LC-39A Revised BCA presented estimated numbers of southeastern beach mice at KSC, MINWR, CANA, and CCSFS potentially exposed to greater than 1 psf and/or 100 dB ASEL from the Proposed Action, using density estimates of 1.2 to 3.6 mice per acre in inland and beach habitats, respectively. For the estimated 15,655 acres affected by a Starship RTLS landing at a nominal heading, it was estimated in the Starship-Super Heavy LC-39A Revised BCA that 18,786 to 56,358 beach mice would potentially be exposed to between 1 psf and 1.7 psf per event. Per Table 4, a Starship RTLS at the 153-degree trajectory may expose an additional 172 acres of potential beach mouse habitat; thus, this trajectory should be used as the representative trajectory for Starship RTLS landings. Resulting calculations produce a new estimate of 18,992 to 56,977 beach mice potentially exposed to between 1 psf and 1.7 psf per Starship RTLS landing.

Individuals present at the time of landings could be disturbed by sonic booms depending on their proximity, with potential for alterations in breeding, feeding, and sheltering. However, such disturbance from low overpressure sonic booms is not reasonably certain to cause a substantial reduction in the fitness of individual southeastern beach mice on a daily or annual basis, and effects are considered insignificant. Thus, NASA has made the determination of **may affect, not likely to adversely affect**, for Starship landing sonic booms. For the overall Proposed Action, NASA maintains the determination of **may affect, likely to adversely affect**, with respect to the southeastern beach mouse, as described in the Starship-Super Heavy LC-39A Revised BCA.

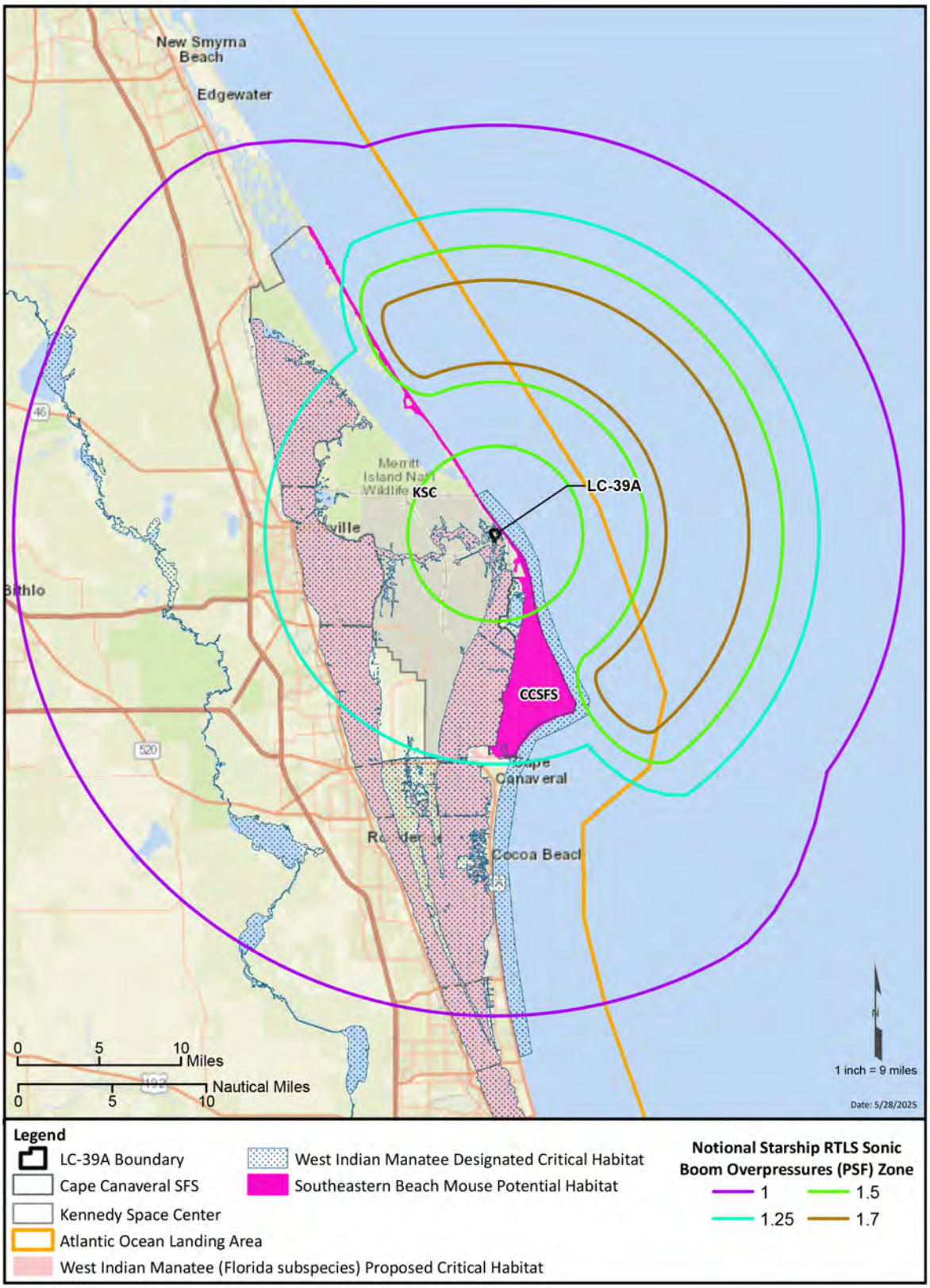

Figure 5. Southeastern Beach Mouse Potential Habitat in Relation to Notional Starship RTLS Sonic Boom Overpressure Zones

Tricolored Bat

The tricolored bat is present within the Action Area. It is unknown how various overpressure levels may affect the echolocation ability of bats. Individuals present at the time of landings could be disturbed by sonic booms depending on their proximity, with temporary interruptions in feeding, breeding, and sheltering. However, the effort required for a disturbed bat to fly to another area to forage or rest would be minimal, and any effects associated with such dispersal are expected to be insignificant. Thus, NASA has made the determination of **not likely to jeopardize** for Starship landings and the overall Proposed Action (as described in the Starship-Super Heavy LC-39A Revised BCA) with respect to the proposed endangered tricolored bat.

West Indian Manatee

As discussed in the Starship-Super Heavy LC-39A Revised BCA, sonic boom harassment risk for submerged marine mammals is associated with an overpressure level substantially greater than levels that would be produced during Starship landings, so potential overpressure effects would be limited to animals at and very near the water surface. Manatees are known to occur within the Action Area, but the potential for an individual animal to be at the surface while a landing occurs would be low. Although individuals present at the time of landings could be disturbed by sonic booms depending on their proximity, any temporary alterations in feeding, breeding, and sheltering would be minor and insignificant. Thus, NASA has made the determination of **may affect, not likely to adversely affect**, for Starship landings and the overall Proposed Action (as described in the Starship-Super Heavy LC-39A Revised BCA) with respect to the West Indian manatee.

Atlantic Salt Marsh Snake

The Atlantic salt marsh snake may occur within a small portion of the area affected by up to 1.25 psf from Starship landing trajectories from the north. Any exposed individuals may temporarily alter feeding, breeding, or sheltering, but at this low psf level, sonic boom effects would be minor and insignificant. Thus, NASA has made the determination of **may affect, not likely to adversely affect**, for Starship landings and the overall Proposed Action (as described in the Starship-Super Heavy LC-39A Revised BCA) with respect to the Atlantic salt marsh snake.

Eastern Indigo Snake

Indigo snake sightings in Brevard and Volusia Counties are rare, but indigo snakes are likely to occur within the area affected by the expanded range of Starship RTLS trajectories. Section 5.3.19 of the Starship-Super Heavy LC-39A Revised BCA estimated that up to 846 indigo snakes at KSC, MINWR, CANA, and CCSFS could potentially be exposed to sonic booms associated with Starship and Super Heavy RTLS landings. This estimate assumed that all potential indigo snake habitat at KSC, MINWR, CANA, and CCSFS was maximally occupied and that the average home ranges cited by (Bauder et al.) in a 2016 Herpetologica journal apply to the Action Area. However, as so few indigo snakes have been documented at these Federal properties, it is unlikely that such high numbers are actually present. Since the sonic booms associated with launches do not reach land, they do not affect indigo snakes and are not discussed.

Most of the areas exposed to sonic booms associated with the expanded range of Starship RTLS trajectories are within KSC, MINWR, CANA, and CCSFS, but overpressures of up to 1.25 psf would affect additional portions of Brevard and Volusia Counties (Figure 2). Potential indigo snake acreages were not available for these new areas, so calculations of the additional number of indigo snakes potentially affected could not be made. However, with a proposed maximum of 44 Starship RTLS landings annually, the expanded range of trajectories would reduce the exposure of any one area to repeated sonic booms. Although indigo snakes exposed to such sonic booms may experience an elevated stress response, exposures would be infrequent and psf levels are not expected to exceed 1.25 psf.

Individuals present at the time of Starship landings could be disturbed by sonic booms depending on their proximity, but any temporary alterations in feeding, breeding, or sheltering would not significantly disrupt normal indigo snake behavioral patterns. Such disturbance from occasional, low overpressure sonic booms is not reasonably certain to cause a substantial reduction in the fitness of individual eastern indigo snakes on a daily or annual basis; effects are considered insignificant. Thus, NASA has made the determination of **may affect, not likely to adversely affect**, for Starship landings. For the overall Proposed Action, NASA maintains the determination of **may affect, likely to adversely affect**, with respect to the eastern indigo snake, as described in the Starship-Super Heavy LC-39A Revised BCA.

Sea Turtles and Critical Habitat

Sea turtle nesting has been recorded in the Action Area, including within the areas affected by sonic booms from the expanded range of Starship RTLS landings. Nighttime landings from May to October are the primary concern for effects on sea turtles within the Action Area. Under the updated Proposed Action expanding the range of Starship RTLS trajectories, the number of Starship night landings would remain the same (i.e., up to 22 annually). A portion of these would occur during sea turtle nesting season. It is unknown whether nighttime sonic booms of less than 1.7 psf would deter females from nesting (i.e., false crawls) or interrupt nesting. However, per Section 4.3.23 of the Starship-Super Heavy LC-39A Revised BCA, analysis of sea turtle crawl observations recorded immediately adjacent to LC 39 A (kilometer 30) from both before and after Falcon 9 program occupancy showed no discernable effects to sea turtle nesting from operations at Pad A. Thus, effects to sea turtles from low-level overpressures associated with Starship landings are considered insignificant.

Table 5-13 in the Starship-Super Heavy LC-39A Revised BCA presented the miles of sea turtle nesting beaches and nesting critical habitat at KSC, MINWR, CANA, and CCSFS exposed to sonic boom overpressures associated with Starship RTLS landings at the nominal heading; this was the only trajectory modeled for Starship RTLS landings. With the expansion of the range of Starship RTLS landings, additional analyses were conducted for the miles of sea turtle nesting beaches and nesting critical habitat within the overpressure contours for Starship RTLS landings at the outmost trajectories of 153 degrees and 320 degrees (Table 5). Figure 6 shows the notional Starship RTLS sonic boom overpressure zone in relation to sea turtle nesting beaches and nesting critical habitat.

Table 5. Updated Sea Turtle Nesting Beaches and Nesting Critical Habitat Exposed to Greater than 1 psf Overpressure from the Proposed Action at LC-39A

Events at LC-39A	Total miles of nesting beaches affected (miles of critical habitat affected)[1]					
	1-2 psf	2-4 psf	4-6 psf	6-10 psf	10-20 psf	>20 psf
Starship-Super Heavy launch	Sonic boom over the Atlantic Ocean does not affect land.					
Starship static fire test	No sonic boom					
Super Heavy static fire test						
Super Heavy landing: 40 degrees	0.2 (0.1)	8.8 (6.4)	10.3 (4.6)	8.2 (3.4)	6.7 (5)	3.2 (3.2)
Super Heavy landing: nominal	0.9 (0.1)	7.5 (5)	13.4 (3.4)	8.2 (3.1)	5.6 (4.5)	2.6 (2.6)
Super Heavy landing: 115 degrees	2.3 (2.2)	12.8 (4.2)	9.7 (3.4)	7.8 (3.4)	6.3 (3.9)	3.5 (3.5)
Starship landing: 153 degrees	49.8 (26.1)	0	0	0	0	0
Starship landing: nominal	42.5 (22.3)	0	0	0	0	0
Starship landing: 320 degrees	42.9 (30.1)	0	0	0	0	0

Notes: > = greater than; LC = Launch Complex; psf = pounds per square foot.

[1.] Loggerhead sea turtle nesting critical habitat (final) and green sea turtle nesting critical habitat (proposed) cover the same area.

With the expanded range of Starship RTLS landings, additional sea turtle nesting beach and critical habitat for nesting in Brevard and Volusia Counties would be exposed to overpressures of up to 1.7 psf (Figure 6). Using Starship landings on the 153-degree heading as the representative trajectory for sea turtle nesting beaches (which includes critical habitat), 49.8 miles of nesting beaches would be affected (Table 5).

Sea turtles may be present on the beach at the time of a Starship landing. While there is the possibility that an individual could be disturbed by the sonic boom depending on its proximity, sea turtle crawl observations recorded immediately adjacent to LC-39A from both before and after Falcon 9 program occupancy show no discernable effects to sea turtle nesting. Additionally, Starship booms would be infrequent and are expected to result in overpressures of less than 1.7 psf; effects to sea turtles from low-level overpressures associated with Starship landings are considered insignificant. Thus, for Starship RTLS landings, NASA has made the determination of **may affect, not likely to adversely affect**, for loggerhead, green, leatherback, hawksbill, and Kemp's ridley sea turtles; **may affect, not likely to adversely affect**, with respect to loggerhead critical habitat for nesting; and **no destruction or adverse modification** for green sea turtle proposed critical habitat. NASA maintains the determination for the overall Proposed Action of **may affect, likely to adversely affect**, with respect to loggerhead, green, leatherback, hawksbill, and Kemp's ridley sea turtles, as described in the Starship-Super Heavy LC-39A Revised BCA. NASA also maintains the determinations for the overall Proposed Action of **may affect, likely to adversely affect**, with respect to loggerhead critical habitat for nesting, and **no destruction or adverse modification** for green sea turtle proposed critical habitat (see Starship-Super Heavy LC-39A Revised BCA).

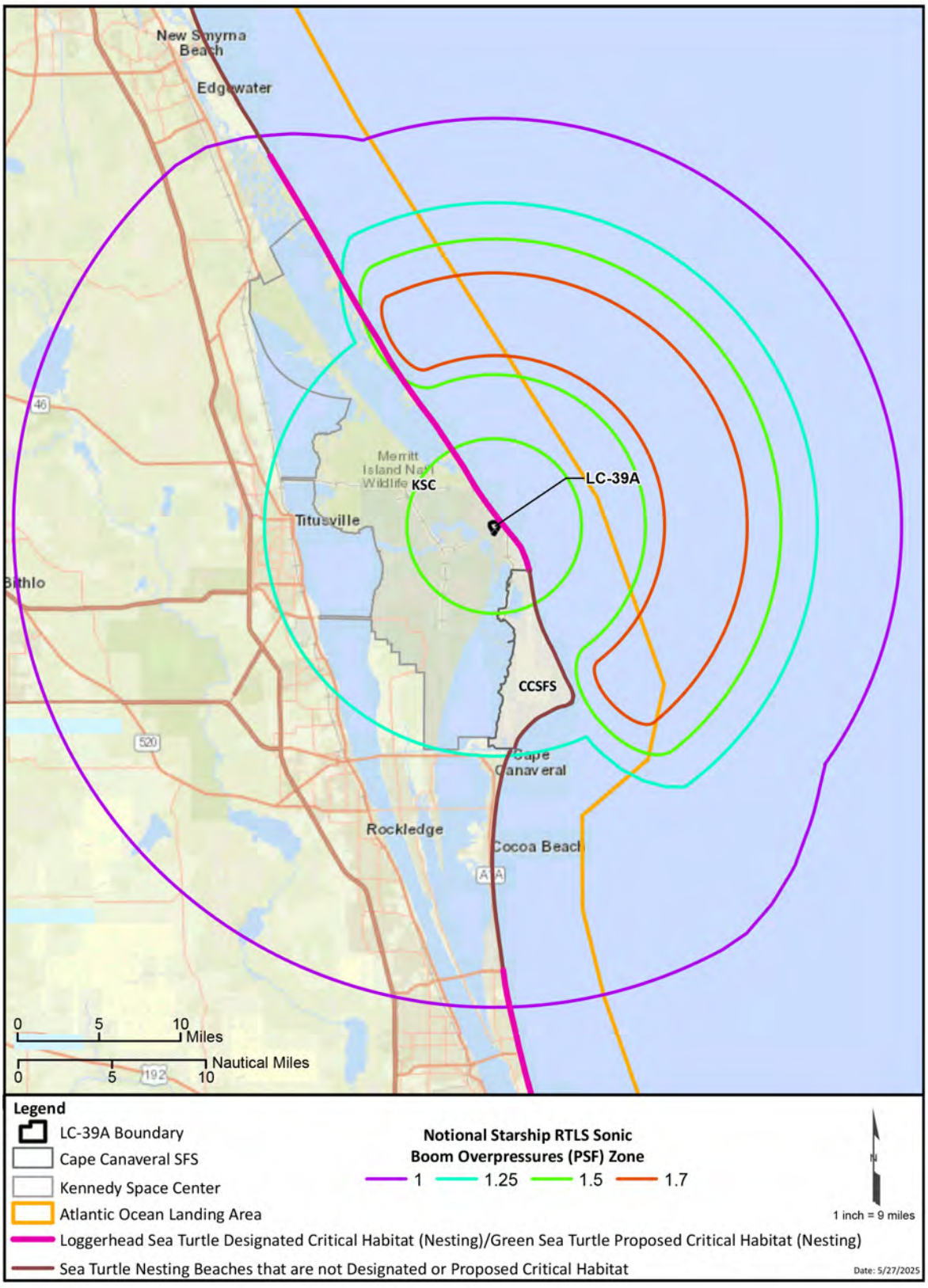

Figure 6. Sea Turtle Nesting Beaches and Nesting Critical Habitat in Relation to Notional Starship RTLS Sonic Boom Overpressure Zones

Corrections to Starship-Super Heavy LC-39A Revised BCA

Please note the following corrections to the Starship-Super Heavy LC-39A Revised BCA provided to the USFWS on May 1, 2025.

1. The Lead agency on the BCA cover page should be NASA not the FAA.
2. Figure 5-36, Sea Turtle Nesting Habitat in Relation to Launch (Nominal Heading) Sonic Boom Overpressure Contours, should have been deleted, as launch sonic booms are offshore and not expected to affect sea turtle nesting habitat. Additionally, this figure incorrectly shows the Starship landing sonic boom. Figure 5-40 is the correct figure to reference for the Starship nominal trajectory landing sonic boom.

References

Bauder et al. (2016). Bauder, J. M., D. R. Breininger, M. R. Bolt, M. L. Legare, C. L. Jenkins, B.B. Rothermel, & K. McGarigal. Seasonal variation in eastern indigo snake (Drymarchon couperi) movement patterns and space use in peninsular Florida at multiple temporal scales. *Herpetologica, 72*(3), 214-226.

NASA. (2025a). *Final Biological and Conference Assessment for SpaceX Starship-Super Heavy Launch and Landing Operations at Launch Complex-39A at the Kennedy Space Center, Merritt Island, Florida (FWS Log Number 2024-0058364).*

NASA. (2025b). *Revised Final Biological and Conference Assessment for SpaceX Starship-Super Heavy Launch and Landing Operations at Launch Complex-39A at the Kennedy Space Center, Merritt Island, Florida (FWS Log Number 2024-0058364).*

Attachment 1

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Florida Ecological Services Field Office
777 37th St
Suite D-101
Vero Beach, FL 32960-3559
Phone: (352) 448-9151 Fax: (772) 562-4288
Email Address: fw4flesregs@fws.gov
https://www.fws.gov/office/florida-ecological-services

In Reply Refer To: 06/04/2025 18:58:45 UTC
Project Code: 2025-0105538
Project Name: Updated KSC LC39A Starship Super Heavy 1 psf/100 dB ASEL

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. **Please include your Project Code, listed at the top of this letter, in all subsequent correspondence regarding this project.** Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered

species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

https://www.fws.gov/sites/default/files/documents/endangered-species-consultation-handbook.pdf

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts see https://www.fws.gov/program/migratory-bird-permit/what-we-do.

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures see https://www.fws.gov/library/collections/threats-birds.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit https://www.fws.gov/partner/council-conservation-migratory-birds.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List
- USFWS National Wildlife Refuges and Fish Hatcheries
- Bald & Golden Eagles
- Migratory Birds
- Marine Mammals
- Coastal Barriers
- Wetlands

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Florida Ecological Services Field Office
777 37th St
Suite D-101
Vero Beach, FL 32960-3559
(352) 448-9151

PROJECT SUMMARY

Project Code: 2025-0105538
Project Name: Updated KSC LC39A Starship Super Heavy 1 psf/100 dB ASEL
Project Type: Airport - New Construction
Project Description: Update to SpaceX Starship-Super Heavy Launch and Landing Operations at Launch Complex-39A (LC-39A) at the Kennedy Space Center (KSC), Merritt Island, Florida BCA (FWS Log Number 2024-0058364). Includes expanded range of Starship RTLS landing trajectories and associated sonic boom footprints. Also updates select maps.

Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@28.57767765,-80.04812966405463,14z

Counties: Florida

ENDANGERED SPECIES ACT SPECIES

There is a total of 33 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

MAMMALS

NAME	STATUS
Florida Panther *Puma (=Felis) concolor coryi* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1763 General project design guidelines: https://ipac.ecosphere.fws.gov/project/SIAD7VT27BEVBFVXPTQRJWILME/documents/generated/7123.pdf	Endangered
Puma (=mountain Lion) *Puma (=Felis) concolor (all subsp. except coryi)* Population: FL No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6049	Similarity of Appearance (Threatened)
Southeastern Beach Mouse *Peromyscus polionotus niveiventris* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/3951	Threatened
Tricolored Bat *Perimyotis subflavus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/10515	Proposed Endangered
West Indian Manatee *Trichechus manatus* There is **final** critical habitat for this species. Your location overlaps the critical habitat. ***This species is also protected by the Marine Mammal Protection Act, and may have additional consultation requirements.*** Species profile: https://ecos.fws.gov/ecp/species/4469 General project design guidelines: https://ipac.ecosphere.fws.gov/project/SIAD7VT27BEVBFVXPTQRJWILME/documents/generated/7281.pdf	Threatened

BIRDS

NAME	STATUS
Black-capped Petrel *Pterodroma hasitata* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/4748	Endangered
Crested Caracara (audubon's) [fl Dps] *Caracara plancus audubonii* Population: FL DPS No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/8250	Threatened
Eastern Black Rail *Laterallus jamaicensis ssp. jamaicensis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/10477	Threatened
Everglade Snail Kite *Rostrhamus sociabilis plumbeus* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/7713	Endangered

NAME	STATUS
Florida Scrub-jay *Aphelocoma coerulescens* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6174	Threatened
Piping Plover *Charadrius melodus* Population: [Atlantic Coast and Northern Great Plains populations] - Wherever found, except those areas where listed as endangered. There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/6039	Threatened
Red-cockaded Woodpecker *Dryobates borealis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/7614	Threatened
Rufa Red Knot *Calidris canutus rufa* There is **proposed** critical habitat for this species. Your location overlaps the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/1864	Threatened
Whooping Crane *Grus americana* Population: U.S.A. (AL, AR, CO, FL, GA, ID, IL, IN, IA, KY, LA, MI, MN, MS, MO, NC, NM, OH, SC, TN, UT, VA, WI, WV, western half of WY) No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/758	Experimental Population, Non-Essential
Wood Stork *Mycteria americana* Population: AL, FL, GA, MS, NC, SC No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/8477 General project design guidelines: https://ipac.ecosphere.fws.gov/project/SIAD7VT27BEVBFVXPTQRJWII.ME/documents/generated/6954.pdf	Threatened

REPTILES

NAME	STATUS
American Alligator *Alligator mississippiensis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/776	Similarity of Appearance (Threatened)
American Crocodile *Crocodylus acutus* Population: U.S.A. (FL) There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/6604	Threatened
Atlantic Salt Marsh Snake *Nerodia clarkii taeniata* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/7729	Threatened
Eastern Indigo Snake *Drymarchon couperi* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/646	Threatened

NAME	STATUS
Green Sea Turtle *Chelonia mydas* Population: North Atlantic DPS There is **proposed** critical habitat for this species. Your location overlaps the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/6199	Threatened
Hawksbill Sea Turtle *Eretmochelys imbricata* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3656	Endangered
Kemp's Ridley Sea Turtle *Lepidochelys kempii* There is **proposed** critical habitat for this species. Species profile: https://ecos.fws.gov/ecp/species/5523	Endangered
Leatherback Sea Turtle *Dermochelys coriacea* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/1493	Endangered
Loggerhead Sea Turtle *Caretta caretta* Population: Northwest Atlantic Ocean DPS There is **final** critical habitat for this species. Your location overlaps the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/1110	Threatened

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* There is **proposed** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/9743	Proposed Threatened

FLOWERING PLANTS

NAME	STATUS
Beautiful Pawpaw *Deeringothamnus pulchellus* Population: No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/4069	Endangered
Carter's Mustard *Warea carteri* Population: No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/5583	Endangered
Lewton's Polygala *Polygala lewtonii* Population: No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6688	Endangered
Papery Whitlow-wort *Paronychia chartacea* Population: No critical habitat has been designated for this species.	Threatened

NAME	STATUS
Species profile: https://ecos.fws.gov/ecp/species/1465	
Pigeon Wings *Clitoria fragrans* Population: No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/991	Threatened
Pygmy Fringe-tree *Chionanthus pygmaeus* Population: No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1084	Endangered
Rugel's Pawpaw *Deeringothamnus rugelii* Population: No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/5355	Endangered
Sandlace *Polygonella myriophylla* Population: No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/5745	Endangered

CRITICAL HABITATS

There are 3 critical habitats wholly or partially within your project area under this office's jurisdiction.

NAME	STATUS
Green Sea Turtle *Chelonia mydas* https://ecos.fws.gov/ecp/species/6199#crithab	Proposed
Loggerhead Sea Turtle *Caretta caretta* https://ecos.fws.gov/ecp/species/1110#crithab	Final
Rufa Red Knot *Calidris canutus rufa* https://ecos.fws.gov/ecp/species/1864#crithab	Proposed

You should contact the local field office to determine whether critical habitat for the following species should be considered:

NAME	STATUS
West Indian Manatee *Trichechus manatus* https://ecos.fws.gov/ecp/species/4469#crithab	Final

USFWS NATIONAL WILDLIFE REFUGE LANDS AND FISH HATCHERIES

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

The following FWS National Wildlife Refuge Lands and Fish Hatcheries lie fully or partially within your project area:

FACILITY NAME	ACRES
MERRITT ISLAND NATIONAL WILDLIFE REFUGE https://www.fws.gov/our-facilities?$keywords="%5C%22MERRITT+ISLAND+NATIONAL+WILDLIFE+REFUGE%5C%22"	130,215.858
ST. JOHNS NATIONAL WILDLIFE REFUGE https://www.fws.gov/our-facilities?$keywords="%5C%22ST.+JOHNS+NATIONAL+WILDLIFE+REFUGE%5C%22"	6,431.258

BALD & GOLDEN EAGLES

Bald and Golden Eagles are protected under the Bald and Golden Eagle Protection Act [2] and the Migratory Bird Treaty Act (MBTA) [1]. Any person or organization who plans or conducts activities that may result in impacts to Bald or Golden Eagles, or their habitats, should follow appropriate regulations and consider implementing appropriate avoidance and minimization measures, as described in the various links on this page.

1. The Bald and Golden Eagle Protection Act of 1940.
2. The Migratory Birds Treaty Act of 1918.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

BALD & GOLDEN EAGLES INFORMATION WAS NOT AVAILABLE WHEN THIS SPECIES LIST WAS GENERATED. PLEASE CONTACT THE FIELD OFFICE FOR FURTHER INFORMATION.

MIGRATORY BIRDS

The Migratory Bird Treaty Act (MBTA) [1] prohibits the take (including killing, capturing, selling, trading, and transport) of protected migratory bird species without prior authorization by the Department of Interior U.S. Fish and Wildlife Service (Service). The incidental take of migratory birds is the injury or death of birds that results from, but is not the purpose, of an activity. The Service interprets the MBTA to prohibit incidental take.

1. The Migratory Birds Treaty Act of 1918.

2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

MIGRATORY BIRD INFORMATION WAS NOT AVAILABLE WHEN THIS SPECIES LIST WAS GENERATED. PLEASE CONTACT THE FIELD OFFICE FOR FURTHER INFORMATION.

COASTAL BARRIERS

Projects within the John H. Chafee Coastal Barrier Resources System (CBRS) may be subject to the restrictions on Federal expenditures and financial assistance and the consultation requirements of the Coastal Barrier Resources Act (CBRA) (16 U.S.C. 3501 et seq.). For more information, please contact the local Ecological Services Field Office or visit the CBRA Consultations website. The CBRA website provides tools such as a flow chart to help determine whether consultation is required and a template to facilitate the consultation process.

OTHERWISE PROTECTED AREA (OPA)

OPAs are denoted with a "P" at the end of the unit number. The only prohibition within OPAs is on Federal flood insurance. ***CBRA consultation is not required for projects within OPAs.*** *However, agencies providing disaster assistance that is contingent upon a requirement to purchase flood insurance after the fact are advised to disclose the OPA designation and information on the restrictions on Federal flood insurance to the recipient prior to the commitments of funds.*

UNIT	NAME	TYPE	SYSTEM UNIT ESTABLISHMENT DATE	FLOOD INSURANCE PROHIBITION DATE
FL-07P	Canaveral	OPA	N/A	11/16/1991

MARINE MAMMALS

Marine mammals are protected under the Marine Mammal Protection Act. Some are also protected under the Endangered Species Act[1] and the Convention on International Trade in Endangered Species of Wild Fauna and Flora[2].

The responsibilities for the protection, conservation, and management of marine mammals are shared by the U.S. Fish and Wildlife Service [responsible for otters, walruses, polar bears, manatees, and dugongs] and NOAA Fisheries[3] [responsible for seals, sea lions, whales, dolphins, and porpoises]. Marine mammals under the responsibility of NOAA Fisheries are **not** shown on this list; for additional information on those species please visit the Marine Mammals page of the NOAA Fisheries website.

The Marine Mammal Protection Act prohibits the take of marine mammals and further coordination may be necessary for project evaluation. Please contact the U.S. Fish and Wildlife Service Field Office shown.

1. The Endangered Species Act (ESA) of 1973.
2. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is a treaty to ensure that international trade in plants and animals does not threaten their survival in the wild.
3. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

NAME

West Indian Manatee *Trichechus manatus*
Species profile: https://ecos.fws.gov/ecp/species/4469

WETLANDS

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

WETLAND INFORMATION WAS NOT AVAILABLE WHEN THIS SPECIES LIST WAS GENERATED. PLEASE VISIT HTTPS://WWW.FWS.GOV/WETLANDS/DATA/MAPPER.HTML OR CONTACT THE FIELD OFFICE FOR FURTHER INFORMATION.

IPAC USER CONTACT INFORMATION

Agency: Private Entity
Name: Stephanie Hiers
Address: 203 Habersham Road
City: Thomasville
State: GA
Zip: 31792
Email hierss@leidos.com
Phone: 8508308335

LEAD AGENCY CONTACT INFORMATION

Lead Agency: National Aeronautics and Space Administration

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B.1.6 Starship-Super Heavy Construction and Operations at LC-39A Biological/Conference Opinion (USFWS)

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Biological / Conference Opinion

Starship-Super Heavy Construction and Operations at LC-39A

FWS Ecosphere Log Number: 2024-0058364

Prepared by:

U.S. Fish and Wildlife Service
Florida Ecological Services

GIANFRANCO BASILI
Digitally signed by GIANFRANCO BASILI
Date: 2025.10.20 11:04:11 -04'00'

Gianfranco Basili, Deputy State Supervisor
Florida Ecological Services Field Office
United States Fish and Wildlife Service
Department of Interior

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CONSULTATION HISTORY

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

March 6, 2024: The Service attended a Cooperating Agency Kickoff/DOPAA meeting for the Starship-Super Heavy launch and landing operations at LC-39A

March 2024 – March 2025: The Service attended multiple meetings with the National Aeronautics and Space Administration (NASA), the Federal Aviation Administration, SpaceX and other Federal agencies providing technical assistance prior to the delivery of a Biological and Conference Assessment (BCA).

March 20, 2025: The Service received a request for formal consultation for Starship-Super Heavy Launch and Landing Operations at Launch Complex-39A at the Kennedy Space Center (KSC) from NASA.

April 11, 2025: The Service transmitted a request for additional information to NASA.

May 1, 2025: NASA transmitted a revised BCA to the Service.

May 5, 2025: The Service deemed a complete consultation package.

June 6, 2025: The Service transmitted the concurrence letter to NASA for all species under informal consultation.

June 12, 2025: The Service received an addendum to the consultation package with the addition of the Starship return to launch site trajectories. New consultation timelines and dates were agreed to between NASA and the Service due to the addendum received.

August 04, 2025: The Service transmitted the DRAFT BO/CO to NASA for review and comment.

September 4, 2025: The Service received an addendum to the consultation package with the clarification of the Federal Aviation Administration's (FAA) portion of the proposed Action. NASA provided updated and revised conservation measures for the proposed Action.

September 8, 2025: The Service transmitted a second DRAFT BO/CO to NASA for review and comment.

September 24, 2025: The Service transmitted a DRAFT of the reasonable and prudent measures, terms and conditions, monitoring and reporting requirements and conservation recommendations for review and comment.

October 20, 2025: The Service transmitted the FINAL BO/CO to NASA.

BIOLOGICAL AND CONFERENCE OPINION

A biological and conference opinion (BO/CO) is the document that states the opinion of the 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/CO is the NASA proposed Starship-Super Heavy (SS-SH) Construction and Operations at LC-39A and the issuance of a vehicle operator's license and future renewals and modifications of the license by the FAA (the Action).A detailed description of the Action is found in Section 1 of this BO/CO. This BO/CO considers the effects of the Action on eastern indigo snake (*Drymarchon couperi*; indigo snake), Florida scrub-jay (*Aphelocoma coerulescens*; FSJ), green sea turtle (*Chelonia mydas*), hawksbill sea turtle (*Eretmochelys imbricata*), Kemp's ridley sea turtle (*Lepidochelys kempii*), leatherback sea turtle (*Dermochelys coriacea*), loggerhead sea turtle (*Caretta caretta*), collectively known hereafter as "sea turtles" and southeastern beach mouse (*Peromyscus polionotus niveiventris*; SEBM) and designated critical habitat for the loggerhead sea turtle and proposed critical habitat for the green sea turtle. The Service and the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) share Federal jurisdiction for sea turtles under the Act. The Service has responsibility for sea turtles on the nesting beach and the NOAA Fisheries has jurisdiction for sea turtles in the marine environment. Our analysis for sea turtles in this document will only address activities that may impact nesting sea turtles, their nests and eggs, and hatchlings as they emerge from the nest and crawl to the sea. Please note the provisions of this consultation do not apply to sea turtles in the marine environment, such as swimming juvenile and adult sea turtles or loggerhead critical habitat in the marine environment. If applicable, NASA is required to consult with the NOAA Fisheries.

NASA determined that the Action is not likely to adversely affect Anastasia Island beach mouse (*Peromyscus polionotus phasma*), Atlantic saltmarsh snake (*Nerodia clarkii taeniata*), Audubon's crested caracara (*Caracara plancus audubonii*), band-rumped storm petrel (*Hydrobates castro*), Bermuda petrel (*Pterodroma cahow*), black-capped petrel (*Pterodroma hasitata*; BCP), eastern black rail (*Laterallus jamaicensis ssp. jamaicensis*), Everglade snail kite (*Rostrhamus sociabilis plumbeus*), Florida bonneted bat (*Eumops floridanus*), Florida grasshopper sparrow (*Ammodramus savannarum floridanus*), Hawaiian petrel (*Pterodroma sandwichensis*), Newell's shearwater (*Puffinus newelli*), piping plover (*Charadrius melodus*), red-cockaded woodpecker (*Dryobates borealis*), roseate tern (*Sterna dougallii dougallii*), rufa red knot (*Calidris canutus rufa*), short-tailed albatross (*Phoebastria (=Diomedea) albatrus*), wood stork (*Mycteria americana*), West Indian manatee (*Trichechus manatus*), and that the Action is not likely to jeopardize the monarch butterfly (*Danaus Plexippus*) and tricolored bat (*Perimyotis subflavus*) or adversely modify or destroy proposed critical habitat for the rufa red knot or proposed and designated critical habitat for the West Indian manatee. The Service provided concurrence with these determinations to NASA by letter dated June 9, 2025.

A BO/CO evaluates the current status and environmental baseline of the species that occur in the action area. The BO also evaluates the effects of a Federal action and from non-Federal actions

unrelated to the proposed Action (cumulative effects), relative to the range-wide status of listed species and the status of designated critical habitat. Adding the effects of the action to the species' baseline, the Service determines whether the action will jeopardize the species' continued existence or destroy or adversely modify critical habitat. A Service opinion that concludes a proposed Federal action is *not* likely to jeopardize species and is *not* likely to destroy or adversely modify 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 C.F.R. § 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 C.F.R. § 402.02).

This BO/CO 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. The basis of our opinion for each listed species and each designated critical habitat identified in the first paragraph of this introduction is wholly contained in a separate level-1 section that addresses its status, baseline, effects of the Action, cumulative effects, and conclusion.

Definitions Related to Space Operations

The following abbreviations and terms related to launch sound disturbance frequently occur throughout this document.

A-weighted

A-weighting was developed based on human hearing; however, the majority of literature related to noise impacts uses this metric. Due to the prevalence in literature, while the frequency perception of animals may vary by species, A-weighted values are often used to associate effects due to sound across species. The human ear does not respond equally to identical noise levels at different frequencies. The normal frequency range of hearing for most people extends from a low of approximately 20 Hertz (Hz) to a high of 10,000 to 20,000 Hz. However, people are most sensitive to sounds in the voice range, between approximately 500 Hz to 2,000 Hz. Therefore, to correlate the amplitude of a sound with its level as perceived by people, the sound energy spectrum is adjusted, or weighted. This specific frequency adjustment is referred to as A-weighting.

Anomaly

Any condition during licensed or permitted activity that deviates from what is standard, normal, or expected, during the verification or operation of a system, subsystem, process, facility, or support equipment (14 C.F.R. § 401.7).

Decibel

Sound is measured and expressed in terms of decibels (dB). There can be multiple “weightings” of sound that focus on measuring specific frequencies related to the activity and organism exposed to the sound.

Launch and Landing Sonic Booms

Each proposed launch and associated landing would generate a separate sonic boom disturbance event. Each launch generates a single sonic boom event that will produce disturbance in the form of overpressure, which is high energy impulsive sound that would last for a fraction of a second. Each landing event of a SH booster and a SS will generate two sonic boom overpressure events. This overpressure is typically measured in pounds per square foot (psf).

Maximum A-weighted Noise Level (LA_{Max})

A-weighted sound levels vary with time. For example, as an aircraft approaches, the sound level increases, then falls and blends into the background as the aircraft recedes into the distance (though even the background varies as birds chirp or the wind blows, or a vehicle passes by). This variation in sound level over time often makes it convenient to describe a particular noise "event" by its maximum sound level, abbreviated as LA_{Max}.

Starship

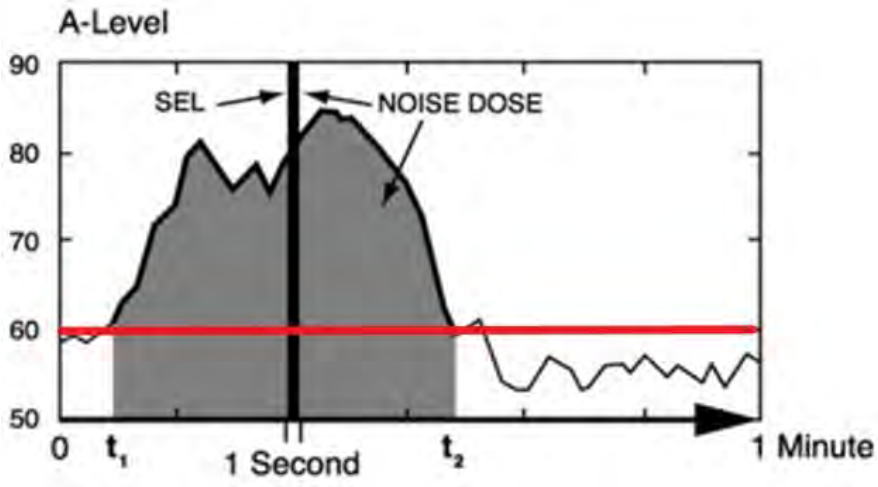
The second stage rocket of the SS-SH rocket platform. Contains 9 Raptor engines powered by liquid oxygen (LOX) and liquid methane (LCH_4), capable of holding up to 2,650 megatons (MT) of these propellants. Maximum thrust is approximately the same as two Space Shuttle solid rocket boosters. The SS-SH rocket starts as a single rocket and will separate into individual

rocket components, the SS and the SH. This will allow for individual landings of each component.

Super Heavy
The first stage rocket of the SS-SH rocket platform. Contains 35 Raptor engines powered by LOX and LCH_4, capable of holding up to 4,100 MT of propellant. Maximum lift-off thrust of approximately 103 meganewtons, approximately the same thrust as 3 Space Shuttle launches. The SS-SH rocket starts as a single rocket and will separate into individual rocket components, the SS and the SH. This will allow for individual landings of each component.

Static Fire Test
Prior to a static fire test, the vehicle is placed on the pad and propellant is loaded. The engines are then ignited for no longer than 15 seconds. This will occur for each new booster, during daytime hours, and approximately 1-3 days prior to launch. Upon a successful test, the vehicle returns to the hangar.

Sound Exposure Level
A-weighted Sound Exposure Level (ASEL) is the most frequently used measure of noise exposure for an individual aircraft noise event. It measures the total noise energy produced during an event, from the time when the A-weighted sound level first exceeds a threshold (normally just above the background or ambient noise) to the time that it again drops below the threshold. This metric includes the additional noise or sound that would be produced above ambient or background noise to allow comparison of noise events with very different durations, ASEL "normalizes" the duration in every case to one second. ASEL is expressed as the steady noise level with just a one-second duration, which includes the same amount of noise energy as the actual longer duration, time-varying noise. In other words, ASEL compresses the entire noise event into one second.



Hypothetical depiction of a sound event and ASEL of approximately 80-85 DBA ASEL. The red line indicates approximate ambient/background noise levels.

Sound Pressure Level

The measure of a given noise source relative to a standard reference value and is typically modeled in unweighted (dB) or A-weighted decibels (dBA). Sound, presented as dB, is measured on a logarithmic scale; therefore, an increase of 10 dB represents a perceived doubling of loudness. The highest sound level measure during a single event is called the L_{max}. A-weighted decibels are presented on an adjusted scale corresponding to the frequency range of human hearing. Unweighted measurements include all sounds regardless of frequency range.

1. PROPOSED ACTION

In 2019, NASA and the FAA proposed to undertake construction and operations at LC-39A at KSC for SS-SH. Specifically, the agencies proposed to undertake construction on a single launch mount and landing pad, additional infrastructure within LC-39A, and the launch of the SS-SH rocket platform up to 24 times/year. The Service completed an informal Section 7(a)(2) consultation for that action under the *Proposed SpaceX Starship and Super Heavy Program at Kennedy Space Center* (FWS Log. No. 04EF1000-2019-1001, Service 2019a), in which the Service determined that the action may affect, but not likely to affect federally-listed species and critical habitat. Due to new species listings, critical habitat designations and multiple modifications to the 2019 action, NASA as the land management agency and the FAA as the licensing agency have determined that a new ESA Section 7(a)(2) consultation with the Service is needed to address the potential effects to federally listed species and critical habitat from SS-SH operations at LC-39A.

NASA is the lead action agency for this Action, which includes infrastructure construction, static fire tests, launches, landings, and daily operations at LC-39A; transport of supplies, personnel, and launch vehicles to LC-39A; expenditure of vehicles and components in the ocean; landings on droneships in the ocean; and transport of supplies and vehicles via barge. In addition, SpaceX must obtain a vehicle operator license from the FAA for SS-SH launch and landing operations at LC-39A. The FAA's Federal action also includes their issuance of temporary airspace closures. NASA's authorization for construction and operation as well as FAA's license, together constitute the agency action at issue, as proposed in NASA's BCA with multiple addendums.

The FAA's portion of the Action is the issuance of the vehicle operator license and subsequent renewals or modifications that are within the scope of the provided BCA and addendums. The Service does not currently have the knowledge or expertise to identify the scope of renewals or modifications of an FAA-issued license, and the FAA has not provided a description of future modifications or renewals of an FAA-issued license. Therefore, this BO/CO does not cover renewals or modifications to an FAA-issued license that alter any effects to the environment or may affect any federally listed species or critical habitat. Modifications and renewals not covered under this BO/CO include, but are not limited to, changes in launch or landing cadence, launch or landing locations, launch or landing trajectories, and vehicle modifications resulting in changes to noise, heat, or vibrations produced by the launch or landing vehicle(s). License renewals or modifications that are administrative in nature, and do not result in effects to the environment or affect federally listed species or critical habitat, are covered under this BO/CO. Future modifications of any FAA-issued license should be examined by NASA to determine if a reinitiation of the Action is needed. The FAA proposes to issue a vehicle operator license to SpaceX that would allow SS-SH operations at LC-39A. NASA's Action includes SS-SH launch and landing operations (up to 44 launches and 88 landings - 44 for each stage of the launch vehicle - per year) at LC-39A, ocean landings of SH in the Atlantic Ocean and SS in the Atlantic, Pacific and Indian Oceans. SS and SH could each land on droneships in the Atlantic Ocean. Below is a table of the launch-related operations within the Action. A detailed discussion of the Proposed Action is provided in subsequent subsections.

Table 1: Number of operations annually proposed under the Action.

Platform	Launches	Landings at LC-39A	Landings Droneship (Atlantic Ocean)	Landings No Droneship (Atlantic Ocean)	Landings (Pacific, Indian Ocean no droneship)	Static Fire Tests	Wet Dress Rehearsals
Starship-Super Heavy	Up to 44	-	-	-	-	-	Up to 44
Super Heavy	-	Up to 44	Up to 11	Up to 5	-	Up to 44	-
Starship	-	Up to 44	Up to 11	Up to 4	Up to 2	Up to 44	-

KSC and Cape Canaveral Space Force Station (CCSFS) have been utilized for government and commercial rocket testing and flight for 70+ years. The Action assumes an environmental baseline of all previously consulted upon federal actions within the boundaries of KSC and CCSFS. This includes up to 340 launches, 59 landings and 431 static fire tests annually of multiple rocket vehicle platforms. The highest number of launches and landings in a calendar year combined from KSC and CCSFS has been 93 and 17, respectively, in 2024.

1.1. Action Area

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" (50 C.F.R. § 402.02). Indirect modifications include those caused by other activities that would not occur but for the Action under consultation. Once the action agencies define the Action Area, the action agencies and the Service determine whether the action area overlap with critical habitat and the physical and biological features therein that we defined as essential to the species' conservation, or areas we defined as essential, in the final critical habitat 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.

The Action Area includes: (1) LC-39A; (2) area surrounding LC-39A that would be exposed to vehicular traffic (e.g., car and truck), launch plumes, noise, and sonic booms (construction, operational, and launch and landing noise); (3) area in the Atlantic Ocean where SH boosters and SS vehicles might land or be expended; (4) area in the Pacific Ocean where SS vehicles might land or be expended; and (5) area in the Indian Ocean where SS vehicles might land or be expended. The landing areas in the Indian Ocean and portions of the Pacific Ocean were not analyzed in the BCA as no ESA species protected under Service jurisdiction is present, as verified in the Service's Information for Planning and Consultation (IPaC) searches.

SLC-39A and Surrounding Areas

NASA delineated the portion of the Action Area surrounding LC-39A as the combination of the outermost predicted (modeled) ASEL 100 dB contour for engine noise (including static fires, launches, and landings) and the outermost predicted (modeled) 1 psf contour for overpressure events. (Figure 1). This area encompasses all areas expected to be affected by construction activities, daily operations, heat and vapor plumes, lighting, vehicle traffic, boat/barge traffic, and events with smaller noise and sonic boom footprints. The Action Area encompasses all of Canaveral National Seashore (CANA), CCSFS and KSC.

Atlantic Ocean

The Atlantic landings area includes the portion of the Atlantic Ocean where SS vehicles and SH boosters may be expended or land on droneships (Figure 2); this landing area comes no closer than within 5 nm of the U.S. coastline. The SH landing area extends in a triangle from LC-39A, as the SH would return within the arc of the 40-degree and 115-degree azimuths, and the SS contingency landing area includes an additional area from 1 nm to 5 nm offshore for 50 miles north and south of LC-39A. The SS contingency landing area (including the 1 psf overpressure contour) encompasses noise and overpressure effects from SS contingency landings (Figures 3 and 4). Noise and ASEL effects from SH Atlantic landings are encompassed within the 1 psf/100 dB ASEL contour surrounding LC-39A. The Atlantic landing area and SS contingency landing area would encompass potential lighting and direct physical impacts associated with Atlantic landings and boat/barge traffic as found in Figure 5.

Pacific Ocean

The Pacific landing area includes multiple locations within the Pacific Ocean where SS vehicles may be expended. The Pacific landing area would encompass potential noise, overpressure, lighting, and direct physical impacts associated with SS landings and boat/barge traffic.

Indian Ocean

The Indian Ocean landing area includes the portion of the Indian Ocean where SS vehicles may be expended. IPaC searches did not report any listed species under Service's jurisdiction for this area, and the Indian Ocean landing area was not discussed further in the provided BCA and will not be analyzed further in this BO/CO.

1.2. Construction

The previous consultation included the construction of the following pieces of infrastructure within the fence line of LC-39A: LOX farm, LCH_4 farm, launch mount, integration tower, evaporation/retention ponds, vaporization farm, landing zone, liquid nitrogen farm and water farm (Service 2019a).

The Action contains the following infrastructure construction that was not covered within the previous consultation: air separation unit, catch tower, deluge pond, natural gas pretreatment and

methane liquefier, “MegaPacks” (a large-scale rechargeable lithium-ion battery stationary energy storage product that can store up to 3.9 megawatt-hours of electricity) and power hub (Figure 6). The location of all infrastructure is approximate, and slight modifications to locations could be made as items are installed. Approximately 9.9 acres of paved areas, mowed grass, or previously disturbed areas will be replaced with the above infrastructure.

Laydown Yard: SpaceX will utilize the grassy, disturbed areas within LC-39A as laydown yard for equipment (e.g., crane) storage and maintenance, as well as storage of associated materials for the construction of infrastructure. No additional clearing of non-disturbed areas for the laydown yard will be required.

Super Heavy Catch Tower: SpaceX would construct an additional tower within the LC-39A fence line to support landing operations. While the integration tower used for launch could support SH landings, an additional landing tower would reduce launch pad refurbishment needed between each launch, providing a shorter turnaround period between launches and increasing the efficiency of launch operations. The catch tower would be approximately 480 feet (146 meters) tall and similar in appearance to the existing integration tower.

Propellant Generation: The SS-SH Raptor engines are powered by LOX and LCH_4. SpaceX is proposing to construct onsite facilities for propellant generation and propellant storage, and storage tanks for LOX and LCH_4 are under construction as previously consulted upon in 2019. Propellant generation facilities would be operated using natural gas and/or existing electrical power lines and MegaPacks. The current concept of operations is that commodities would be trucked to LC-39A to generate propellant. For the purposes of a “maximum use” analysis, current estimates of the number of trucks per launch for commodities include 270 for LOX, 80 for liquid nitrogen (LN_2), and 90 for LCH_4. At 44 launches per year, this equates to a total of 19,356 trucks per year. During a 12-hour period for operations occurring 365 days per year, this approximates to 53 trucks per day (or 4-5 trucks per hour). However, there could be more or fewer trucks per hour depending on launch frequency and specific commodity needs. There would be a pull-off for opposite flowing traffic with an estimated wait time of 5 minutes. Traffic following SS-SH, cargo, and payloads to LC-39A would need to wait until arrival at LC-39A or pause to pass with an expected wait time of 15 minutes. Bulk storage of commodities would serve to also minimize the need for trucks over time. SpaceX would process natural gas brought to the site for propellant generation. A natural gas pretreatment system would remove impurities such as mercury, sulfur, water, carbon dioxide, and hydrocarbons heavier than methane from the natural gas to produce a stream of higher purity gaseous methane; impurities would be captured through a filtration system and managed according to KSC solid and hazardous waste requirements. Surplus natural gas would be used for process work and power generation or would boil off like a natural gas line venting.

In the future, natural gas would be supplied to LC-39A through a multi-user pipeline extending from the existing natural gas mainline on KSC. Florida City Gas is in the process of planning an underground pipeline extension at KSC to provide additional service. No details are currently available regarding specific location or timeframe; therefore, establishment of this pipeline will not be considered further within this consultation. The extension of the pipeline would occur regardless of this Action. The natural gas pretreatment system would include a small amine

treating unit for carbon dioxide removal, a scrub column to remove heavy hydrocarbons that would be up to 100 feet (30 meters) tall and 10 feet (3 meters) in diameter, and four to six smaller vessels approximately 6 feet (2 meters) in diameter and up to 30 feet (9 meters) tall.

Air Separation Unit (ASU): SpaceX proposes to construct an ASU within the LC-39A fence line to generate LN_2 and LOX to support launch activities. An ASU dehumidifies, liquefies, and separates air into its major components (oxygen and nitrogen). The liquid would then be transferred via pipeline to storage tanks at LC-39A. In addition to the primary oxygen and nitrogen liquid products, a waste nitrogen stream composed of rejected atmospheric gases would be produced (primarily nitrogen, oxygen, and argon) that would be vented back to the atmosphere; the amount to be vented is unknown. However, an ASU primarily emits only the air gases already present in the atmosphere, meaning its primary emissions are essentially "clean air" with minimal impurities, as the process primarily separates air into its constituent components like nitrogen and oxygen, with minimal additional emissions (European Industrial Gases Association, 2017).

The ASU would be cooled by a typical evaporative cooling tower, requiring approximately 20,000 gallons of water per hour and producing approximately 2,000 gallons of wastewater per hour. The ASU would be up to approximately 180 feet (55 meters) tall with supporting infrastructure up to approximately 60 feet (18 meters) tall. An onsite ASU reduces the need to transport nitrogen and oxygen to LC-39A from offsite via trucks as discussed previously.

Wastewater generated by the ASU and stormwater would be treated onsite via evaporation and retention ponds. Any residuals may be treated on-site, hauled off, or conveyed in a wastewater system. On-site treatment could include but is not limited to methods such as membrane aerated biofilm reactors or other processes. Reclaimed wastewater could then be discharged on site via a stormwater pond, exfiltration trenches, infiltration basins, class V group 6 drainage wells, percolation/evaporation ponds, industrial evaporators, used for irrigation purposes or some other permitted method. This class of drainage well is a fluid injection well used to inject below the lowermost underground source of drinking water and the group of well is for stormwater run-off. If discharge would occur, SpaceX would acquire all necessary permits from the St. Johns River Water Management District. Utility work within LC-39A would occur to provide power and water to the system, with any new utility lines placed underground. As mentioned previously, up to 12 MegaPacks would be installed to support 24 MW/48 megawatt-hours of power generation. Existing commodity tanks would be used where practicable, and a 10,000-gallon aboveground storage tank would be constructed to store LN_2 for system purges.

Surveying and Staking: Surveying and staking will occur within the construction area prior to the start of construction. The limits of construction and locations of proposed facilities would be marked by stakes or other distinguishing markers.

Erosion and sediment controls: SpaceX will implement erosion and sediment control measures prior to construction to minimize the impacts of soil erosion and sedimentation on the surrounding environment. Erosion controls such as silt fences and sediment barriers will be installed to stabilize exposed soil surfaces and prevent soil movement caused by wind, water, or other factors. Soil erosion can result in the transport of sediment, nutrients, and pollutants into

nearby waterbodies. Sediment controls such as drain inlet protections can help prevent sediment-laden runoff before it reaches waterways.

Clearing and grading: SpaceX will conduct clearing and grading operations using heavy equipment. The removed vegetation will be placed in wheeled dump trucks and transferred out of the clearing and grading area for disposal, but it is unknown at this time where the disposal site will be located. The off-site disposal location will be determined by the SpaceX contractor and will comply with all local, state, and federal regulations.

Site Preparation and Use: SpaceX will create a suitable work area for construction equipment, vehicles, and personnel. This will include the removal of any potential hazards, such as rocks or debris, to ensure all construction areas are safe for construction activities to commence. The duration of proposed construction activities is expected to be approximately three months.

Deluge and Diverter System: The deluge system would apply a large amount of water to rapidly cool and create a barrier between the steel plate of the launch mount and rocket exhaust that would help to absorb sound energy and heat produced by the rocket engines and would allow the steel plate to be reused. It is expected that approximately 92 percent of the water would be vaporized by the heat of the rocket engines (FAA, 2023). Water delivery to the site would be by truck or pipeline as previously described and stored in tanks.

The deluge system and associated operational parameters are still in the design phase, and specific details are currently unknown. However, the diverter, which is part of the deluge system and is designed to redirect SS-SH heat and exhaust plume away from the launch vehicle, is expected to be bifurcated, i.e., split, directing some of the heat and exhaust plume different ways. In particular, the diverter, will redirect the heat and exhaust plume vertically to reduce the radial extent of the plume, which has the potential to disturb vegetation or wildlife if directed horizontally out of LC-39A. Deluge system components and operational parameters would likely include water containment, water storage, press tank (to push water through the system), a pumping system and piping network, and a control system and valves. SpaceX proposes to construct additional pond(s), if needed, to manage water associated with deluge and stormwater within LC-39A (Figure 6). The deluge system would be activated during each ignition event on the orbital launch pad, including static fire tests, launches and landings. Each launch is associated with an estimated two static fire engine tests (one each for SS and SH). Therefore, the deluge system may operate up to 220 times per year (44 static fires of SS, 44 static fires of SH, 44 launches, 44 SS landings, and 44 SH landings).

The deluge system would be activated immediately prior to an engine ignition or landing event, allowing water to flow from the storage tanks, through the piping network, and to the spray nozzles at the launch pad. Five seconds prior to ignition, water would begin discharging. Most of this preignition water would be captured by the containment structures. The amount of water applied during activation of the deluge system will differ depending on the type of ignition event. With estimates of 300,000 gallons per static fire event (88 total), 400,000 gallons per launch (44 total), and 68,000 gallons per landing (88 total), SpaceX estimates that up to 50 million gallons of water per year would be utilized for operations at the site (approximately 137,000 gallons per day). SpaceX plans to reuse deluge water that is retained onsite (i.e., not evaporated). The system

would pump and filter water from the deluge pond into storage tanks for reuse. In the event SpaceX is unable to reuse the deluge water, it may be hauled off site, discharged, or land applied. Prior to any discharge or land application, SpaceX would apply for any applicable Florida Department of Environmental Protection permits. All ponds would be lined to prevent percolation of contaminants into the groundwater and would be maintained and monitored by SpaceX. Berms would be built around the ponds to eliminate additional storm/rainwater inflow/outflow. No deluge water is expected to enter the Banana River or adjacent waterbodies or wetlands.

During engine ignition of the SS-SH, the surface of the pad flame diverter could experience a small amount of ablation (erosion of steel from the metal surface resulting from heat and force; considered common on metal launch infrastructure). The ablated steel would quickly recondense near the launch mount when exposed to the deluge water. The metal components of the steel could remain localized to the launch pad, captured in the deluge water and retained onsite, or dispersed in vapor. Per findings presented in the *2025 Final Tiered EA for SpaceX Starship/Super Heavy Vehicle Increased Cadence at the SpaceX Boca Chica Launch Site* i*n Cameron County, Texas* (FAA, 2025), the amount of metal deposition from the vapor plume is expected to be minimal.

SpaceX would implement sampling protocols in accordance with an amended Multi-Sector General Permit for industrial stormwater from the Florida Department of Environmental Protection and would remove water containing contaminants that exceed the water quality criteria and haul it to an approved industrial wastewater treatment facility. SpaceX would pump all other water not within permitting standards back to the water storage tanks for the deluge system.

Cleanup and Restoration: SpaceX will conduct cleanup and restoration once construction is completed. These efforts include removing construction debris and waste materials from the construction area; disposing of construction and waste debris in accordance with all local, state, and federal regulations; and restoring disturbed areas of the laydown yard with grassy vegetation consistent with other grassy areas associated with launch complexes within CCSFS and KSC (Bahia grass or similar sod species)**.**

1.3. Launch and Landing Operations

The SS-SH launch vehicle consists of a first-stage booster (SH), a second stage (SS), and a payload. SH is powered by 35 Raptor engines, fueled by LCH_4 and LOX, which produces a total thrust of approximately 23.1 million pounds at liftoff. The SH booster is able to return to landing site (RTLS) at LC-39A. The second stage of the launch vehicle is SS and is powered by 9 Raptor engines that produce a total of approximately 6.45 million pounds of thrust The SS booster is able to RTLS at LC-39A and anticipated to be able to conduct future landings on a drone ship within the Atlantic Ocean.

The below items further detail the operations of the Action.

Wet Dress Rehearsal: A wet dress rehearsal is a full launch rehearsal with the launch vehicle fueled. This test allows the launch team to practice timelines and procedures used for launch and to identify potential issues. The goal of these operations is to verify that all vehicle and ground systems are functioning properly, as well as to verify that all procedures are properly written.

Static Fire Testing: Static fire tests will be performed one to three days before a launch. Currently, each launch is preceded by this engine test, which lasts up to 15 seconds per static fire test. The need to conduct an engine static fire test depends on the individual mission and is determined on a case-by-case basis. Static fire tests at other locations are not covered under this BO/CO. The total amount of time per calendar year for static fire tests is 1,320 seconds or 22 minutes total and could occur up to 88 separate times per year.

Launches: SS-SH would launch from LC-39A up to 44 times per year and could occur at any time of day or night; for purposes of noise analysis, it is assumed that 22 launches would occur during the day (7:00 a.m. – 10:00 p.m.) and 22 launches would occur at night (10:00 p.m. – 7:00 a.m.). During a launch, ignition of the SH booster Raptor engines would generate a heat plume. The plume would consist of water vapor, carbon dioxide, carbon monoxide, hydrogen, methane, nitrogen oxides, and oxygen. The heat plumes and increased temperatures in this area would be temporary; they would only occur during engine ignition and would dissipate within minutes. For more information on the water deluge system and diver, please see Section 1.2 of the BO/CO. Based on measurements taken during SS-SH operations in Boca Chica, Texas, the plume at LC-39A is expected to reach 90°F approximately 0.2 miles from the launch pad for launches and static fire tests. Launches would result in noise and vibration, and nighttime launches would require lighting.

Closures associated with SpaceX launches and reentry would be necessary. The U.S. Coast Guard (USCG) or other local waterborne law enforcement sweep areas and limit boating access in the Limited Access Area; this would involve one boat per event. Limited Access Areas are established by the USCG prior to necessary space operations that require closure of marine waters for public safety. Closures of portions of CANA, CCSFS, KSC and MINWR would also be needed during portions of the Action including launches, landings, statice fire tests and wet dress rehearsals. Subsequent successful launches are anticipated to have smaller closure areas compared to the initial launch as the SS-SH program becomes a mature rocket platform allowing for the reduction in closure areas, similar to the Falcon program at CCSFS and KSC.

Landings:

Super Heavy Landings

Each SS-SH launch would include landing a SH at LC-39A, downrange in the Atlantic Ocean on a droneship, or in the Atlantic Ocean, no closer than approximately 1 nautical mile (nm) off the coast within the SH Atlantic Ocean Landing Area (Figure 2). NASA assumes that 22 landings would occur during the day (7:00 a.m. – 10:00 p.m.) and 22 landings would occur at night (10:00

p.m. – 7:00 a.m.). While it is acknowledged that there may be landings occurring in the ocean, the goal is for all landings to occur at LC-39A.

During flight, SS's engines would start, most of SH's engines would cut off, and the SH booster would separate from SS. SS would continue to the desired orbit location, and SH would rotate and ignite to conduct the retrograde burn, which would place it in the correct angle to move the vehicle impact point to approximately its final target. Once SH is in the correct position, the engines would cut off. SH would then perform a controlled descent using atmospheric resistance to slow down and guide it for a return to the launch at the LC-39A landing site, where it would be caught with the launch tower's arms. As SH slows down during its landing approach, a sonic boom would be generated. Once near the landing location, SH would ignite its engines to conduct a controlled landing. Based on measurements taken during SS-SH operations in Boca Chica, Texas, the landing plume at LC-39A is expected to reach 90°F approximately 96 feet from the landing pad for both SS and SH booster landings.

SH would land vertically at LC-39A or other landing location, such as a floating platform within one of the ocean landing areas and go into an automated safing sequence where the engines shut down and any remaining LOX and LCH_4 would be offloaded to ground storage or released to the atmosphere. If landing at the catch tower at LC-39A, another plume would be generated and the deluge system would be employed, utilizing approximately 68,000 gallons of water. Due to the risks to personnel, SpaceX is unable to reconnect the vehicle to ground systems when methane remains on the vehicle. In the future, SpaceX may recycle methane back into tanks, as technology and design develops, but that is not analyzed further in this BO/CO.

While SpaceX intends SH to be fully reusable and to RTLS following operational flights, it may be necessary to expend (i.e., not recover) vehicles. SpaceX anticipates this to be an infrequent occurrence given the goals of the reusable concept. SH could be expended in the Atlantic Ocean during the initial stages of launch operations at KSC if mission payload or desired orbit requirements would result in too little propellant remaining in SH to RTLS. This expenditure process would occur several minutes after launch and after SS separates from the SH booster. An expended SH would break up above the ocean's surface or on impact with the ocean's surface, and debris or the intact vehicle would sink. As of September 4, 2025 there have been ten SS expenditures with multiple unscheduled explosions of the vehicle over portions of the Gulf and Caribbean Sea. There have been six SH expenditures. During any expenditure, some residual propellant would remain within the SH, and the impact with the water surface would disperse any remaining propellants and drive the structural failure of the vehicle. The structural failure would allow the remaining propellant to mix, resulting in an explosive event upon impact with the ocean's surface.

SpaceX is required to surveil the splashdown area before committing to launch and will not launch if the area cannot be confirmed clear of vessel traffic. Several spotter aircraft, including drones, and surveillance vessels (or boats) are used during launch activities to ensure that designated hazard areas are clear of non-participating crafts. Combinations of radar, visual spotter aircraft, surface surveillance, and law enforcement vessels, may be deployed prior to launch. Most fixed-wing aircraft operate at altitudes of 15,000 feet (4,572 meters) but may drop to 1,500 feet (457 meters) to obtain a call sign visually from a non-participating vessel.

SH could also conduct a soft water landing where the vehicle's engines would fire prior to impact with the ocean's surface, causing the vehicle to land vertically and intact. The vehicle would then take on water and sink on its own, be purposefully sunk or transported back to land. If recovered in the open ocean, via water landing or on a droneship it would be delivered by vessel to Port Canaveral or the KSC turn basin and transported horizontally the remaining distance to the proposed launch site or other SpaceX facilities over the roadways. Dimensions of the droneships are unknown at this time; however, it is believed that SS-SH would employ a similar concept of operations to the Falcon offshore recovery model but would likely require newer and larger droneships.

Following SH landings at LC-39A, the vehicle may be transported from the landing pad to the adjacent launch mount or to one of SpaceX's production locations over the roadways for refurbishment. Any potential refurbishment actions would take place at SpaceX's facilities at the launch site or at other SpaceX facilities at KSC. No roadway improvements to support transportation are proposed as part of this Action. At this time, SpaceX does not anticipate a scenario where SH would launch from KSC and land at CCSFS; therefore, this scenario is not further analyzed in this BO/CO.

Starship Landings

SS could land at LC-39A, on a droneship in the high seas between 55 degrees south latitude and 55 degrees north latitude, or in the Atlantic Ocean. In the Atlantic Ocean, SpaceX may land the SS vehicle anywhere within the boundary of the SS Atlantic Landing Area (Figure 2). However, part of the SS Atlantic Landing Area consists of an Atlantic Contingency Landing Area between 1 nm and 5 nm from shore and runs 50 miles north and south of LC-39A. The remainder of the Atlantic landing area begins 5 or more nm from shore. SS contingency landing operations could occur up to five times per year during the initial years of operation at KSC when something impedes use of the catch tower, there are issues with SS vehicle operating parameters, or other extenuating safety circumstances which prevent SS RTLS landing operations at KSC. The timeframe for recovery of SS within the Atlantic Ocean contingency landing area would be dependent upon the location of occurrence and the rapidity of the SpaceX recovery team's mobilization. Should SS land in shallow waters, SpaceX would coordinate with the USCG to mitigate any potential navigable hazard until recovery is accomplished. SpaceX recovery personnel would follow standard salvage procedures in compliance with applicable state and federal requirements for the salvage activity and perform an assessment of structural stability required to tow and stabilize SS as it is returned to Port Canaveral. Recovery operations typically consist of one barge and a tugboat.

SS would perform a controlled descent using atmospheric resistance to slow the vehicle down and guide it to its landing location. Guidance systems are used to maneuver the vehicle, and trajectories determine flight paths. Figure 2 shows the approximate flight path of a SS reentry and landing. As SS slows down during its landing approach, a sonic boom would be generated. If landing at the catch tower at LC-39A, another plume would be generated and the deluge system would be employed, utilizing approximately 68,000 gallons of water. Following a successful landing, SS would go into an automatic safing sequence. After SS is in a safe state, a mobile hydraulic lift would raise SS onto a transporter. If a SS landing occurred downrange in the broad

ocean area, it would be delivered by vessel to Port Canaveral or the KSC Turn Basin and transported the remaining distance to the proposed launch site or other SpaceX facilities over the roadways. Following SS landings at the launch site, it would be transported from the landing pad to the adjacent launch mount or to one of SpaceX's production locations over the roadways for refurbishment. Any potential refurbishment actions would take place at SpaceX's facilities at the launch site or at other SpaceX facilities at KSC.

SpaceX could require expending SS during launches early in the Action in the broad open ocean (Figure 5). SpaceX anticipates this to be an infrequent occurrence given the goals of the reusable concept. SS could be expended in two different ways: a controlled descent that would result in SS's intact impact with the ocean's surface or an uncontrolled descent resulting in breakup during atmospheric reentry. The timeframe between launch, expenditure and location of expenditure would vary, depending on mission requirements. If SpaceX assets are in the vicinity, an attempt would be made to recover SS. SpaceX will surveil the splashdown area before committing to launch and will stand down in the event the area cannot be confirmed clear of vessel traffic.

For an uncontrolled descent, SpaceX could expend SS through a breakup during atmospheric entry. Descent target areas would be in the broad open ocean (Figure 5). SpaceX expects most of the launch vehicle debris would sink because it is made of steel. Lighter items not made of steel, such as composite overwrapped pressure vessels, may float but are expected to eventually become waterlogged and sink. If large debris remains, SpaceX will coordinate with a party specialized in marine debris to survey the situation and sink or recover as necessary any large floating debris. SpaceX will coordinate with all land and water regulatory authorities, including the USCG and the State Department, prior to recovering debris to ensure it is recovered as expeditiously as possible.

Following a landing, SS would have remaining LOX and LCH_4 in the vehicle. Remaining LOX would be released to the atmosphere, and remaining LCH_4 would likely be released to the atmosphere or safely combusted. Due to risks to personnel, SpaceX is unable to reconnect the vehicle to ground systems when LCH_4 remains on the vehicle. In the future, SpaceX may recycle LCH_4 back into tanks. At this time, SpaceX does not anticipate a scenario where SS would launch from KSC and land at CCSFS and is not further analyzed in this BO/CO.

Ideally, all SS and SH boosters would be capable of reuse; however, some launches might require the landing of either booster within the Atlantic and the SS booster within the Pacific or Indian Ocean. Table 1 outlines the possible amount of wet dress rehearsals, static fire tests, launches and landings for each stage of the SS-SH rocket and the locations of each.

Refurbishment and Repair

Fabrication, assembly, delivery, and integration of components would be as described in the previous 2019 consultation and would occur at existing SpaceX facilities located on KSC and CCSFS. Most manufacturing and assembly would occur at the SpaceX facility at Boca Chica, Texas, and Cidco Industrial Park, Cocoa, Florida. SS or SH components would be delivered over currently built roadways on a mobile transporter like the transports performed for SpaceX's

Falcon programs (Service 2020a). Large vehicle components would be transported by barge from the Port of Brownsville, Texas, utilizing the KSC Turn Basin to the Vehicle Assembly Building location, then via Crawlerway to LC-39A (Figure 7). The Crawlerway is a 130-foot-wide double pathway between the Vehicle Assembly Building and LC-39A and 39B. Transport of supplies and vehicle components would involve approximately 40 barges per year transiting to the Turn Basin and five barges per year transiting to Port Canaveral. These are the same locations and processes utilized for current large vehicle transport (i.e., Falcon) and were previously used during the Shuttle Program.

Transport of SS-SH and related components to and across KSC would generally occur as transport of rocket components currently does at KSC. This could include transport via barge or over land from SpaceX production sites, including Boca Chica, Texas, and Hawthorne, California, using standard transportation methods and routes. Any potential refurbishment actions would take place at SpaceX's facilities at KSC. SS-SH would be transported from LC-39A to a SpaceX facility via SpaceX transporter over KSC roadways (Figure 8). At this time, no improvements to KSC infrastructure outside those previously identified for LC-39A are proposed. Improvements to KSC infrastructure that would support general SpaceX and other KSC operations were previously analyzed and approved through ESA Section 7 consultation (*Biological Opinion for the Kennedy Space Center SpaceX Roberts Road SpaceX Operations Facility*; FWS Log #: 04EF1000-2019-0193 / 2023-0036318; NASA, 2024a).

Similar processes would be followed for landings, recoveries, and salvage operations in the Atlantic Ocean. Planned landing and recovery operations for SHs and SSs in the Atlantic landing area (greater than 5 nm offshore) would involve one droneship barge and one tug per vehicle per event. The droneship barge/tug would unload the vehicle at the Turn Basin, and the droneship barge would be docked at Port Canaveral. Contingency SS salvage operations in the Atlantic (between 1 and 5 nm offshore) would involve one salvage barge and one tug per event. The salvage barge/tug would unload the SS at the Turn Basin.

General maintenance and repairs would occur following an incident that may cause damage to LC-39A, the launch mount, integration tower or landing tower to ensure safety and functionality of the infrastructure. A damage assessment will be conducted, and engineers will develop a repair plan including an outline of the repairs, materials needed, and a timeline. Before repair work begins, precautions will be implemented to ensure the safety of personnel and equipment. Throughout the repair process, quality control measures will be implemented to ensure that the repairs are carried out to the necessary standards and upon completion, documentation will be provided to capture the work that was done.

Vegetation management within LC-39A will include mowing and trimming and conducted occasionally based on the season. Summer months require more frequent mechanical vegetation management to reduce vegetation height and density.

Anomaly

Anomalies are unplanned events that may occur during SH-SS operations. As such, NASA cannot provide the potential number of anomalies that could occur over the course of the Action.

Therefore, the Service will not analyze the potential of anomalies within this BO/CO and will coordinate with NASA and FAA if an anomaly does occur.

1.4. Conservation, Avoidance, and Minimization Measures

The below items have been provided by NASA within the BCA as part of the Action. The Service has lightly edited the measures for clarity by removing references to different portions of the Service (e.g., Refuges or Ecological Services), providing grammatical clarity with the BO/CO and providing definitions to acronyms where none were provided previously in the BO/CO.

Natural Resources Training

The following training requirements (Conservation Measures (CM) 1-3) will be applicable for the duration of construction and operations activities, unless otherwise agreed to by NASA and the Service's Ecological Services. During development, training materials will be provided to the Service for input.

CM 1. SpaceX will develop natural resources training for contractors and employees. Prior to beginning onsite activities (i.e., construction, operations) and annually thereafter, SpaceX will ensure that all personnel, including staff and contractors, receive the natural resources training. As new staff/contractors come on board, they will receive the training. Training will include, but not be limited to, the following topics:

- Instructions on implementing the conservation measures in the BCA and the terms and conditions from the resulting BO/CO
- Photos of listed species and their habitats, guidance on wildlife encounters (e.g., do not feed wildlife), and other relevant details, including the importance of dark beaches for sea turtles and other wildlife, and prescribed fire for Florida scrub-jay habitat maintenance
- Instructions to immediately report the following to the KSC Duty Office and Environmental Management Branch (EMB): injured, dead, or sick wildlife (including road kills); or wildlife utilizing buildings or infrastructure for roosting or nesting
- Lighting restrictions as detailed in the KSC LC-39A Lighting Operations Manual (LOM) (PLN-1210)
- Instructions on how to minimize the introduction and spread of invasive non-native plant species
- Speed limits and restriction of vehicles to existing roads, parking areas, paved areas, and authorized construction sites
- Wildfire prevention measures
  Proper disposal of litter and garbage and securing refuse containers

CM 2. NASA will continue educational outreach activities related to the protection and recovery of federally listed species.

Additional Conservation, Avoidance and Minimization Measures

These below measures are applicable for the duration of construction and operations (e.g., daily operations; vehicle preparation, launches, landings), unless otherwise agreed to by NASA and the Service:

CM 3. To minimize adverse impacts from temporary and long-term lighting to federally listed species and designated critical habitat within the Action Area, SpaceX will update and follow the LC-39A LOM; the LOM will address applicable requirements for lighting associated with the Action, including measures for lighting minimization during sea turtle nesting season. SpaceX will submit an updated LC-39A LOM to NASA. NASA will coordinate review of the LOM with the Service. The LOM must be approved by NASA and the Service prior to operation of the Action. A full review of the LOM by the Service will be completed within 30 days upon receiving the updated LOM.

CM 4. -Per the *KSC Center Wide Operations BO* (FWS Log No. 04EF1000-2016-F-0083; Service 2017), NASA EMB and the Service through Merritt Island National Wildlife Refuge (MINWR) staff (through cooperative agreement) will continue to monitor for lighting impacts on KSC beaches, take corrective actions (if feasible), and submit annual reports to the Service.

CM 5 SpaceX will work with NASA and the Service to develop a plan to implement noise and vibration monitoring at a sub-set of sea turtle nests in the vicinity of LC-39A such that site-specific operational conditions and any potential effects to sea turtle nests, eggs, and hatchlings can be documented and reported.

CM 6. Any construction project at KSC with the potential to affect protected species requires a biological survey by the applicant/launch service provider in coordination with NASA EMB prior to disturbances.

- If a gopher tortoise burrow is discovered within the LC-39A area prior to construction, SpaceX, in coordination with NASA EMB, will scope the burrow with an infrared burrow camera. SpaceX, in coordination with NASA EMB, will remove any tortoises from the burrow either by bucket trapping or excavation with a backhoe. Any discovered indigo snakes will be allowed to leave the site prior to collapsing the burrow. If relocation is necessary, SpaceX, in coordination with NASA EMB, will relocate gopher tortoises and indigo snakes in accordance with the Service's MINWR protocols.
- If southeastern beach mice or their burrows are observed during pre-construction surveys, NASA will contact the Service to determine if relocations are needed based on site conditions. SpaceX, in coordination with NASA EMB, would conduct trapping over at least three consecutive nights and a total of five nights using Sherman live traps set at 33-foot (10-meter) intervals throughout the vegetated portion of the proposed area to be disturbed by construction activities. SpaceX, in coordination with NASA EMB, would relocate mice to the dune east of LC-39A or another suitable location as agreed upon with the Service.

CM 7. Construction and operations activities will follow the *2024 Standard Protection Measures for the Eastern Indigo Snake* (Service 2024a), including displaying educational signs/posters,

avoiding gopher tortoise burrows, and allowing indigo snakes to leave construction and operations areas unharmed. If an eastern indigo snake (alive, dead, or skin shed) is observed on the project site during construction activities, all such activities will cease until the established procedures are implemented, which includes notifying the Service (fw4flesregs@fws.gov) and NASA-EMB.

CM 8. To increase wildlife awareness and reduce road mortality for species such as indigo snakes, NASA will continue its coordination with MINWR staff to develop, install, and maintain wildlife crossing awareness signage on NASA property, particularly along rights-of-way for transportation routes associated with the Action.

CM 9. Red obstruction lighting for towers will comply with FAA Advisory Circular No. 70/7460-1M, Change 1 (AC 70/7460-1M Chg 1) or more updated guidance document, if applicable.

CM 10. To discourage protected birds and bats from roosting or establishing maternal colonies on LC-39A infrastructure, buildings, and equipment, SpaceX will incorporate measures such as visual fright devices.

CM 11. Consistent with current SpaceX wildlife management at LC-39A, if SpaceX identifies a listed species in a location where it may conflict with construction or operations at LC-39A, SpaceX will report the occurrence to NASA EMB. NASA EMB will contact MINWR staff to respond and determine the appropriate next steps, which can include trapping, translocation, removing the bird nest or bat roost, and/or excluding bats from facilities according to best management practices (per cooperative agreement). SpaceX will not remove bats, maternity roosts, bird nests, or other federally listed species before MINWR staff has evaluated the situation.

CM 12. Per the *KSC/MINWR Interagency Agreement* (NASA and Service, 2024) and within the constraints of sensitive payloads and mission operations described in the *2025 MOU for Prescribed Burning* (SLD 45, Service, and KSC, 2025), NASA and MINWR will continue to conduct management activities on NASA property at a level that maintains habitat for continued use by federally listed species. Activities will include but not be limited to prescribed burning, fire break maintenance, and invasive and nuisance species control.

CM 13. NASA and the Service (through cooperative agreement) will continue to regularly monitor sea turtles, Florida scrub-jays, and manatees on NASA property using current protocols identified within Section 1.5 of the BCA. SpaceX will continue to coordinate with NASA and the Service to minimize interference from construction and operations at LC-39A with monitoring efforts for federally listed species.

CM 14. Using data collected per current monitoring protocols, NASA and SpaceX will assess potential changes in the distribution and abundance of sea turtles, Florida scrub-jays, and manatees on NASA property. As part of an adaptive management approach, NASA, SpaceX, Space Launch Delta (SLD 45), and the Service will meet annually to review monitoring results

and determine next steps (e.g., continue or modify monitoring, reinitiate consultation, reduce or terminate monitoring).

CM 15. To minimize the potential for negative interactions with manatees, SpaceX barge/boat operations will follow the following manatee protection measures, which are primarily applicable for the Action's operations within Indian River Lagoon (IRL) and within 1 mile offshore in the Atlantic Ocean, 50 miles north and south of LC-39A.

- SpaceX will provide a dedicated observer (e.g., biologist or person other than the watercraft operator that can recognize manatees) that is responsible for surveying for manatees with the aid of binoculars during all in-water activities, including transiting estuarine and marine waters for surveillance or for transport of supplies, boosters, spacecraft, or other launch-related equipment or debris.
- When a manatee is sighted, the observer will alert the vessel operators to maintain a minimum distance of 50 feet from the animal. Boats will make all efforts to avoid passing over a submerged manatee. If the vessel is not able to avoid passing over a submerged manatee, the engine will be placed in idle until the animal is clear of the area. The engine will be placed in idle only if navigation and safe operation of the vessel can be maintained. If safe operation and navigation of the vessel cannot be maintained with the engine in an idle position, the vessel will operate at the lowest possible speed to maintain navigation and safe operation while reducing potential effects to manatees.
- Vessels will follow routes of deep water and previously established and maintained channels or basins whenever possible.
- Where manatees are observed within the IRL, personnel will restrict boat speeds to 10 knots or less outside of the channel.
- Vessels will operate at "no wake/idle" speeds while near the dock unless human safety considerations dictate otherwise.

CM 16. NASA and SpaceX will document any incidents of injury or death of a federally listed species and report them to the Service within 24 hours.

1.5. Tables and Figures for Proposed Action

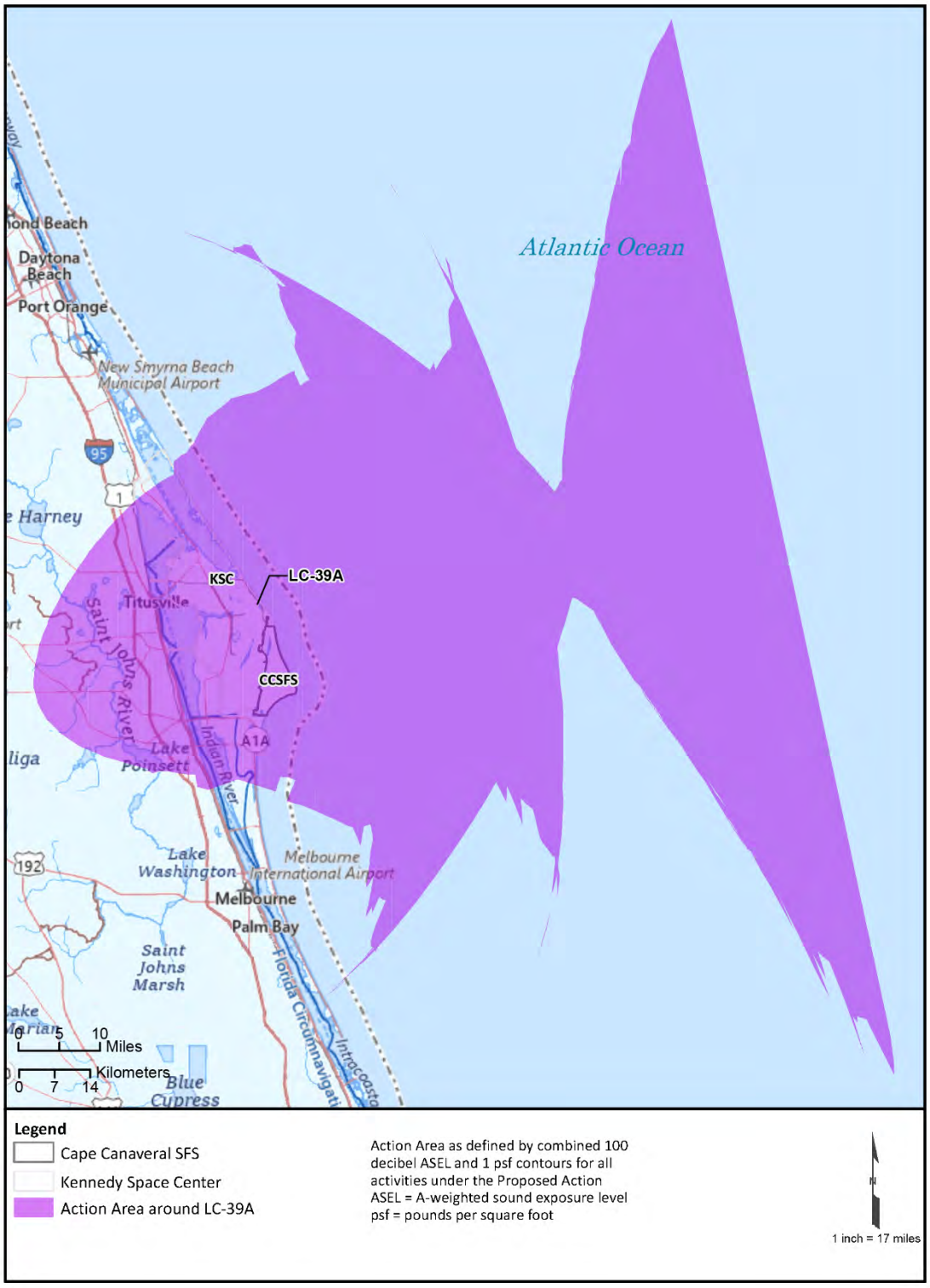


Figure 1: LC-39A and Surrounding Area: Combined 1 psf and 100 dB ASEL Contour

Figure 2: Proposed SS and SH landing trajectories and Atlantic landing areas

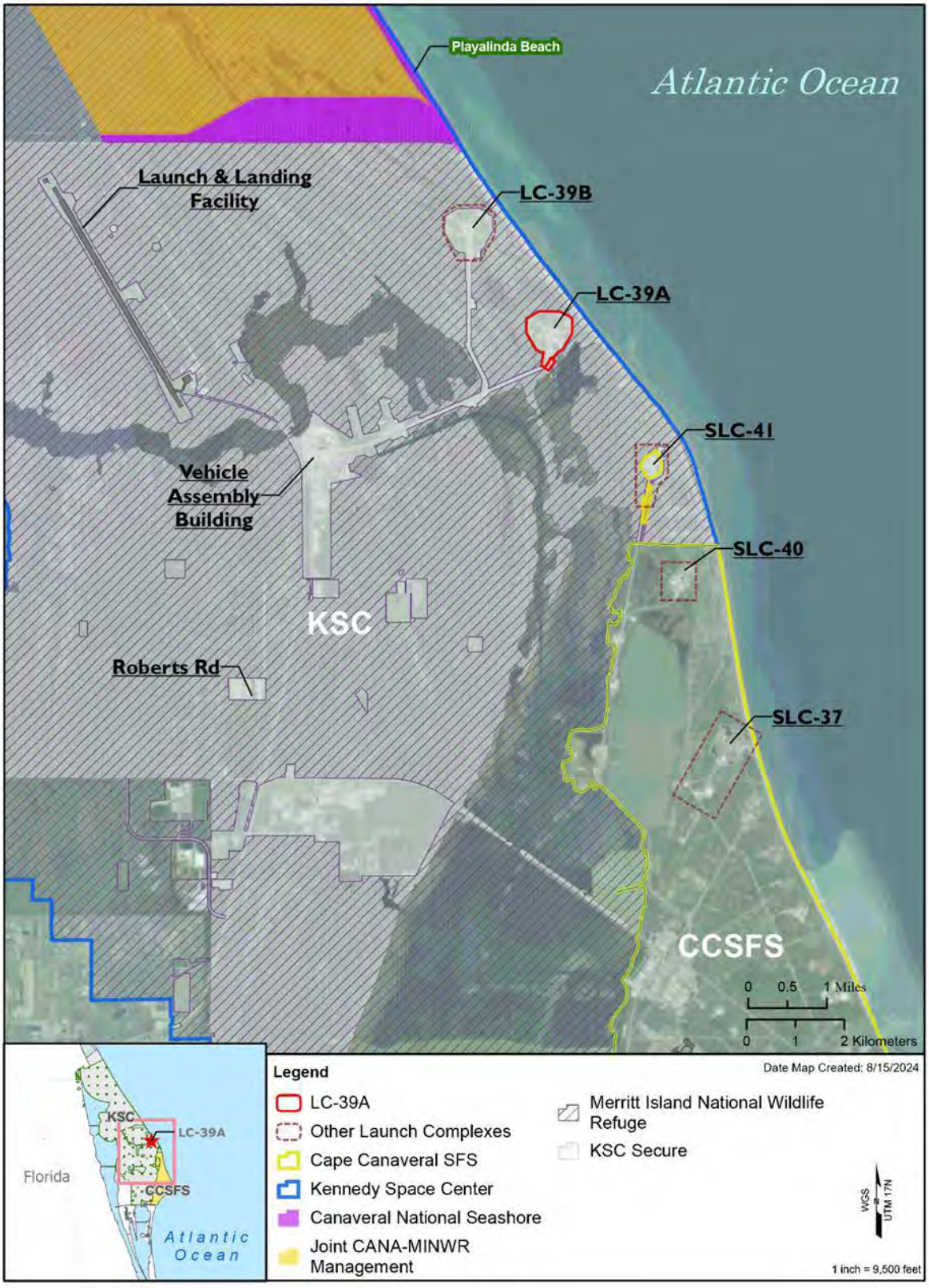


Figure 3: LC-39A and Select Other Launch Complexes and Space Launch Complexes at KSC and CCSFS

Figure 4: Location of LC-39A in relation to other properties

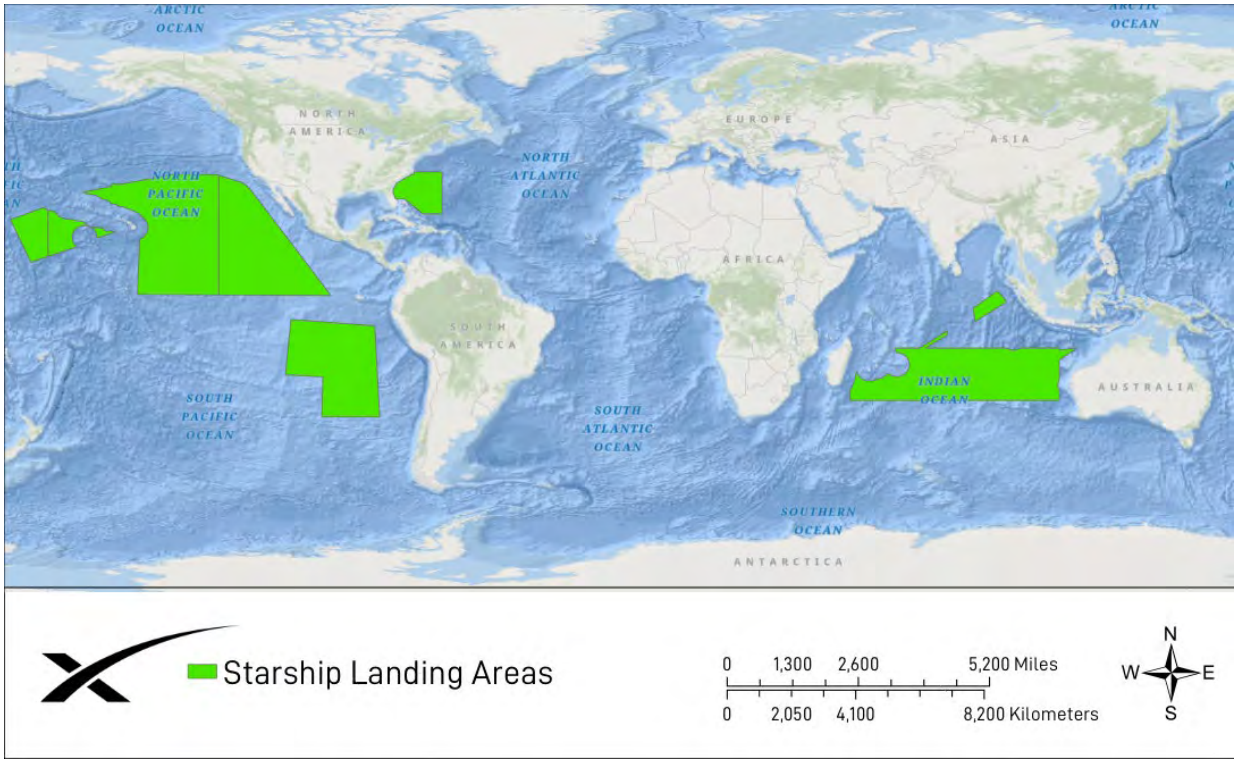


Figure 5: Proposed Starship landing areas

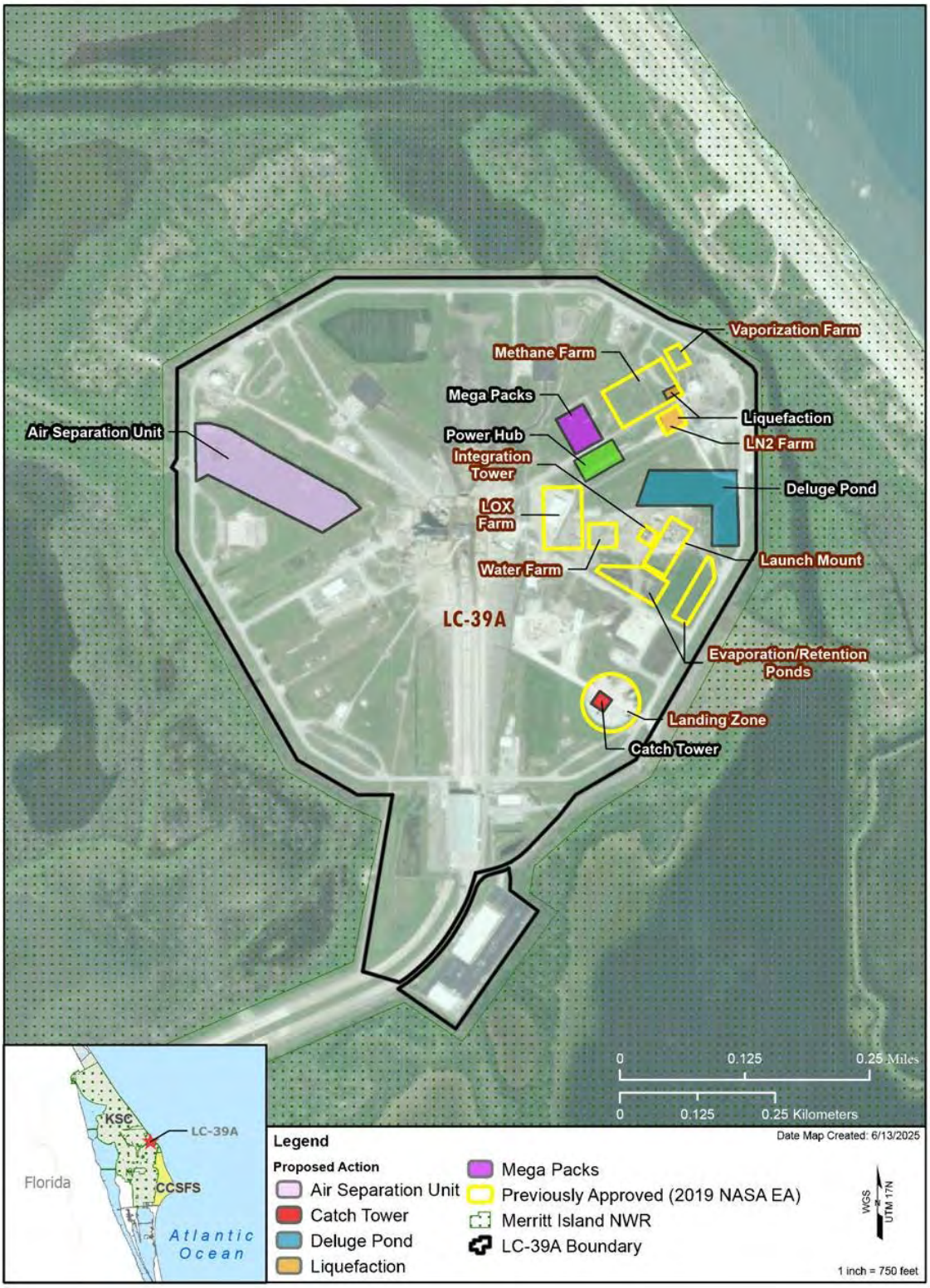


Figure 6: LC-39A boundaries and infrastructure development for SS and SH landings and launches.

Figure 7: Barge transport routes

Figure 8: Land transportation routes within KSC and CCSFS

2. EASTERN INDIGO SNAKE

The indigo snake has been documented within the Action Area at KSC, MINWR, CCSFS and CANA. However, it has not been documented within the area of construction.

2.1. Status of Eastern Indigo Snake

The documents available at the web address below summarize best available data about the biology and current condition of indigo snake throughout its range that are relevant to formulating an opinion about the Action. The Service published its decision to list indigo snake as threatened on May 03, 1978 (43 FR 4026-4029). For more information regarding the status of indigo snake and the factors affecting their conservation status, please refer to proposed and final listing determinations, critical habitat designations, recovery plans, species status assessments, and five-year reviews available at: http://ecos.fws.gov/ecos/indexPublic.do.

2.2. Environmental Baseline for Eastern Indigo Snake

Environmental baseline refers to the condition of the listed species or its designated critical habitat in the Action Area, without the consequences to the listed species or designated critical habitat 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 §7(a)(2) consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The impacts to listed species or designated critical habitat from Federal agency activities or existing Federal agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 C.F.R. § 402.02).

2.2.1. Action Area Numbers, Reproduction, and Distribution of Eastern Indigo Snake

NASA does not currently monitor the indigo snake at KSC. The last confirmed observation of an indigo snake on CCSFS was in 2004, but an unconfirmed, yet reliable, observation was made in December 2023. A 2018 herpetological survey did not result in any observations, but a roadkill indigo snake was observed that year approximately 0.5 mile north of the KSC-CCSFS boundary (i.e., on KSC). From 1998 to 2002 more than 70 indigo snakes were captured throughout Brevard County, including KSC and MINWR, and indigo snake home range estimates were between 44-76 hectares (109-188 acres) for females and between 156-202 hectares (385-499 acres) for males (Breininger et al., 2011). The population is not known within the Action Area for indigo snakes, but there is 66,758 acres of potential indigo snake habitat within the Action Area and the potential for more than 100 individuals to occur based on the amount of available habitat and the approximate home ranges of individuals.

The Action Area encompasses all of CCSFS, KSC and the majority of CANA and MINWR. Construction will occur completely within the lease boundary of LC-39A. Females typically

overlap males, but males do not overlap other males. Based on the home range sizes and the type of habitat throughout the Action Area, the Service anticipates the Action Area habitat potentially supports multiple indigo snakes. The construction area portion of the Action Area is currently developed. The area contains minimal indigo snake habitat of mostly mowed and ruderal fields, with a significant portion containing developed infrastructure. The area is too small to support the entire home range of a single individual.

2.2.2. Action Area Conservation Needs of Eastern Indigo Snake

The Action Area contains a diversity of landcover types. Within the Action Area, the indigo snake is reasonably certain to occur within coastal scrub, scrub, coastal grassland, beach dune, coastal strand, ruderal areas, and some wetland areas, such as swales (Service 2019b). This comprises an estimated 66,758 acres of potential indigo snake habitat (FWC 2023). Within the construction area, landcover is a mixture of developed infrastructure, including ruderal field and coastal scrub (FWC 2023). The total acreage of disturbance within LC-39A is approximately 9.9 acres.

To support indigo snakes, fire-dependent vegetative communities must be burned at an intensity and fire-return interval that mimics the natural fire regime and promotes high-quality indigo snake habitat. Management with either prescribed fire or mechanical means should ensure, as much as practicable, that suitable refugia sites are left undisturbed. Refugia sites may include stump holes, root masses, gopher tortoise burrows, rock outcrops, and debris piles (Service 2019b).

2.3. Effects of the Action on Eastern Indigo Snake

This section analyzes the direct and indirect effects of the Action on the indigo snake, which includes all consequences to listed species or critical habitat that are caused by the proposed Action, including the consequences of other activities that are caused by the proposed Action but that are not part of the Action. A consequence is caused by the proposed Action if it would not occur but for the proposed Action and it is reasonably certain to occur. Effects of the Action may occur later in time and may include consequences occurring outside the immediate area involved in the Action. (50 C.F.R. § 402.02). Analyses are organized according to the description of the Action in section 1 of this BO/CO.

2.3.1. Effects of Construction on Eastern Indigo Snake

2.3.1.1 Vegetation Removal

Construction and removal of vegetation is not expected to result in direct take of individuals. Construction activities will include heavy equipment to clear ruderal field, mowed, and governmental areas. A preconstruction survey for gopher tortoise burrows will be conducted and follow current Florida Fish and Wildlife Conservation Commission (FWC) guidelines. SpaceX and their associated contractor(s) will implement the *2024 Standard Protection Measures for Eastern Indigo Snake* (Service 2024a) prior to and during land clearing and construction activities.

During construction, 9.9 acres will be disturbed with the permanent removal of 2.03 acres of potential indigo snake habitat for the construction of SS-SH launch mounts, towers and other infrastructure. Indigo snakes are primarily active during the day when most construction activities are expected. Therefore, there is potential for exposure to construction activities, including movement of heavy equipment, removal of vegetation, and grading. It is expected that indigo snakes may seek refugia to avoid activities. SpaceX will conduct a biological survey prior to land clearing and construction staging activities. SpaceX will implement the *2024 Standard Protection Measures for Eastern Indigo Snake* (Service 2024a), which includes an onsite observer during initial site clearing activities. By implementing the *2024 Standard Protection Measures for Eastern Indigo Snake* (Service 2024a) and CMs 1, 2, 3, 7, 8, 12 and 18 found in Section 1.4, effects from land disturbance within LC-39A related to construction are anticipated to be insignificant.

2.3.1.2. Increased Roadway Traffic

Increased traffic from construction activities within the LC-39A lease boundary, associated roadways, and the main vehicular arteries within KSC and CCSFS will increase the probability of vehicle strikes on the indigo snake throughout the portions of the Action Area where increased vehicular traffic will occur during construction. SpaceX and NASA are committed to implementing the most recent version of the *2024 Standard Protection Measures for Eastern Indigo Snake* (Service 2024a) as found in CM 7 and 8 in Section 1.4 of this BO/CO, which should reduce adverse impacts from traffic by making vehicle operators aware of the presence of the species and adherence to posted speed limits. NASA will also continue to coordinate with the Service to develop, install, and maintain wildlife crossing awareness signage on NASA property, with emphasis on rights-of-way for transportation routes associated with the Action.

The exact amount of vehicular traffic increase that will occur over the course of the Action due to construction is not currently known, but collisions with indigo snakes have previously occurred at KSC and CCSFS and the species is reasonably certain to occur within the Action Area. Most traffic associated with the Action is expected to occur during daylight hours, when indigo snakes are most likely to be mobile. Over the course of the Action, it is anticipated that no more than 1 individual indigo snake will be taken through direct harm due to vehicular mortality or injury.

2.3.1.3. Noise

Unpredictable and stressful conditions elicit a stress response from vertebrate organisms (Wingfield 2005). Noise created through construction activities can increase stress on indigo snakes (Bogan et al. 2024; see also 2.3.2.2, below). The increased stress can result in immunosuppression, which can increase mortality of individuals (Bogan et al. 2024). Indigo snakes are susceptible to various pathogens, including snake fungal disease and *Cryptosporidium spp*. (Service 2019b). The addition of further stress may increase mortality of already infected snakes. Noise generated from typical equipment used on construction sites (e.g., front-end loader, generator, concrete mixer) range between approximately 80 to 85 dBA at 50 feet (Knauer and Pedersen 2006). Construction noise extending 100 m beyond the construction area is expected to attenuate to approximately 68 dBA. Indigo snakes occurring within this area are

expected to disperse if the noise level elevates to a point of disturbance; therefore, effects of noise from construction related to increased mortality through comorbidity factors of noise and pathogenic infection are expected to be insignificant.

2.3.2. Effects of Operations on Eastern Indigo Snake

2.3.2.1. Increased Roadway Traffic

As noted above, the Action is anticipated to increase the amount of vehicular traffic within the LC-39A lease boundary, associated roadways and the main vehicular arteries within KSC and CCSFS. The exact amount of vehicular traffic increase that will occur over the course of the Action due to operations is not precisely known, but an estimated increase of 19,356 trucks per year would be anticipated during a cadence of 44 launches per year. It is expected that it will take several years for the launch cadence to reach this level, and the Service anticipates the number of trucks to be lower than 19,356 trucks per year until full cadence is reached. After additional pieces of infrastructure are constructed and are fully operational (commodity bulk storage, air separator unit, pipelines), it is anticipated that vehicle traffic will be reduced as commodities will be produced within LC-39A.

Increases in vehicular traffic also occur at MINWR and CANA during other launch and landing operations occurring during operational hours for these properties (6 AM – 8 PM during the summer and 6 AM – 6 PM during the winter). The Service anticipates that the SS-SH platform will attract a large influx of visitors to MINWR and CANA to view the launch and landing portions of the Action as this is a novel vehicle platform not previously seen in the area. Even with the large influx of visitors during current launch or landing operations, the Service has not documented and is not aware of documented injury or mortality to indigo snake due to vehicular traffic generated from park visitation increases during launch operations, though there is the potential for interactions to occur as indigo snake are reasonably certain to occur within the portion of the Action Area that contains visitor vehicular traffic.

SpaceX and NASA are committed to implementing the most recent version of the *2024 Standard Protection Measures for Eastern Indigo Snake* (Service 2024a) as found in CM 7 and 8 in Section 1.4 of this BO/CO, which should reduce adverse impacts from traffic by making vehicle operators aware of the presence of the species and the need to adhere to posted speed limits. NASA will also continue to coordinate with the Service to develop, install and maintain wildlife crossing awareness signage on NASA property, with emphasis on rights-of-way for transportation routes associated with the Action.

Collisions with indigo snakes have previously occurred at KSC and the species is reasonably certain to occur within this portion of the Action Area. Most traffic associated with the Action is expected to occur during daylight hours, when indigo snakes are most likely to be mobile, but up to 22 launches will occur during night hours. Over the course of the Action, it is anticipated that no more than 1 individual indigo snake will be taken through direct harm due to vehicular mortality or injury. Incidental take has already been covered in Section 2.3.1.2 of this BO/CO.

2.3.2.2. Noise

Operations, launches, landings and static fire tests may impair indigo snake behavior and may also result in elevated stress levels due to noise and vibration. There are concerns regarding the amplitude level and temporal frequency of noise that may negatively impact listed species occurring at LC-39A, including the indigo snake. Current and past launch programs at CCSFS, including the Atlas, Titan, and Delta launches, did not document animal mortality associated with noise. However, mortality of a cryptic, semi-fossorial snake (the indigo snake) would be difficult to detect, and other indirect effects such as stress, increased predation, increased road mortality due to fleeing, or other injurious effects were not studied.

Snakes do not possess a tympanic auditory system found in mammals and are more likely to hear based on vibrations from connections between the lower jaw and inner ear (Wever, 1978). We do not anticipate measurable adverse effects to indigo snake auditory systems from sound during launches, landings or static fire tests. However, reptiles exposed to intermittent, high-amplitude noise, such as that from aircraft flyovers, exhibit multiple indicators signifying an elevated stress response and demonstrated altered foraging behavior (Kepas et al. 2023). Increases in anthropogenic disturbance, including noise, likely cause elevated stress responses for indigo snakes (Bogan et al. 2024). The increased stress can result in immunosuppression, which can increase mortality of individuals (Slabbekoorn et al. 2018, Van Waeyenberge et al. 2018). Indigo snakes, like many native snakes, are susceptible to various pathogens, including but not limited to *Cryptosporidium*, pentastomes (lung worms), and snake fungal disease (Service 2024b). *Cryptosporidium* is a protozoan that can cause a parasitic disease in snakes. Symptomatic snakes have poor growth, weight loss, regurgitation, and gastric hypertrophy leading to a visible midbody swelling. Severe clinical infections are progressively debilitating and may lead to fatal gastric cryptosporidiosis (Bogan 2019). Pathogens, like *Cryptosporidium*, are present in the environment however, the infection appears amplified when snakes are exposed to stressful environments (Service 2024b). A recent indigo snake translocation effort found most snakes captured within an area disturbed by anthropogenic noise to be severely affected by *Cryptosporidium* (Service 2024b). However, in a survey of over 200 free-ranging snakes, including indigo snakes, *Cryptosporidium* was not detected in areas unaffected by intense anthropogenic disturbance, including noise (O'Hanlon et al. 2023). Indigo snakes subjected to intense disturbance when in proximity of mining operations in Florida also presented with declining health condition after being infected with *Cryptosporidium* (Service 2024b).

Additionally, acute, high-amplitude noises, such as those related to launch operations are expected to impact indigo snakes, which may further impair natural behaviors. Indigo snakes are an active hunting snake, typically seeking out prey (Service 2019b). Snake species that are considered more active, like indigo snakes, exhibited more movement when exposed to sound as opposed to snakes with a more sessile, ambush-style foraging behavior (Zdenek et al. 2023). Movement response when exposed to low frequency noise, like that produced by rocket launches, resulted in movement towards the source, away from the source, and in random directions as well (Zdenek et al. 2023). Startling of indigo snakes is expected to result in movement that would otherwise not occur naturally (Slabbekoorn et al. 2018). This movement may result in fleeing to a different location and abandoning their feeding or breeding activity (Slabbekoorn et al. 2018). Unintended movement has the potential to increase exposure to

predation, intraspecific conflict, or interaction with motor vehicles, all leading to a reduction in survival (Slabbekoorn et al. 2018, Service 2019b). The species is expected to be in refugia at night due to its diurnal nature and sheltered from impacts of sound. Though indigo snakes might startle, seek shelter or alter their movement due to sound from launches, static fire tests and landings, they are expected to quickly resume normal behavior pattern immediately or shortly after high-amplitude noises and the effects are expected to be insignificant.

Snake responses to vibration are not well researched. Royal pythons, which are large, burrow-using, ground-hunting snakes, were exposed to multiple levels of vibration and sounds and shown to sense airborne sounds, with the greatest responses between 80 and 160 Hz with volumes between 50 and 110 dB (Christensen et al 2012). Likewise, indigo snake are anticipated to startle and potentially seek shelter during launches, landings and static fire tests due to vibrations, which is expected at similar levels from these activities. However, they are expected to continue foraging and moving shortly after these operations cease and the species will be in refugia at night and sheltered from impacts of sound. At this time, the Service anticipates an insignificant effect to indigo snake from vibration caused during launches, landings and static fire tests.

Some of the lowest frequencies produced during launches and landings are from sonic booms, with most frequencies below 100 Hz. It is currently unknown whether indigo snakes have a similar response to frequencies from sonic booms. Sonic booms produced during launches will occur over the upland and marine environment, and those produced over the marine environment will have no effect on indigo snake. The Action anticipates 22 launches will occur during the night (10 PM – 7 AM) and effects from sound and overpressure are anticipated to have an insignificant effect on indigo snake at night, as the species is mostly diurnal, and the species will be in refugia at night and sheltered from impacts. Indigo snakes are anticipated to startle and potentially seek shelter during launches, landings and static fire tests due to sonic boom overpressure events during the day. The Service anticipates up to 44 sonic boom events occurring per year during the day (22 SH landings and 22 SS landings). Overpressures of 20 PSF or greater could occur from SH landings at LC-39A and of 1.7 PSF or greater from SS landings in the immediate area of LC-39A. Overpressures could have an unweighted decibel equivalent of between 151.7 and 154 between 16 and 20 PSF. Based on the low number of sonic boom events annually during the day (up to 44 total), the anticipated short-term duration of impacts to indigo snake from sonic boom overpressures and the lack of information regarding indigo snake responses to sonic booms, the Service anticipates an insignificant effect to indigo snake from sonic boom overpressure caused during landings.

2.3.2.3. Prescribed Fire and Land Management

The indigo snake, like many other wildlife species in the southeast, evolved within a landscape that depends on relatively frequent fires. Absent of a natural fire regime, prescribed fire is the most effective tool to replicate the natural processes that result in appropriate habitat conditions for a variety of species. Land management activities, including application of prescribed fire throughout CANA, CCSFS, KSC and MINWR, are not expected to be impacted by any activities covered within this Action. NASA and the Service will continue to conduct land management

activities, including prescribed fire, as outlined in CM 13 in Section 1.4 of this BO/CO. Any effects on the indigo snake due to impacts to land management are expected to be discountable.

2.3.2.4. Lighting

Launch operations will require additional lighting to ensure the protection and safety of SpaceX personnel and hardware. Leading up to a SS-SH launch, spotlighting may illuminate the launch vehicle at LC-39A for several days, likely involving 3 continuous nights of lighting of launch pad. Additional lighting would also be employed during landings, both at LC-39A and in the ocean. Under non-launch conditions, brighter lights would be turned off or reduced. During standard non-launch ground support operations, daily operations would require varying levels of artificial lighting 7 days a week, throughout the year; however, these routine operations do not require engine ignition or bright spotlighting. Operational lighting at night and light resulting from rocket plumes during launches, landings or static fire tests at night are not expected to adversely affect indigo snakes, as they are a diurnal species and are expected to have minimal foraging, movement or be within a burrow or other refugia while lighting is operational. Any effects due to artificial lighting are expected to be discountable.

2.3.3. Summary of the Effects of the Action on Eastern Indigo Snake

An estimated 1 individual over the course of the Action, is expected to be taken by being killed from an increase in traffic related to the construction and operations of the Action. Land management activities are expected to proceed unimpeded due to NASA and SpaceX's commitment to continue conducting management activities on NASA property at a level that maintains habitat for continued use by federally listed species. Effects from sound and vibration are anticipated to occur but not reach the level of likely to adversely affect the indigo snake, as we determine that effects from those stressors are insignificant, and the relatively few numbers of individuals likely to occur within the portion of the action area impacted by the above-discussed stressors.

2.4. Cumulative Effects on Eastern Indigo Snake

For purposes of consultation under ESA §7, cumulative effects are those caused by future state, tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future Federal actions that are unrelated to the proposed Action are not considered, because they require separate consultation under §7 of the ESA.

In its request for consultation, NASA did not describe any non-Federal actions, and the Service does not anticipate additional cumulative effects that must be considered in formulating our opinion for the Action.

2.5. Conclusion for Eastern Indigo Snake

"*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 C.F.R. § 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 biological opinion that the Action is not likely to jeopardize the continued existence of the eastern indigo snake.

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

An estimated 1 individual is expected to be taken by direct injury or mortality resulting from an increase in traffic related to the Action. The removal of 1 individual as a result of the Action will not jeopardize the continued existence of the species, as it occurs throughout Florida and Georgia in 51 populations, with 17 defined as resilient (Service 2024). Population estimates are difficult to estimate due to the species' large home ranges, secretive behavior and low densities. The incidental take of 1 indigo snake over the course of the Action is estimated to be a minimal reduction to the population throughout its range.

3. FLORIDA SCRUB-JAY

FSJ are known to occur throughout various areas on KSC and have been documented within the Action Area at CCSFS, MINWR and CANA. FSJ have not been documented within the area of construction in LC-39A, and no FSJ habitat occurs within the area of construction.

3.1. Status of Florida Scrub-Jay

The documents available at the web address below summarize best available data about the biology and current condition of FSJ throughout its range that are relevant to formulating an opinion about the Action. The Service published its decision to list FSJ as threatened on June 03, 1987 (52 FR 20715-20719). For more information regarding the status of FSJ and the factors affecting its conservation status, please refer to proposed and final listing determinations, critical habitat designations, recovery plans, species status assessments, and five-year reviews available at: http://ecos.fws.gov/ecos/indexPublic.do.

3.2. Environmental Baseline for Florida Scrub-Jay

Environmental baseline refers to the condition of the listed species or its designated critical habitat in the Action Area, without the consequences to the listed species or designated critical habitat 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 §7(a)(2) consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The impacts to listed species or designated critical habitat from Federal agency activities or existing Federal agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

3.2.1. Action Area Numbers, Reproduction, and Distribution of Florida Scrub-Jay

The Action Area contains the second largest contiguous population of FSJs in the species' range (Northeast Coastal Genetic Unit C). Together, CCSFS, KSC, CANA, and MINWR are estimated to have 20,000+ acres of potentially suitable scrub-jay habitat; however, numbers have declined by more than 50 percent since 1987, and the population continues to decline (NASA, 2024b). For clarity of analysis, the rest of the analysis will refer to FSJ within KSC, MINWR and CANA as occurring within KSC. KSC has a potential population size of 700 breeding pairs and NASA does not monitor all FSJ groups. FSJ are cooperative breeders, and a group is a breeding pair with associated helpers and juveniles. KSC has averaged 153 studied groups throughout the property from 2014-2023 and current estimates range from approximately 225-270 groups (Service 2020b). There were an estimated 112 FSJ groups at CCSFS in 2024. At KSC, the core habitat zone represents habitat of greatest importance to the FSJ population; the support habitat zone has lesser importance, although it is necessary for connecting population cores and providing a population with high persistence probabilities. Auxiliary habitat is of lower habitat quality than core or support habitat regardless of management history. Monitoring of color-banded FSJ populations on KSC began in 1987 and showed that territory sizes average approximately 25 acres (Breininger et al., 1995). Most habitat on KSC remains suboptimal (i.e., short, closed-medium, tall mix) due to habitat degradation during a period of fire-suppression and is about half its potential carrying capacity.

Historically, FSJ monitoring was conducted near pads LC-39A and LC-39B, but this monitoring was discontinued as the areas were viewed as "sinks," and monitoring and management efforts were focused in areas with greater potential for recovery. Currently, the closest FSJ territory is ±0.80 miles from the launch pad.

At CCSFS, there are ±8,400 acres of potential suitable habitat for FSJs based on estimated acreages for oak scrub, disturbed oak scrub, coastal strand, and disturbed coastal strand habitats. The scrub acreage is divided into three categories: good, fair, and poor (USSF, 2023b).

3.2.2. Action Area Conservation Needs of Florida Scrub-Jay

Within the Action Area, Florida scrub-jays primarily occur within coastal scrub and scrub vegetation communities (Service 2019c). Within the construction area, landcover is a mixture of developed infrastructure, ruderal areas, and sodded areas. There is no FSJ habitat within the area of construction, and FSJ are not expected to be present within the boundaries of LC-39A. Total FSJ habitat within the Action Area is approximately greater than that found within KSC, MINWR, CCSFS and CANA as the Action Area extends into inland Brevard County.

To support FSJ, fire-dependent vegetative communities must be burned at an intensity and fire return interval that mimics the natural fire regime and promotes high-quality Florida scrub-jay habitat. Mechanical management of scrub habitat has occurred throughout the Action Area to varying degrees of success. For coastal scrub and scrub communities, the fire return interval is typically between 2-6 years depending on the current state of the scrub. Scrub where fire has been excluded will typically require a more frequent fire return interval to restore it to high-quality FSJ habitat. Management with either prescribed fire or mechanical techniques should

ensure that there is a suitable amount of bare ground present for FSJ, between 10 and 50 percent (Service 2019c). NASA is committed to maintaining FSJ habitat within the Action Area for the continued use by federally listed species through a multitude of land management activities including, but not limited to prescribed burning, fire break maintenance, and invasive and nuisance species control. This conservation measure (CM 13) can be found in Section 1.4 of this BO/CO.

3.3. Effects of the Action on Florida Scrub-Jay

This section analyzes the direct and indirect effects of the Action on the FSJ, which includes all consequences to listed species or critical habitat that are caused by the proposed Action, including the consequences of other activities that are caused by the proposed Action but that are not part of the Action. A consequence is caused by the proposed Action if it would not occur but for the proposed Action and it is reasonably certain to occur. Effects of the Action may occur later in time and may include consequences occurring outside the immediate area involved in the Action. (50 C.F.R. § 402.02). Our analyses are organized according to the description of the Action in section 1 of this BO/CO.

3.3.1. Effects of Construction on Florida Scrub-Jay

3.3.1.1. Vegetation Removal

FSJ occurs within the Action Area but does not occur within the fence line of LC-39A where vegetation clearing will be done. Vegetation clearing from construction is expected to have no effect on the FSJ.

3.3.1.2. Increased Roadway Traffic

Increased roadway traffic from construction activities has the potential to increase the probability of vehicle strikes on FSJs. NASA and SpaceX are committed to obeying all traffic regulations, including NASA reductions of posted speed limits, if implemented. The Service is unaware of FSJ vehicle strikes from current activities performed at LC-39A or vehicle strikes associated with previous Actions from this area; however, there have been documented vehicle mortalities of FSJ at CCSFS and multiple vehicle mortalities at KSC. FSJ are highly mobile but are known to forage along roadsides and rights-of-way within KSC and MINWR, and roads have been documented as a potential source of injury or mortality for FSJ (Mumme et al 2000). The species is diurnal and not expected to be present along roadways during the night but could be present during low-light periods of dawn and dusk. All personnel associated with the Action will be required to adhere to current traffic speed limits and all conservation measures identified in Section 1.4 of this BO/CO. Based on the above large increase in traffic, portions of the Action occurring through FSJ habitat with known territories and the previously document vehicular mortalities of FSJ within the Action Area, the Service anticipates incidental take of up to 1 FSJ individual annually during the course of the Action.

3.3.1.3. Noise

Sound generated from typical equipment used on construction sites (e.g., front-end loader, generator, concrete mixer) range between 80 to 85 dBA at 50 feet (Knauer and Pedersen 2006). Construction is anticipated to occur year-round for two years. The closest FSJ territory is ±0.86 miles from the nearest area of construction. Studies have shown that anthropogenic sound (e.g., traffic, urban environments) influences FSJ, but it is unclear if these effects act as a chronic stressor on the species (Ellis et al. 2022, Morgan et al. 2012). Sound from construction is anticipated to attenuate over the distance of 0.86 miles based on distance from the fence line and vegetation reducing sound levels between the construction area and FSJ habitat. At a distance of 0.86 mi, the sound level is expected to attenuate to background or ambient sound levels of approximately 60 dBA, and FSJ are not anticipated to be disturbed at these levels. Due to construction being contained within the fence line of LC-39A, the distance of construction to the closest known FSJ territory and the expected attenuation of sound from construction activities to FSJ habitat, sound produced through construction activities are expected to result in an insignificant effect on FSJ.

3.1.3.4. Lighting

Night-time construction is expected to occur intermittently over the course of two years. Lighting required for construction activities would be limited to the immediate vicinity of the construction site and requirements for ensuring human health and safety. LC-39A currently experiences a large amount of night-time lighting due to the current Falcon 9 and Falcon Heavy program within the complex. However, FSJ is diurnal, and night-time lighting would trespass into the surrounding environments. Due to the limited amount of night-time lighting needed and the limited exposure FSJ would have to the artificial lighting resulting from the distance of occupied FSJ habitat and its diurnal nature, it is anticipated that construction lighting would have an insignificant effect on FSJ.

3.3.2. Effects of Operations on Florida Scrub-Jay

3.3.2.1 Increased Roadway Traffic

Increased roadway traffic from operational activities has the potential to increase the probability of vehicle strikes on FSJs. Estimates provided are ±19,356 trucks annually (53 trucks/day). This is for a 12-hour period for operations occurring over 365 days. NASA and SpaceX are committed to obeying all traffic regulations, including NASA reductions of posted speed limits, if implemented. The Service is unaware of FSJ vehicle strikes from current activities performed at LC-39A or vehicles associated with current and previous Actions from this area; however, there have been documented vehicle mortalities of FSJ at CCSFS and multiple vehicle mortalities at KSC. FSJ are highly mobile but are known to forage along roadsides and rights-of-way within KSC and MINWR, and roads have been documented as a potential source of injury or mortality for FSJ (Mumme et al 2000). The species is diurnal and not expected to be present along roadways during the night but could be present during low-light periods of dawn and dusk. It is not known the exact number of additional vehicles that will be needed for operation of the

Action and NASA has committed to the conservation measures identified in Section 1.4 of this BO/CO for vehicular traffic over the course of the Action.

Vehicular traffic currently increases at MINWR and CANA during other launch and landing operations occurring during operational hours for these properties (6 AM – 8 PM during the summer and 6 AM – 6 PM during the winter). The Service anticipates that the SS-SH platform will attract a large influx of visitors to MINWR and CANA to view the launch and landing portions of the Action as this is a novel vehicle platform not previously seen in the area. Even with the large influx of visitors during current launch or landing operations, the Service has not documented, and is not aware of, documented injury or mortality to FSJ due to vehicular traffic related to park or refuge visitors. Therefore, effects related to increases in vehicle traffic at MINWR and CANA due to operations from the Action are anticipated to be insignificant. Based on the above large increase in traffic, portions of the Action occurring through FSJ habitat with known territories and the previously documented vehicular mortalities of FSJ within the Action Area, the Service anticipates incidental take of up to 1 FSJ individual annually during the course of the Action. This incidental take was covered in Section 4.3.1.3 of this BO/CO.

3.3.2.2. Noise

Launches, landings and static test fires may startle FSJ and can result in elevated stress levels due to sound and vibration. There are concerns regarding the amplitude level and temporal frequency of sound associated with space activities that may negatively impact listed species occurring near LC-39A. Current and past launch programs at CCSFS, such as the Atlas, Titan, and Delta launches did not document any animal mortality associated with sound, however other effects such as stress, increased predation, reduction in nesting and breeding success, or injury by deafening were not studied. Additionally, the study did not address any spatial shifts over time. Therefore, previous studies related to the Atlas, Titan, and Delta programs do not adequately study the impacts to listed species such as FSJ and should not be used to indicate absence of effects.

FSJ are known to occupy areas ±0.8 miles (1.43 km) of the launch pad with a current FSJ territory occurring ±0.8 miles from ; this is within the 140 dBA SEL of SS-SH launches, the 120 dBA SEL of SH landings, 1.5 psf contours of SS landings and 20 psf contours of SH landings. SS-SH launches have the potential to produce sound of 150 dB LMax or greater, SS landings of 150 dB LMax or greater, SH landings of 150 dB LMax or greater and static fire tests of 150 dB LMax or greater. SH landings could produce up to 20 psf adjacent to the landing zone. Based on information within the BCA, 100 dBA SEL or greater will occur within approximately 26 km of the launch site. It is also anticipated that 10 psf will occur within 5 km of LC-39A, 6 psf will occur within 9 km of LC-39A and 4 psf will occur within approximately 11 km of LC-39A. The approximate equivalent unweighted and A-weighted SPLs for sonic boom overpressures are provided below in Table 2. These activities can occur year-round, including during the breeding and nesting season for FSJ. Some space operations, such as launches or landings, can be highly dependent on payload availability, planetary orbits, and other factors outside the control of NASA and SpaceX. For the purposes of this analysis, the Service will assume operations will be distributed evenly over the calendar year. Therefore, it is expected that 33% of operations may occur during the 122-day Florida scrub-

jay breeding season (1 March – 30 June). This would result in approximately 15 launches, 15 SH and 15 SS landings, and 15 SH and 15 SS static fire tests during breeding season. All other operations would occur outside of the breeding season.

Table 2: Sonic Boom Overpressure and Associated Decibel Levels

Sonic Boom Overpressure (psf)	Unweighted Sound Pressure Level (dB)	A-weighted Sound Pressure Level (dBA)
1	127.6	116.5
2	133.6	122.5
4	139.6	128.5
6	143.1	132.1
10	147.6	136.5
11	148.4	137.3
15	151.1	140.0
16	151.7	140.6
21	154.0	142.9

FSJ calls can occur between 750 Hz and 5 kHz, indicating that the species can hear within this range (Woolfenden and Fitzpatrick 2020). Anthropogenic sound can cause various effects to avian species, including physical damage to ears, stress responses, behavioral changes such as unpredicted fright–flight responses, avoidance responses, effects to foraging, changes in reproductive success, altered vocal communication, or interference with the ability to hear predators and other important sounds (Ortega 2012). When exposed to impulsive sound, avian species have abandoned sites at sound levels as low as 72.2 dBA (Wright et al. 2013). Acute exposure of 10-20 seconds to 97 dB sound, at a frequency of 430-470 Hz produces a stress response in laboratory birds (Corbani et al. 2021). This is within the typical frequency range produced by a rocket when launched but lower in amplitude and duration than is expected during peak launch activities. Hence, stress responses could be greater than observed in this study. On top of hormonal responses to stress, animals exposed to loud sounds also display behaviors that could negatively impact basic survival functions, such as breeding, feeding, and predator avoidance (Kight and Swaddle 2011). Stress responses can also result in suppression of the immune system, causing an increase in susceptibility to pathogens and a reduction in survival (Van Raaij et al. 1996, Slabbekoorn et al. 2018, Bogan et al. 2024). Startle responses can affect the avian species' ability to successfully raise young (Kight et al. 2012). Startle responses and other sound induced changes, such as stress, can affect the ability of avian species to successfully incubate developing embryos (i.e., eggs) within a nest and care for young (Kight et al. 2012). A study exposed budgerigars to four 169 dB SPL impulses within 20 meters resulting in temporary auditory threshold shifts between 1 and 4 kHz and permanent auditory threshold shifts at 500 Hz 40 days after exposure (Hashino et al. 1988). It is anticipated that FSJ will experience high-intensity sounds from launches, landings, and static fire tests more than once every 40 days with the potential for an event on average every 2 days (365 days / 220 high-intensity sound events = 1 event every 2 days). There is the possibility that static fire tests for the SS and SH boosters could occur on the same day. Avian species are

known to regenerate auditory hair cells over the course of several weeks and can recover from hearing loss over this period of time (Sato et al. 2024). FSJ might experience temporary auditory threshold shifts of a continuous nature as noise events from operations could occur at a rate that full recovery isn't achieved.

There is not a confirmed conversion between different sound metrics (SPL, SEL), however the metric SEL is the most frequently used measure of noise exposure for an individual aircraft noise event. It measures the total noise energy produced during an event, from the time when the A-weighted sound level first exceeds a threshold (normally just above the background or ambient noise) to the time that it again drops below the threshold. The Service believes this level is the most appropriate metric to use (if available) for sound related to launches and landings. A rough extrapolation of A-weighted SEL decibels provided in the BCA indicate that during the loudest part of operations (launches) approximately 150 dBA SEL occurs up to ±0.51 miles, 140 dBA SEL up to ±1.07 miles, and 130 dBA SEL up to ±1.85 miles from the launch site. The Service could not find exact comparisons of 140 dBA SEL to common environmental noises, but 140 dBA is comparable to a jet engine at 100 feet (Yale 2025). Based on the above information regarding stress responses, startle responses and temporary auditory threshold shifts, the Service anticipates harm to FSJ exposed to repeated operations within the 140 dBA SEL contours of the launch site during operations. The harm results from sub-lethal injury due to temporary threshold shifts associated with up to 44 SS-SH launches, 44 SS static fire test and 44 SH static fire tests which can lead to increased stress and startle responses, breeding, predator avoidance and temporary auditory threshold shifts. The area within the 140 dBA SEL contour has historically supported at least 1 FSJ family group (four individuals). As a result, the Service estimates that approximately 1 FSJ family group (4 individuals) annually will be harmed.

Landing events generate an overpressure event (sonic boom) measured in psf and FSJ will experience them almost instantaneously as compared to noise generated by rocket engines from static fire tests, launches and landings. The Action Area extends to the 1 psf limits of a sonic boom generated from a landing event. Though atmospheric and local weather conditions and the trajectory that the SH booster and SS take can attenuate or accentuate a sonic boom overpressure, the Service generally regards a 1 psf overpressure event as equivalent to a peak sound pressure level of approximately 127 dB and 116 dBA. Landing operations associated with the Action would not occur in repeated succession but would occur up to 88 times per year (44 SH landings and 44 SS landings). Sonic booms are almost instantaneous events, and adverse effects to a portion of FSJ within the Action Area from them are anticipated to result in temporary auditory threshold shifts. As described previously, the Service anticipates that FSJ will also experience some level of startle response ranging from a reduced number of calls, movement into vegetation, movement off nests with eggs or young, a reduction in the amount of foraging post-operation due sound produced from sonic boom overpressures. Based on the psf to dB conversion in Table 2, the Service estimates that FSJ exposed to 10 psf (~140 dBA) or greater will experience sub-lethal harm through temporary auditory threshold shifts. The Service was only provided overpressure contours in 1, 2, 4, 6, 10, 15 and 20 psf contours and does not have the current ability to estimate overpressure contours within the provided contours. The Service also understands that 140 dBA and 140 dBA SEL are two different metrics that can have difficulties in being compared but will use them as rough equivalents for the purpose of this

analysis. Temporary threshold shifts can manifest as a reduction in frequencies the species is able to hear for a short-term period (hours to weeks) in certain frequencies. This can lead to a reduction in the species' ability to respond to auditory environmental cues such as calls from other individuals of the species, identification of predators and detection of prey. A reduction in the FSJ's hearing ability temporarily leads to a reduction in the breeding and feeding ability of the species.

Quantifying the number of FSJ family groups, and then individuals, that might be adversely affected by sonic booms is difficult due to not all potential habitat being surveyed for FSJ territories and not all potential habitat being occupied by the species. The Service will use an average of 4 individuals per family group, an average of 25 acres per territory, the amount of core habitat and the currently known FSJ territories within the 10+ psf contour to determine the amount of incidental take.

Table 3: FSJ core habitat at KSC, MINWR and CCSFS Exposed to >1 psf overpressure. Taken from BCA.

Events at LC-39A	Acres of FSJ core habitat affected					
	1-2 psf	2-4 psf	4-6 psf	6-10 psf	10-20 psf	>20 psf
Starship-Super Heavy launch	Sonic boom over the Atlantic Ocean does not affect land					
Starship static fire test	No sonic boom					
Super Heavy static fire test						
Super Heavy landing[1]	21	2,420	7,304	8,303	4,519	167
Starship landing	23,954	0	0	0	0	0

[1]Super Heavy landing at 40 degrees was used as the representative landing, as it would expose the greatest amount of Florida scrub-jay core habitat to the highest overpressure levels.

Table 3 shows there is approximately 12,989 acres of core FSJ habitat that could be occupied within the 10+ psf contour. However, not all of this acreage is monitored at this time by NASA nor is all habitat anticipated to be occupied at the same time. The Service will use the 2024 number of FSJ territories within the 10+ psf contour to determine the amount of incidental take associated with overpressure due to these reasons. The Service anticipates up to 61 FSJ family groups or 244 individuals annually that will experience harm through temporary hearing threshold shifts that could affect calling of other FSJs, feeding nestlings or fleeing from predators, leading to increased predation and reduced productivity. The Service did not include the FSJ territory ±0.80 miles north of the LC-39A launch pad in the incidental take number for overpressure as this territory was already included in the analysis for noise from launches. This number is anticipated to be a theoretical maximum, and family groups exposed to the effects of sound by the Action might be lower based on the number of operations annually combined with localized weather or atmospheric conditions altering the degree to sonic boom overpressures per event.

3.3.2.3. Prescribed Fire and Land Management

Historically, launch operations, including payload processing, vehicle integration, payload transport, static test fires, wet dress rehearsals, and launching of a rocket, have constrained the

abilities of land managers to properly apply prescribed fire needed to maintain habitat of federally listed species, including FSJ, at KSC and CCSFS.

Prescribed fire as a land management tool is vital to the persistence of FSJ throughout the Action Area. The scrub community functions as a fire-dependent system, evolving from lightning-originated wildfires. Implementation of successful prescribed fire is complex and relies on more than a specific number of days available for prescribed fire operations. NASA has recently updated the *Memorandum of Understanding between the Space Launch Delta 45, United States Fish and Wildlife Service, and John F. Kennedy Space Center for Prescribed Burning on Merritt Island National Wildlife Refuge, John F. Kennedy Space Center, and Cape Canaveral Space Force Station, Florida* that establishes and defines a coordinated process through cooperative guidelines that allows the Service to conduct prescribed burns on CCSFS and KSC while protecting personnel, infrastructure, and spaceflight hardware. NASA committed to conducting management activities on NASA property at a level that maintains habitat for continued use by federally listed species. Activities will include but not be limited to prescribed burning, fire break maintenance and invasive and nuisance species control found in CM 13 found in Section 1.4 in this BO/CO. Based on the above, effects limiting prescribed fire and land management activities are expected to have an insignificant effect on FSJ.

3.3.2.4. Lighting

FSJ are a diurnal species and forage during daylight hours. Launch operations will require additional lighting to ensure the protection and safety of SpaceX personnel and hardware. Leading up to a SS-SH launch, spotlighting may illuminate the launch vehicle at LC-39A for several days, likely involving 3 continuous nights of lighting of launch pad. Additional lighting would also be employed during landings, both at LC-39A and in the ocean. Under non-launch conditions, brighter lights would be turned off or reduced. During standard non-launch ground support operations, daily operations would require varying levels of artificial lighting 7 days a week, throughout the year; however, these routine operations do not require engine ignition or bright spotlighting. Lighting associated with night-time launch activities can be expected to occur for up to 22 night-time launches, 44 landings (22 SH + 22 SS) and 44 night-time static fire tests (22 SH + 22 SS) per year. SH landings would be associated with a launch for a total of 88 discrete events annually (22 SH launches + 22 SH static fire tests + 22 SS static fire tests + 22 SS landings at LC-39A) requiring lighting at night. Lighting during operations would be associated with white light needed for human health and safety within LC-39A and flames associated with rocket engine ignitions. LC-39A currently has a LOM for LC-39A to reduce the amount of lighting trespassing outside of LC-39A and this will be updated and approved by NASA and the Service prior to operations beginning as found in Conservation Measure 4 in Section 1.4 of this BO/CO. Multiple pieces of infrastructure will exceed the height of the surrounding vegetation and there will be some light trespass into areas that would otherwise be dark. Lights needed for launch, landing and static fire tests operations will only be focused on the vehicle and other essential components within the boundaries of LC-39A. The closest FSJ family group is ±0.86 miles from LC-39A. Effects of lighting on FSJ at KSC is currently not monitored or studied, but potential effects include an increase in predation due to increased lighting and decreased fitness through reduced roosting. The species is diurnal and roosts in vegetation at night, which has the potential to decrease

potential effects by blocking portions of light intruding into dark areas at night. Light from operations is anticipated to attenuate over the ±0.86 miles to the nearest FSJ group to a level that is insignificant. Effects of lighting at LC-39A from the Falcon program on FSJ are currently unknown as specific monitoring of these effects has not occurred. Based on the above, effects from the production of artificial lighting associated with operations on FSJ are expected to be insignificant.

3.3.2.5. Heat

The closest FSJ territory is 0.86 miles from the fence line of LC-39A. Construction of a bifurcated flame diverter trench and deluge system is expected to divert most radiant heat from launches, landings and static fires in a primarily vertical direction and not horizontally. Launches and static fire tests will generate a heat plume that extends up to 0.2 miles from the diverter and 96 feet from the landing pad during landings. There is no FSJ nesting or foraging habitat within the 0.2-mile or 96-foot radius of the heat plumes to be generated by launches, landings or static fire tests. Based on the above, effects of the heat plume through launches, landings and static test fires on the FSJ are expected to be discountable.

3.3.3. Summary of the Effects of the Action on Florida Scrub-Jay

Land management activities are expected to proceed unimpeded due to NASA and SpaceX's commitment to continue conducting management activities on NASA property at a level that maintains habitat for continued use by federally listed species. An estimated 62 family groups or 248 individuals annually (4 individuals through harm + 244 individuals through harm) are estimated to be harmed due to effects from sound and lead to temporary auditory threshold shifts, and 1 individual is expected to be killed through vehicular mortality due to the increase in vehicular traffic over the course of the Action.

3.4. Cumulative Effects on Florida Scrub-Jay

For purposes of consultation under ESA §7, cumulative effects are those caused by future state, tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future Federal actions that are unrelated to the proposed Action are not considered, because they require separate consultation under §7 of the ESA.

In its request for consultation, NASA did not describe any non-Federal actions, and the Service does not anticipate, additional cumulative effects that must be considered in formulating our opinion for the Action.

3.5. Conclusion for Florida Scrub-Jay

"*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 C.F.R. § 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 biological opinion that the Action is not likely to jeopardize the continued existence of the Florida scrub-jay.

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

An estimated 62 family groups (248 individuals) will be harmed due to effects from sound and lead to temporary or permanent hearing threshold shifts due to the Action. Up to 1 individual FSJ will be killed due to vehicular mortality over the course of the Action. FSJs occur on public conservation lands within 26 counties in Florida, including Brevard County. At least 5 locations in Brevard County currently have occupied FSJ habitat and are outside of the area of adverse effects from the Action (Service 2025). In addition, six other focal landscapes in peninsular Florida ranging from Marion County in north central Florida to Lee and Martin County in southwest and southeast Florida, with potential estimates being 2,883 – 3,197 family groups on public conservation lands. The largest focal landscape encompasses Ocala National Forest and between 1,907 and 1,973 family groups (Service 2025). The status of occupancy on private lands is currently unknown but previous private land estimates were 3,400-3,600 family groups statewide in 2020 (Service 2020b; Service 2025). This provides a potential amount of FSJ family groups between 6,283 – 6,979. The exact number of FSJ range-wide is difficult to determine as a large portion (±52%) could be found on private or non-public conservation lands and are not routinely monitored.

The incidental take through sub-lethal harm of up to 62 family groups (248 individuals) and 1 additional individual killed annually from the Action will not jeopardize the continued existence of the species as this represents ±1% of the total FSJ population range wide.

4. SEA TURTLES

4.1. Status of Green, Hawksbill, Kemp's Ridley, Leatherback, and Loggerhead Sea Turtles

For more information regarding the status of sea turtles species that may be affected by the Action and the factors affecting their conservation status, please refer to proposed and final listing determinations, critical habitat designations, recovery plans, status of the species assessments, and five-year reviews available at: http://ecos.fws.gov/ecos/indexPublic.do.

4.2. Environmental Baseline for Green, Hawksbill, Kemp's Ridley, Leatherback, and Loggerhead Sea Turtles

Environmental baseline refers to the condition of the listed species or its designated critical habitat in the Action Area, without the consequences to the listed species or designated critical habitat 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 section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The impacts to listed species or

designated critical habitat from Federal agency activities or existing Federal agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 C.F.R. § 402.02). This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the green, hawksbill, Kemp's ridley, leatherback and loggerhead sea turtles, their habitat, and ecosystems within the Action Area.

4.2.1. Action Area Numbers, Reproduction, and Distribution of Green, Hawksbill, Kemp's Ridley, Leatherback, and Loggerhead Sea Turtles

Sea turtle nesting beach habitat is located ±0.22 miles from the LC-39A fence line and ±0.31 miles from the closest launch pad. Sea turtle nesting and hatching season can occur in Florida between February 15 – December 31, but exact timing can fluctuate and is different for each sea turtle species. Nest laying within the Action Area is most often seen between March and October, and nest laying attempts outside of this time period are not expected. Incubation ranges from about 45 to 80 days, depending on the species. There are 47.6 miles of federally owned nesting beaches between CANA, CCSFS and KSC. 6.2 miles of beach is within the KSC Security Beach. Sea turtle nesting within the Action Area is highly productive. Over the past 5 years (2019-2024), CCSFS averaged 3,380 loggerhead, 530 green, 1 Kemp's ridley, 11 leatherback and no hawksbill sea turtle nests. No more than 4 nesting female sea turtles (all species) have disoriented in a given year at CCSFS (Angy Chambers Pers. comm. 2025). From 2015-2022, total sea turtle nesting at CANA averaged 8,949 total sea turtle nests with an average of 4,684 loggerhead, 3,827 green, 25 leatherback, 1 Kemp's ridley and no hawksbill. Sea turtle nesting at the KSC Security Beach averaged 1,431 loggerhead, 958 green and 5 leatherback nests over the past 5 years, with no hawksbill or Kemp's ridley nests during that time. Figure 9 below shows the sea turtle nesting activity at KSC from 1983-2023. Over the past 5 years, total sea turtle crawls at KSC averaged 2,874 loggerhead, 1,716 green, 6 leatherback, 0 Kemp's ridley and 0 hawksbill.

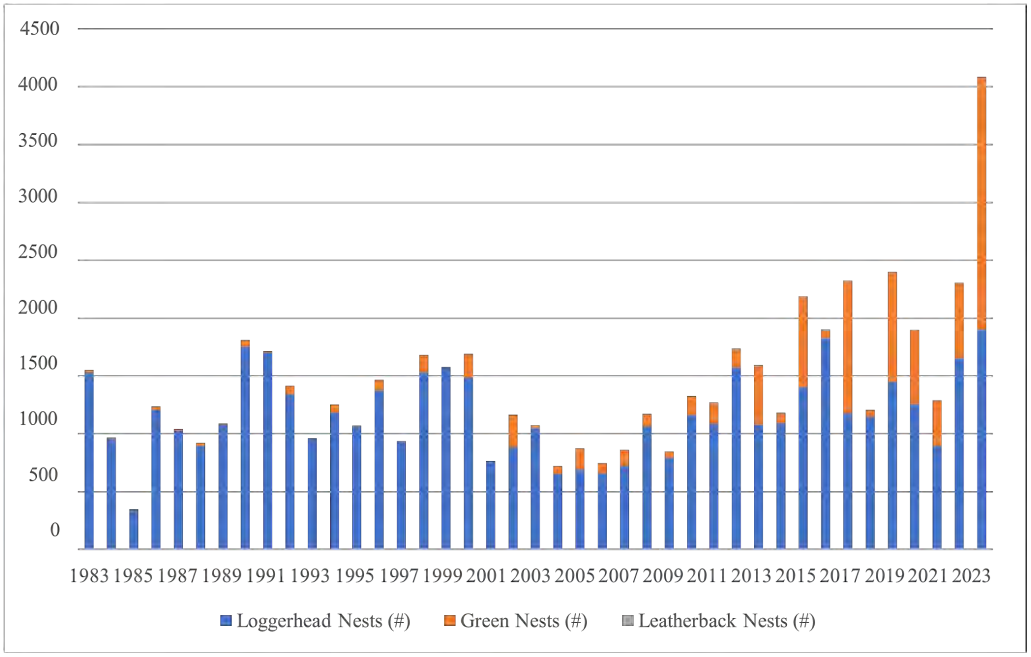


Figure 9: Sea Turtle Nests at KSC Security Beach (1983 to 2023)

4.2.2. Action Area Conservation Needs of Green, Hawksbill, Kemp's Ridley, Leatherback, and Loggerhead Sea Turtles

The entire Florida Space Coast Federal Complex (CCSFS, KSC, MINWR and CANA) provides high quality sea turtle nesting habitat within the Atlantic Coast of Florida. Portions of CCSFS, KSC and CANA have experienced erosion of beach material over the past several decades, impacting turtle nesting habitat. The increase in development on private and federal lands within the Action Area has increased the amount of short wavelength light visible at night on nesting beaches, also impacting sea turtles.

Additional threats to the Action Area include sea level rise, an increase in space operations, native and non-native predation, marine debris on nesting beaches and natural disaster impacts through tropical storms, hurricanes, and storm surge associated with large storm systems.

4.3. Effects of the Action on Green, Hawksbill, Kemp's Ridley, Leatherback, and Loggerhead Sea Turtles

This section analyzes the direct and indirect effects of the Action on sea turtles, which includes all consequences to listed species or critical habitat that are caused by the proposed Action, including the consequences of other activities that are caused by the proposed Action but that are not part of the Action. A consequence is caused by the proposed Action if it would not occur but for the proposed Action and it is reasonably certain to occur. Effects of the Action may occur later in time and may include consequences occurring outside the immediate area involved in the Action. (50 C.F.R. § 402.02). Our analyses are organized according to the description of the Action in section 1 of this BO/CO.

4.3.1. Effects of Construction on Green, Hawksbill, Kemp's Ridley, Leatherback, and Loggerhead Sea Turtles

4.3.1.1. Vegetation Removal

Sea turtles occur within the Action Area but do not occur within the construction area. Construction activities including survey and staking, erosion and sediment controls, clearing and grading, site preparation and use, cleanup and restoration are anticipated to occur during daylight hours, but night-time work will be needed. Construction is expected to take approximately two years to complete. Based on the above, vegetation removal will have no effect on sea turtles.

4.3.1.2. Noise

Noise generated from typical equipment used on construction sites (e.g., front-end loader, generator, concrete mixer) range between approximately 80 to 85 dBA at 50 feet (Knauer and Pedersen 2006). Nesting sea turtles and sea turtle nests occur approximately±0.22 miles from the LC-39A fence line and ±0.31 miles from the launch pad. At this distance, construction noise is estimated to attenuate down to background noise associated with crashing waves on nesting

habitat. Based on the above, noise produced through construction activities is expected to result in a discountable effect on sea turtles.

4.3.1.3. Lighting

Lighting associated with construction at night will be needed for human health and safety standards. Construction is expected to occur for up to two years and is reasonably likely to occur during the sea turtle nesting season during that time period. Dunes and vegetation located between LC-39A and the beach block some of the light, but lighting from multiple tall structures at the sites, as well as other exterior lighting, would reach the beach. SpaceX will work with NASA to update the LC-39A LOM (CM 4 in Section 1.4 of this BO/CO) to minimize adverse impacts from temporary and long-term lighting to federally-listed species and designated critical habitat within the Action Area. Lighting at night already routinely occurs at all portions of the year at LC-39A due to the Falcon 9 and Falcon Heavy program operating at LC-39A and construction lighting is not expected to significantly increase the amount of additional short wavelength lighting over the course of the Action. Visual cues are the primary sea-finding mechanism for hatchling sea turtles (Mrosovsky and Carr 1967, Mrosovsky and Shettleworth 1968, Dickerson and Nelson 1989, Witherington and Bjorndal 1991). When artificial lighting is present on or near the beach, it can misdirect hatchlings once they emerge from their nests and prevent them from reaching the ocean (Philibosian 1976, Mann 1977). In addition, a significant reduction in sea turtle nesting activity has been documented on beaches illuminated with artificial lights (Witherington 1992). Because lighting associated with construction is not expected to exceed current lighting levels, lighting produced through construction activities is anticipated to be insignificant to sea turtles.

4.3.2. Effects of Operations on Green, Hawksbill, Kemp's Ridley, Leatherback, and Loggerhead Sea Turtles

4.3.2.1. Noise

Space operations generate a large amount of sound, mostly during the launch and landing operations. A lesser, but still large amount of sound, is generated during the static fire test phase. The deluge system located at LC-39A will assist in reducing the noise produced during a launch and static fire test events. The amplitude level and temporal frequency of noise associated with space-launch activities may negatively impact listed species occurring near launch complexes at KSC. Current and past launch programs at CCSFS, such as the Atlas, Titan, and Delta launches have not documented wildlife mortality associated with these operations.

Nesting sea turtles, sea turtle nests, and sea turtle hatchlings will fall within the 1 psf and 100 dBA SEL modeled contours of the Action. Tables 4 and 5 detail the amount of sea turtle nesting shoreline and sea turtle critical habitat within the Action Area.

Table 4: Sea Turtle Nesting Beaches and Nesting Critical Habitat Exposed to Greater than 100 dB ASEL from the Proposed Action at LC-39A

Events at LC-39A	Total miles of nesting beaches affected (miles of critical habitat affected)[1]						
	100-110 dB ASEL	110-115 dB ASEL	115-120 dB ASEL	120-130 dB ASEL	130-140 dB ASEL	140-150 dB ASEL	>150 dB ASEL
Starship-Super Heavy launch	21.3 (10.4)	5.3 (2.8)	3.6 (2.1)	4.2 (3.8)	2.3 (2.3)	1.7 (1.7)	0
Starship static fire test	3.8 (3.8)	1 (1)	0.7 (0.7)	1 (1)	0.9 (0.9)	0	0
Super Heavy static fire test	5.2 (4.2)	1.4 (1.4)	1 (1)	1.3 (1.3)	0.9 (0.9)	0.5 (0.5)	0
Super Heavy landing	8.0 (4.4)	2.6 (2.6)	1.7 (1.7)	2.1 (2.1)	1.8 (1.8)	0	0
Starship landing	3.6 (3.6)	1.1 (1.1)	0.9 (0.9)	1.7 (1.7)	0	0	0

[1]Loggerhead sea turtle nesting critical habitat (final) and green sea turtle nesting critical habitat (proposed) cover the same area.

Table 5: **Sea Turtle Nesting Beaches and Nesting Critical Habitat Exposed to Greater than 1 psf Overpressure from the Proposed Action at LC-39A**

Events at LC-39A	Total miles of nesting beaches affected (miles of critical habitat affected)[1]					
	1-2 psf	2-4 psf	4-6 psf	6-10 psf	10-20 psf	>20 psf
Starship-Super Heavy launch	Sonic boom over the Atlantic Ocean does not affect land					
Starship static fire test	No sonic boom					
Super Heavy static fire test						
Super Heavy landing	2.3 (2.2)	12.8 (4.2)	9.7 (3.4)	7.8 (3.4)	6.3 (3.9)	3.5 (3.5)
Starship landing	42.5 (22.3)	0	0	0	0	0

[1]Loggerhead sea turtle nesting critical habitat (final) and green sea turtle nesting critical habitat (proposed) cover the same area.

A study on the effects of noise on sand digging and the emergence activities for green sea turtle hatchlings showed that the number of digging bouts was significantly higher during loud noise exposure (Maeda et al. 2024). Sea turtle hatchlings have also been documented responding to jet noises (Balazas and Ross 1974). It is not currently known if rocket sound and sonic boom overpressures have adverse effects on nesting and hatchling sea turtles (i.e., if these behaviors demonstrate adverse effects). Monitoring of sound and overpressure from these operations is encouraged to further understand potential adverse effects.

Sonic boom overpressures are episodic events and generally will be experienced for SS and SH landings. Though atmospheric and local weather conditions and boost back profiles can increase or decrease a sonic boom overpressure, by converting from psf to decibels, a 1 psf overpressure event is equivalent to a peak sound pressure level of approximately 127 dB (Table 2). It has not been documented that the exposure to sonic booms from launches, landings, static fires have caused adverse effects to nesting sea turtles or hatchlings. Juvenile green sea turtles have hearing on land between 50 and 800 Hz, with maximum sensitivity between 300-400 Hz (Piniak et al. 2016). The majority of acoustic energy during sonic booms occur below 100 Hz. At this time, effects from overpressure on sea turtles are anticipated to be insignificant.

It is not currently known the dB or dBA levels on land that adversely affect sea turtles. A study that exposed green sea turtle nests to different levels of sound in 30-minute increments and showed that the number of digging bouts within nests were significantly higher during loud noise exposure than those nests kept at a control of silence (Madea et al. 2024). On days when operations occur sea turtle nests would be exposed to increased sound levels from operations, potentially for several minutes (SS-SH launch + SH landing + SS landing). There have not been known sound-caused adverse effects on sea turtles from SS-SH operations at Boca Chica and Starbase, Texas. However, a significant portion of sea turtle nests are collected from Texas beaches, while sea turtle nests at CANA, CCSFS and KSC are not collected or removed from the beach. Nevertheless, there have been no known sound-related adverse effects reported or described at CANA, CCSFS or KSC related to any rocket platform. At this time, effects from sound levels on sea turtles are anticipated to be insignificant.

4.3.2.2. Lighting

Sea turtle hatchlings that do not reach the ocean can become prey for ghost crabs, birds and other predators. Female sea turtles that engage in a false crawl can abandon a nesting attempt while digging an egg chamber or abandon the nesting attempt while ascending the beach. Lights associated with space operations on nesting beaches may deter females from coming ashore to nest, misdirect females trying to return to the surf after a nesting event, or misdirect emergent hatchlings from adjacent stretches of beach.

Launch operations will require additional lighting to ensure the protection and safety of SpaceX personnel and hardware. Leading up to a SS-SH launch, spotlighting may illuminate the launch vehicle at LC-39A for several days, likely involving 3 continuous nights of lighting of launch pad. Additional lighting would also be employed during landings, both at LC-39A and in the ocean. Under non-launch conditions, brighter lights would be turned off or reduced. During standard non-launch ground support operations, daily operations would require varying levels of artificial lighting 7 days a week, throughout the year; however, these routine operations do not require engine ignition or bright spotlighting. Lighting associated with night-time launch activities is expected to occur for up to 22 night launches, 44 night static fire tests and up to 66 night landings per year. SH night landings would be associated with a night launch and SS landings could occur during the day or night. Approximately 132 nights per year would need lighting at night for operations due to an average of 3 nights per launch event. Lights needed for operations should only be focused on the vehicle and other essential components to achieve successful and safe operations, but it is likely there will be some light trespassing into areas that would otherwise be dark.

As mentioned in Section 4.3.1.3, there is currently a LOM for the existing operations at LC-39A. It is expected that the current light fixtures, shielding, bulbs and other lighting infrastructure previously installed for operations will remain the same or need minimal updating. The LOM will be updated and approved by NASA and the Service prior to the start of operations. Effects and take associated with lighting and sea turtles handled under the monitoring associated with effects of lighting on sea turtles from the Action will be conducted in addition to the sea turtle monitoring currently in place at KSC for the *2017 Kennedy Space*

Center Master Plan Revision (Lighting Only) BO (Service 2017; 2017 KSC Lighting BO). Additional monitoring for the Action is described in Section 7.4.

Sea turtle nests are marked to track disorientation annually by qualified sea turtle biologists. Monitoring under the 2017 KSC Lighting BO includes a subsample of nests marked based on the FWC Nest Protocol Assessment. Disorientation reporting from KSC 2020-2024 shows that no disorientations occurred during this 5-year period for the entire KSC Security Beach. The KSC Security Beach is approximately 700 feet from the LC-39A fence line and is susceptible to impacts from lighting. All reports during this period confirm an amount of incidental take under the 3% per year as indicated in the 2017 KSC Lighting BO. Multiple disorientation events at CCSFS attributed to lighting from SLC-40 have occurred in the past few years. Though several of these disorientations were in the visual line of sight for LC-39A, it was not confirmed that lighting from LC-39A was the cause of the disorientations. Additional lighting from rocket ignitions during launches, landings, and static fire tests would occur, but this lighting would coincide with operational lighting at LC-39A and be for short durations (15 seconds to <5 minutes). The increases of launches, landings and static fire test operations, along with other support operations at LC-39A are anticipated to result in an increased number of sea turtle disorientations occurring within CANA, CCSFS, and KSC due to the increase in lighting needed to accommodate operations during the sea turtle nesting season.

It is difficult to calculate the amount of incidental take from lighting due to the annual fluctuations in nesting populations; therefore, the Service will use a percentage of total disorientations of hatchlings from sea turtle nests (hereafter referred to as nest disorientations) and nesting females from the effects of lighting associated with the Action, similar to what is found in the 2017 KSC Lighting BO. Based on the anticipated large increase in night operations requiring additional lighting within LC-39A, the Service does not anticipate green and loggerhead sea turtle nest disorientations to exceed more than 3% per year and no more than 3% of green and loggerhead sea turtle nesting females disorientating from lighting directly attributed to SS-SH operations at LC-39A.

A 3% disorientation rate described above would equate to approximately 29 green and 43 loggerhead nests, and 51 green and 86 loggerhead nesting females disoriented annually combined from the KSC Security Beach based on the past 5 years of sea turtle nesting data at KSC. It is not anticipated that disorientations of nesting females or sea turtle nests will occur at CANA due to the distance of the CANA sea turtle nesting beach to LC-39A (~2.75 miles). Due to the extremely low number of occurring nests from certain species in the action area, no more than 1 nesting female and 1 nest are expected to disorient annually from hawksbill, Kemp's ridley or leatherback sea turtle nests as a consequence of lighting directly associated with operations at LC-39A (Stewart and Johnson 2006; Service 1993; Service 2015). In addition, hawksbill sea turtles are highly unlikely to nest within the Action Area, though previous hawksbill nests have been documented north of the Action Area and the potential exists for them to nest in the Action Area.

The incidental take as a consequence of lighting directly attributed to SS-SH operations at LC-39A will be included as incidental take described under the 2017 KSC Lighting BO, whether

direct disorientation events from LC-39A occurs at CANA, the KSC Security Beach, or CCSFS. Incidental take within the Action Area observed through sea turtle monitoring due to lighting effects from the Action must be directly attributable to lighting from LC-39A and cannot be associated with additional sky glow, other launch complexes or facilities outside of the boundaries of LC-39A not associated with SS-SH operations or other activities not associated with the SS-SH operations of LC-39A; such as dredging or operations from Port Canaveral, activities at other launch complexes outside of LC-39A, and other infrastructure lighting causing disorientations.

4.3.2.3. Heat

Sea turtles and their associated habitat do not occur within the area of a potential heat plume. Effects of the production of the heat plume through launching and static test fires on sea turtles is expected to be discountable.

4.3.2.4. Vibration

Vibration from space operations is known to occur, but the effects to nesting sea turtles, sea turtle nests, and hatchlings due to vibration is not well known. There is the potential for vibrations to occur from operations approximately 165 times during sea turtle nesting season (33 SS-SH launches + 33 SH landings + 33 SS landings + 33 SH static fires + 33 SS static fires). The closest sea turtle nesting beach to the Action is approximately ±0.22 miles from the LC-39A fence line and ±0.31 miles from the launch pad. Sea turtles can perceive vibrations and can respond to low-frequency sounds and vibrations. The provided BCA states, "Depending on frequency and duration, vibrations may result in physiological impacts to certain species and could also harm incubating eggs (i.e., cracks, addling)." NASA and SpaceX will implement a monitoring program to evaluate potential vibration effects to sea turtle nests in the vicinity of LC-39A, as found in Section 1.4 of this BO/CO.

Sea turtles can perceive vibrations and can respond to low-frequency sounds and vibrations (Bartol et al. 1999; Clabough et al. 2022;). Vibrations between pig-nosed turtle embryos suggest that embryos could detect and respond to other embryonic vibrations (Doody et al. 2012). It is currently unknown what level of vibration affects sea turtle hatching to a potential level of total or partial nest failure, though large additional vibrations above current vibrations from crashing waves or other naturally occurring vibrations may result in early hatching or increased movement of embryos prior to hatching.

Current and previous launch operations at LC-39A and other launch complexes within Florida have not been documented to cause sea turtle nest failures or lead to early nest hatching or increased incidence of false crawls by nesting females due to vibration, but to the knowledge of the Service, specific analyses and monitoring of these effects have not been conducted. The proposed launch cadence of a rocket platform the size of SS-SH has not previously been experienced at KSC or CCSFS. Specifically, the SS-SH platform will be the largest rocket platform launched or landed within Florida and has the potential to be >2 times more powerful than the Space Launch System launched (Gee et al. 2025). Vibration monitoring of Falcon 9 launches was conducted at Vandenburg Space Force Base and showed vibrational effects to

the substrate up to 10 kilometers (~6.2 miles) from the launch site (farthest distance of monitoring). Vibration monitoring of SS-SH launches was conducted at Boca Chica, Texas, and showed vibrational affects to the substrate from 0.3 miles up to 8 miles from the launch site (farthest distance of monitoring). Data was collected from accelerometers (i.e., ground vibration monitors) placed in the dunes roughly 0.3 miles to the east of the launch pad at depths of 1 foot and 3 feet below ground surface. Acceleration lasted a total of approximately 30 seconds. The peak particle velocity (PPV) of over 1 inch per second had a dominant up and down movement lasting for approximately 15 seconds (SpaceX 2024). PPV is the maximum rate of change of ground displacement with time. This means that the ground moved up and down over one inch per second during the launch and vibrations from the launch lasted approximately 30 seconds. Additional vibration monitoring at Boca Chica, Texas, during SS-SH launches for the historic structures in the area, showed PPV of some structures at >3 inches/second several miles from the launch site but the substrate (open flats) is not appropriately comparable to dune systems (SpaceX 2023). It is expected that vibrations from operations will be a reduction of those measured at Boca Chica, TX due to the deluge system and bifurcated divertor design, though the degree to which reductions in vibrations will occur is unknown at this time as the bifurcated divertor design has not been tested nor has modeling been provided within the BCA. A significant portion of sea turtle nests are collected from Texas beaches, removing the potential to study effects on sea turtle nests on site. There have been no known vibration-related adverse effects to sea turtles (addling, nesting female or hatchling disorientations, nest collapse, etc.) reported or described at CANA, CCSFS or KSC related to any rocket platform.

Based on the current lack of information regarding vibrational effects to sea turtles, the Service anticipates effects to sea turtle nests from vibration to be insignificant and NASA and SpaceX will be implementing a monitoring program to further monitor potential effects from vibration to sea turtles.

4.3.3. Summary of the Effects of the Action on Green, Hawksbill, Kemp's Ridley, Leatherback, and Loggerhead Sea Turtles

As a result of the Action, sea turtles may be exposed to what is largely considered to be high-intensity noise through the activities related to launch operations, including static fire tests, launches and landings of a SS and/or SH. The Service expects no more than 3% of green and loggerhead sea turtle nests and nesting females would experience disorientations as a consequence of lighting directly attributed to operations at LC-39A. This would equate to approximately 24 green and 41 loggerhead nests, and 51 green and 86 loggerhead nesting females disoriented annually. The Service expects no more than 1 nesting female, and 1 nest will be disoriented from each of hawksbill, Kemp's ridley, or leatherback sea turtles as a consequence of lighting directly attributed to operations at LC-39A. Due to uncertainties related to the effects of space launch operations on wildlife, the Service intends to work with NASA using an adaptive approach to monitor incidental take.

4.4. Cumulative Effects on Green, Hawksbill, Kemp's Ridley, Leatherback, and Loggerhead Sea Turtles

For purposes of consultation under ESA §7, cumulative effects are those caused by future state, tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future Federal actions that are unrelated to the proposed Action are not considered, because they require separate consultation under §7 of the ESA.

In its request for consultation, NASA did not describe, and the Service is not aware of additional non-federal actions that must be considered in formulating our opinion for the Action.

4.5. Conclusion for Green, Hawksbill, Kemp's Ridley, Leatherback, and Loggerhead Sea Turtles

"*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 C.F.R. § 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 biological opinion that the Action is not likely to jeopardize the continued existence of the green, hawksbill, Kemp's ridley, leatherback or loggerhead sea turtle.

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

The Service does not anticipate adverse effects from heat or sound from the Action. Lighting and vibration associated with the Action will result in incidental take through disorientations of nesting females and hatchlings and confusion or early excavation by nestlings. The number of loggerhead sea turtle nests in Florida in 2024 was 72,562. KSC averaged 1,431 loggerhead sea turtle nests annually over the past 5 years and 3% incidental take is ±43 nests annually. KSC averaged 2,874 total loggerhead crawls over the past 5 years and 3% incidental take is ±86 nesting females annually. The number of green sea turtle nests in Florida in 2024 was 2,658. KSC averaged 958 green sea turtle nests over the past 5 years and 3% incidental take is ±29 nests annually. KSC averaged 1,274 total green crawls over the past 5 years and 3% incidental take is ±51 nesting females annually. The Service does not have the total amount of crawls annually for green or loggerhead sea turtles, however each female for each species makes multiple nesting attempts per season and the Service anticipates that the number of female nesting disorientations will be minimal to the overall amount within the North Atlantic distinct population segments. The number of leatherback sea turtle nests in Florida in 2024 was 1,960. KSC averaged 25 leatherback sea turtle nests over the past 5 years. One leatherback nest and nesting female taken annually is <.01% of the total amount of leatherback nests laid and nesting attempts in 2024 in Florida. The number of Kemps' ridley sea turtle nests in Florida in 2024 was 9 and 19,440 in Mexico in 2023, the most recent year data was available. KSC averaged 1 Kemp's ridley sea turtle nest over the past 5 years and incidental take of one nest and one nesting female annually is <.01% of the total amount of Kemp's ridley nests laid in the past two years. The number of hawksbill sea turtle nests in Florida in 2024 was 0 and nesting estimates in the Atlantic Ocean can range from 3,626 – 6,108 nests annually. KSC averaged 0 hawksbill sea turtle nests and

nesting females over the past 5 years and the incidental take of 1 nest and 1 nesting female annually is <.01% of the total amount of hawksbill nests historically laid in the Atlantic Ocean. The amount of potential annual take would be <1% of total green, hawksbills, Kemp's ridley, loggerhead and leatherback sea turtle nest and nesting attempts annually within the Atlantic populations for all sea turtle species.

5. SOUTHEASTERN BEACH MOUSE

Within the Action Area, SEBM occur throughout CCSFS and CANA and within the coastal areas of MINWR and KSC. Southeastern beach mice are not known to occur within the fence line of LC-39A. No SEBM habitat is expected be directly removed as a result of the Action.

5.1. Status of Southeastern Beach Mouse

The documents available at the web address below summarize best available data about the biology and current condition of SEBM throughout its range that are relevant to formulating an opinion about the Action. The Service published its decision to list SEBM as threatened on May 12, 1989 (54 FR 20598-20602). For more information regarding the status of southeastern beach mouse and the factors affecting their conservation status, please refer to proposed and final listing determinations, critical habitat designations, recovery plans, species status assessments, and five-year reviews available at: http://ecos.fws.gov/ecos/indexPublic.do.

5.2. Environmental Baseline for Southeastern Beach Mouse

Environmental baseline refers to the condition of the listed species or its designated critical habitat in the Action Area, without the consequences to the listed species or designated critical habitat 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 section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The impacts to listed species or designated critical habitat from Federal agency activities or existing Federal agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 C.F.R. § 402.02). This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of southeastern beach mouse, its habitat, and ecosystem within the Action Area.

5.2.1. Action Area Numbers, Reproduction, and Distribution of Southeastern Beach Mouse

SEBM occur throughout the Action Area and use a variety of landcover types including coastal dune, coastal strand, ruderal and old field-type areas, scrub, and coastal scrub. SEBM are found throughout CCSFS but primarily occur within the coastal ecosystem at CANA, MINWR and KSC. The CCSFS SEBM population is located directly south of KSC and is considered the "core" population for the entire subspecies. Construction will occur completely within the lease

boundary of LC-39A. SEBM has been detected in various areas throughout KSC (Zimmerman et al. 2015, Stolen et al. 2025).

Total SEBM habitat within the Action Area is estimated to be ±15,982 acres, with ±8,674 acres found within the 100 dBA SEL and ±15,982 acres being within the 1 psf overpressure contours from SS and SH landings. Robust density estimates are not currently available for SEBM. There is no SEBM habitat within the area of construction in LC-39A. Small mammal populations can fluctuate seasonally, as well as annually, across landcover type and by relative habitat condition. The Smyrna Dunes Park and CCSFS, KSC, MINWR and CANA are the two existing populations for the species and are currently considered self-sustaining (Service 2019c). However, the range wide SEBM population is assumed to have remained stable since 2008 (Service 2019c). The species currently has the potential to occupy ±80 km of coastline in these two extant populations (Service 2019c).

5.2.2. Action Area Conservation Needs of Southeastern Beach Mouse

The Action Area includes all of CCSFS, CANA and KSC and is composed of various natural vegetative communities, including beach dune, coastal strand, coastal scrub, scrub, hammock, and various areas of open grassland. Many of these communities, including coastal strand, scrub, and coastal scrub require periodic fire to maintain a high-quality condition. These interior, fire dependent landcover types are important for SEBM as inland refugia during storm events (Swilling et al. 1998, Sneckenberger 2001, Stout et al. 2012). To support SEBM, scrub, coastal scrub, and coastal strand should be managed using prescribed fire.

For coastal scrub and scrub communities, the fire return interval is typically between 2-6 years depending on the current state of the scrub. Scrub where fire has been excluded will typically require a shorter fire return interval to restore it to high-quality habitat. NASA is committed to maintaining SEBM habitat on NASA property for the continued use by federally listed species through a multitude of land management activities including, but not limited to prescribed burning, fire break maintenance, and invasive and nuisance species control. This CM can be found in Section 1.4 of this BO/CO.

SEBM are at increased risk to predation and tend to modify their foraging behavior when exposed to artificial lighting (Bird et al. 2004, Falcy and Danielson 2013). Because they are a nocturnal species, SEBM are specifically adapted to forage and avoid predation with reduced lighting. Artificial lighting should be minimized to protect coastal species including SEBM which are vulnerable to impacts related to excessive artificial lighting.

5.3. Effects of the Action on Southeastern Beach Mouse

This section analyzes the effects of the Action on SEBM, which includes all consequences to listed species that are caused by the proposed Action, including the consequences of other activities that are caused by the proposed Action but that are not part of the Action. A consequence is caused by the proposed Action if it would not occur but for the proposed Action and it is reasonably certain to occur. Effects of the Action may occur later in time and may include consequences occurring outside the immediate area involved in the Action. (50 C.F.R. §

402.02). Analyses are organized according to the description of the Action in section 1 of this BO/CO.

5.3.1. Effects of Construction on Southeastern Beach Mouse

5.3.1.1. Vegetation Removal

Construction activities will occur within the fence line of LC-39A for up to two years. No SEBM habitat occurs within LC-39A, but NASA will conduct a biological survey prior to disturbance as found in the Conservation Measures in Section 1.4 of this BO/CO. Earth movement activities will not occur within SEBM habitat. Therefore, the Service anticipates vegetation removal to have no effect on the SEBM.

5.3.1.2. Increased Roadway Traffic

The exact amount of vehicular traffic increase that will occur over the course of the Action due to construction is not currently known but estimates provided are up to ±19,356 trucks annually (53 trucks/day). This is for a 12-hour period for operations occurring over 365 days. Most traffic associated with the Action is expected to occur during daylight hours, when SEBM are not expected to be present. Sound from vehicle traffic associated with construction is expected to be similar to current traffic utilizing current roadways. Increased traffic from construction activities will occur within the LC-39A lease boundary, associated roadways, and the main vehicular arteries within KSC and CCSFS. No known vehicular mortalities or injuries of SEBM have been documented at either property. NASA will continue to coordinate with MINWR staff to develop, install, and maintain wildlife crossing awareness signage on NASA property, with emphasis on rights-of-way for transportation routes associated with the Action. Based on the above, increased vehicular traffic is expected to have an insignificant effect on the SEBM.

5.3.1.3. Noise

Noise from construction activities are anticipated to dissipate to ambient or non-adverse levels when reaching SEBM habitat 0.2-miles from the fence line of LC-39A. Service does not anticipate the species to be present within the fence line of LC-39A; however, if SEBM or their burrows are observed during pre-construction surveys, the Service will be contacted to discuss future steps. Based on the above, noise from construction on SEBM are expected to be discountable.

5.3.1.4. Lighting

Intermittent nighttime lighting associated with construction activities is expected to occur for up to 2 years. The closest SEBM habitat to the LC-39A fence line is approximately 0.2 miles away. Lighting will be focused on essential elements, but there is likely to be additional light trespass into areas that would otherwise be dark. SEBM is an obligatory nocturnal species that has adapted to forage at night and avoid predation and occurs within the Action Area year-round. Previous research indicates SEBM tend to shift their behavior and forage less during times of full moon or when exposed to artificial lighting (Bird et al. 2004, Falcy and Danielson 2013). A

LOM for LC-39A is currently in use to reduce white light to the greatest extent practicable while still providing for human health and safety. White light will only be used for essential activities related to human health and safety. LC-39A is a currently operational facility for the Falcon 9 and Falcon Heavy program and utilizes white lighting for these operations throughout the year. The inclusion of white lighting for construction activities will be exceedingly difficult to parse from the current operational lighting or construction lighting associated within current SS-SH construction previously consulted upon. The addition of white lighting for the construction activities is not anticipated to significantly increase the amount of lighting that may affect SEBM habitat. Therefore, additional lighting from construction will have an insignificant effect on the SEBM.

5.3.2. Effects of Operations on Southeastern Beach Mouse

5.3.2.1. Increased Roadway Traffic

NASA and SpaceX are committed to obeying all traffic regulations, including NASA reductions of posted speed limits, if implemented. The Service is unaware of SEBM vehicle strikes from current activities performed at LC-39A or vehicles associated with current and previous Actions from this area. The species is nocturnal and is not expected to be present during the day, when vehicular traffic is more likely to occur. Vehicular traffic is expected to be found only on maintained roadways and not in SEBM habitat.

Increases in vehicular traffic occur at MINWR and CANA during other launch and landing operations occurring during operational hours for these properties (6 AM – 8 PM during the summer and 6 AM – 6 PM during the winter). The Service anticipates that the SS-SH platform will attract a large influx of visitors to KSC, MINWR and CANA to view the launch and landing portions of the Action as this is a novel vehicle platform not previously seen in the area. Viewing areas at KSC are not in proximity to SEBM habitat, and MINWR and CANA are expected to be accessible only during the daytime when SEBM are not anticipated to be active. The Service has not documented and is not aware of documented injury or mortality to SEBM due to vehicular traffic at MINWR or CANA. Based on the above, effects related to increases in vehicle traffic due to operations from the Action are anticipated to be discountable.

5.3.2.2. Noise

Sound produced by launch activities, including rocket launches and static test fires, can cause impacts to wildlife. Proposed night-time operations include 22 SS-SH launches, 22 SH landings, 22 SS and 22 SH static fires tests; this is when SEBM are expected to be on the surface, outside of their burrows. The sandy substrate and vegetation surrounding the burrows is predicted to reduce the amplitude of sound that mice would be exposed to within burrows.

Previous studies involving small mammals and short duration, high amplitude noise showed a variety of adverse impacts. Studies replicating the effects from the exact frequency, amplitude, duration, and recurrence as expected from SS-SH operations on species considered within this BO are not available. Therefore, the Service used the best available information to draw reasonable conclusions. Rats exposed to 104 dB caused changes in the inferior colliculus, the

section of the brain where much of the processing of auditory information occurs (Szczepaniak and Møller 1996). The excitability of the inferior colliculus is associated with conditions related to tinnitus which can affect the ability to isolate subtle noises (Goble et al. 2009). Hearing is especially important to small mammal predator avoidance strategies, such as employing interaural time and level differences to detect the location of a perceived predator (Grothe and Pecka 2014, Carr and Christensen-Dalsgaard 2015). A similar study exposing rats to 104 dB saw altered responses in place cells within the hippocampus (Goble et al. 2009). Place cells are a subset of neurons that are involved in spatial thought. Additionally, mice suffering from hearing loss as a result of exposure to 123 dB in a laboratory setting showed cognitive impairment in the way of spatial learning and memory (Liu et al. 2016). When rats in a laboratory setting were exposed to 80 to 104 dB SPL over 5 weeks and frequencies ranging from 1-20 kHz, noise-induced hearing loss reached a permanent threshold shift when exposure lasted 18-24 hours (Chen et al. 2014). Mice were found to experience temporary threshold shifts (TTS) when briefly exposed to noises at 146 dB SPL and may recover from threshold shifts over several weeks after exposure (Gratias et al. 2021). However, it is not known how repeated exposure may affect recovery time. At the proposed rate of launch activities, it is expected mice will be exposed to high-amplitude noise levels at least once per week. Given this rate of repeated exposure, it is reasonable to predict that mice will not be able to recover from hearing loss and would likely experience additional deleterious effects.

SS-SH launches will have the loudest sound of all operations, with >150 dBA SEL being experienced in the immediate vicinity of the launch site and decreasing with distance from LC-39A. The Service estimates that SEBM exposed to sounds >140 dBA SEL on a recurring basis, will experience temporary or permanent threshold shifts in hearing. Given there is approximately ±187 acres of potential SEBM habitat exposed to the 140 dBA SEL contour or greater, it can be reasonably certain that 99 – 2,309 SEBM adults may occur within this area and be subjected to harm. SEBM pups are not anticipated to be harmed from the effects of sound as they reside in burrows and are not anticipated to be exposed to the effects of sound during operations. Based on the above, sound from the Action will result in adverse effects to SEBM resulting in sub-lethal harm through temporary or permanent auditory threshold shifts. Temporary and permanent threshold shifts can manifest as a reduction in frequencies the species is able to hear for a short-term period (hours to days) to permanent loss of hearing in certain frequencies. This can lead to a reduction in the species' ability to respond to auditory environmental cues such as calls from other individuals of the species, identification of predators and detection of prey. A reduction in the SEBM's hearing ability temporarily or permanently leads to a reduction in the breeding and feeding ability.

Landing events generate an overpressure event, referred to as a sonic boom, and is measured in psf. The Action Area extends to the 1 psf limits of a sonic boom generated from a landing event. There are no sonic booms generated from static fire tests and sonic booms generated during launches occur over the Atlantic Ocean. Though atmospheric and local weather conditions and boost back profiles can attenuate, or potentially accentuate, a sonic boom overpressure in certain locations, the Service generally regards a 1 psf overpressure event as equivalent to a peak sound pressure level of approximately ~128 dB and ~117 dBA with both metrics increasing with the corresponding psf levels (10 psf = ~148 dB / ~137 dBA; 21 psf = ~154 dB / ~143 dBA). Effects on small mammals through sonic booms have not been widely studied; however, large

overpressure levels would have the potential for SEBM to exhibit adverse effects that may range from startle responses to irreversible physiological damage. A study on mice exposed to high-amplitude (146 dB SPL), short-duration noise, equivalent to a 10 psf sonic boom, resulted in TTS that took weeks to recover (Gratias et al. 2021). Additionally, a lab experiment of exposing chinchillas to multiple, sequential sonic booms with overpressures between 2.2 and 5.5 psf, showed bleeding into the basal turn of the scala tympani of the cochlea (Reinis 1978). Since SEBM have similar auditory systems to chinchillas, the Service anticipates that SEBM exposed to overpressure due to SH landings will have similar adverse effects on SEBM individuals.

Landing operations associated with the Action would not occur in repeated succession as in this study but would occur up to 88 times per year (44 SH + 44 SS). The Service anticipates that overpressure related to SS landings will not reach the level of adverse effects and that only the 44 SH landings will have overpressure to a degree where adverse effects will be experienced by SEBM. SH booster landings would occur within 10 minutes after SS-SH launches, depending on the mission objective. Previous sonic boom monitoring at Boca Chica, TX showed SH booster landings produced sonic booms 1-4 psf greater than previously modeled at 10 km (Gee et al. 2024). Due to the instantaneous nature of sonic booms and the longer temporal scale of 44 SH overpressure events over the course of a year, the Service will use a higher psf contour line to evaluate adverse effects to SEBM than the 5.5 psf shown in the Reinis study above. We will use the 10 psf contour line as it is comparable to the 146 dB levels identified in other studies to cause TTS in mice (Gratias et al. 2021). It is reasonably certain that adverse effects through sub-lethal injury to auditory systems and behavioral changes from sound will occur to SEBM at the launch and landing site and extend out to the 10 psf contour based on the above cited studies. The Service will use the 10 psf contour as the limit of incidental take for sonic boom overpressures. The modeled 10+ psf can extend out to approximately ±4 miles to the south and ±3.75 miles to the north along the coastline.

Given there is approximately ±1,218 acres of potential SEBM habitat exposed to the 10+ psf contour, it can be reasonably certain that 646 – 15,042 SEBM adults may occur within this area and be subjected to sub-lethal harm through temporary or permanent auditory threshold shifts, based on density estimates of 0.53-12.38 mice per acres. SEBM pups are not anticipated to be harmed from the effects of sound as they reside in burrows and are not anticipated to be exposed to the effects during operations. The previously described incidental take from effects associated with operational noise at or above 140 dBA SEL (99 – 2,309 SEBM adults) is anticipated to be nested within the incidental take associated with sonic booms due to that area of effect being encompassed by the 10+ psf contours and these individuals would be exposed to noise and overpressure effects during the described portion of the Action. Auditory threshold shifts can manifest as a reduction in frequencies the species is able to hear for a short-term period (hours to days) to permanent loss of hearing in certain frequencies. This can lead to a reduction in the species' ability to respond to auditory environmental cues such as calls from other individuals of the species, identification of predators and detection of prey. A reduction in the SEBM's hearing ability temporarily or permanently leads to a reduction in the breeding and feeding ability.

5.3.2.3. Prescribed Fire and Land Management

Historically, launch operations, including payload processing, vehicle integration, payload transport, static test fires, wet dress rehearsals, and launching of a rocket, have constrained the abilities of land managers to properly apply prescribed fire needed to maintain habitat of federally listed species at KSC and CCSFS.

Prescribed fire as a land management tool is vital to the persistence of SEBM throughout the interior areas within Action Area. Landward coastal scrub and scrub communities serve as vital inland habitat and refugia for SEBM and this community functions as a fire-dependent system, evolving from lightning-originated wildfires. Implementation of successful prescribed fire is complex and relies on more than a specific number of days available for prescribed fire operations. NASA has recently updated the *Memorandum of Understanding between the Space Launch Delta 45, United States Fish and Wildlife Service, and John F. Kennedy Space Center for Prescribed Burning on Merritt Island National Wildlife Refuge, John F. Kennedy Space Center, and Cape Canaveral Space Force Station, Florida* that establishes and defines a coordinated process through cooperative guidelines that allows the Service to conduct prescribed burns on CCSFS and KSC while protecting personnel, infrastructure, and spaceflight hardware. NASA committed to conducting management activities on NASA property at a level that maintains habitat for continued use by federally listed species. Activities will include, but not be limited to prescribed burning, fire break maintenance and invasive and nuisance species control found in CM 13 found in Section 1.4 in this BO/CO. Based on the above, effects limiting prescribed fire and land management activities are expected to have an insignificant effect on SEBM.

5.3.2.4. Lighting

Launch operations will require additional lighting to ensure the protection and safety of SpaceX personnel and hardware. Leading up to a SS-SH launch, spotlights may illuminate the launch vehicle at LC-39A for several days, likely involving 3 continuous nights of lighting at the launch pad. Additional lighting would also be employed during landings, both at LC-39A and in the ocean. Under non-launch conditions, brighter lights would be turned off or reduced. During standard non-launch ground support operations, daily operations would require varying levels of artificial lighting 7 days a week, throughout the year; however, these routine operations do not require engine ignition or bright spotlighting. Lighting associated with night-time operations is expected to occur a maximum of 22 times per calendar year for SS-SH launches, SH landings and up to 22 additional times per year for SS landings and a combined 44 times per year for SS and SH static fire tests (88 times / year). Landings of SH at LC-39A would be associated with a launch combining those 2 events for a total of 88 discrete events potentially requiring lighting at night. Most facility lighting is expected to be narrow wavelength amber LED with full cutoff shielding to minimize adverse effects to wildlife during sea turtle season. However, white light is routinely needed for launch operations to illuminate the launch vehicle and other essential components. Lighting will be focused on essential elements, but there is likely to be additional light trespass into areas currently experiencing some level of light trespass which would increase the overall light profile of area. Light reaching ground level will be partially blocked by vegetation above the ground, reducing the amount of total light at ground level. Several elements

used for operations of SS-SH at LC-39A will be 400+ feet tall and are expected to have some degree of white lighting associated with them. Previous research indicates SEBM tend to shift their behavior and forage less during times of full moon or when exposed to artificial lighting (Bird et al. 2004, Falcy and Danielson 2013). SEBM pups are anticipated to be within burrows below ground and not experience effects from increased lighting. SpaceX has implemented a LOM for all operations at night during sea turtle nesting season (March 1 – October 31), but this LOM is not currently implemented outside of sea turtle nesting season. Based on the distance to SEBM habitat and anticipated low light trespassing, it is anticipated that while SEBM be exposed to additional lighting, they will still be able to use the areas surrounding LC-39A and lighting will have an insignificant effect on SEBM.

5.3.2.4. Heat

Using information gained from previous SEBM surveys at KSC, CCSFS and other sites throughout the species' range, SEBM are reasonably certain to occur within all available SEBM habitat within the Action Area, including 0.2 miles to the east of the LC-39A fence line. Current modeling for the heat plume diverter proposed within the Action shows that ambient temperatures during launch will be reached at 0.2 miles from the launch mounts and 96 feet from the landing pads during SH landings. All static test fires, launch and landing events would produce a heat plume. The heat plume would funnel through a bifurcated design and be directed mostly vertical, minimizing potential adverse impacts to SEBM. The heat plume is not anticipated to reach the ground-level SEBM habitat. Based on the above, effects of the heat plume on SEBM are expected to be discountable.

5.3.2.5. Vibration

Vibration monitoring of SS-SH launches was conducted at Boca Chica, Texas, and showed vibrational affects to the substrate from 0.3 miles up to 8 miles from the launch site (farthest distance of monitoring). Data were collected from accelerometers (i.e., ground vibration monitors) placed in the dunes roughly 0.3 miles to the east of the launch pad at depths of 1 foot and 3 feet below ground surface. Acceleration lasted a total of approximately 15 seconds. The peak particle velocity (PPV) of up to 1 inch per second had a dominant up and down movement lasting for approximately 15 seconds (SpaceX 2024). PPV is the maximum rate of change of ground displacement with time. This means that the ground moved up and down over one inch per second during the launch and vibrations from the launch lasted approximately 15 seconds. Additional vibration monitoring at Boca Chica, Texas, during SS-SH for the historic structures in the area showed PPV of some structures at >3 inches/second several miles from the launch site but the substrate (primarily poorly drained, fine sand) is not appropriately comparable to the Florida dune systems (SpaceX 2023). It is expected that vibrations from operations will be a reduction of those measured at Boca Chica, TX due to the deluge system and bifurcated divertor design, though the degree to which reductions in vibrations will occur is unknown at this time as the bifurcated divertor design has not been tested nor has modeling been provided within the BCA.

Beach mice are a semi-fossorial mammal that relies on constructing underground burrows within a sandy substrate. SEBM nest chambers are located between 2-3 feet below the surface and

burrow tunnels are roughly several inches wide. There are currently no existing studies related to SEBM burrow collapse; however, previous studies related to seismic exploration and material hauling have found some level of burrow collapse for pygmy rabbits and kangaroo rats when exposed to vibrations (Barneich et al 2004, Wilson 2011). These studies did not collect data in a similar fashion as the vibration data that have been collected for the SS-SH. It is a reasonable expectation that if vibrations are produced near SEBM burrows, it may result in some form of burrow collapse or soil fall-in. The effect of burrow collapse on SEBM may range from a minor energetic cost in rebuilding the burrow to increased exposure to avian predators or suffocation of young altricial mice within the burrow. Additionally, previous research determined that vibration may affect mice from a physiological perspective, especially pregnant mice (Carman et al. 2008, Reynolds et al. 2018). However, it has not been studied how vibrational forces may affect SEBM or their burrows specifically.

The Service expects that SEBM burrows will experience collapse or soil fall-in up to 0.3 miles from the SS-SH launch site within LC-39A as this is consistent with previous SS-SH dune vibration studies at Starbase, TX that showed movement within the dune system east of the launch site of slightly more than 1 inch and the dampening of vibrational effects due to the inclusion of the bifurcated divertor design are currently unknown. It is expected vibration resulting from the Action will affect approximately ±21.02 acres of SEBM habitat. Using data from previous trapping efforts at CCSFS occurring over multiple seasons, years, and vegetative communities, averages of the high- and low-minimum number known alive, a relatively conservative population estimator, we calculated a range of 0.58 - 12.35 mice per acre (Oddy 2001, Stout et al. 2007). Vibration from the Action is expected to kill or wound 36-777 SEBM individuals (12-259 adults, 24-518 pups). This take is an estimate based on current knowledge of SEBM potential densities per acre. Based on the above, vibrational effects from operations will have an adverse effect through harm of burrow collapse on SEBM up to 0.3 miles from the launch pad through injury or mortality.

5.3.3. Summary of the Effects of the Action on Southeastern Beach Mouse

As a result of the Action, SEBM won't be harmed through activities related to construction. SEBM will be exposed to increased lighting associated with operations up to 1-mile from the LC-39A fence line. Approximately 21.02 acres of SEBM habitat will be exposed to vibrations from operations, resulting in the harm of 36-777 SEBM individuals (12 adults + 24 pups up to 259 adults + 518 pups). SEBM will be exposed to what is considered to be sub-lethal short-duration, high-intensity, sound greater than or equal to 140 dBA SEL through the activities related to static fire tests, landings and launches during the night. As a result of this exposure, ±187 acres or 99 – 2,309 individual SEBM adults are expected to be injured through damage to the auditory system due to sound up to 88 times per year due to SS-SH launches. SEBM will also be exposed to short-duration, high-intensity, sonic booms greater than or equal to 10 psf through landings during the night. As a result of this exposure ±1,218 acres and 646 – 15,072 SEBM adults are expected to be injured through auditory threshold shifts due to sound up to 44 times per year. However, the sound and overpressure from operations have great overlap and it is anticipated that the number of individuals exposed to these effects will be duplicative to some degree and not reach the upper bounds of these numbers of incidental take.

5.4. Cumulative Effects on Southeastern Beach Mouse

For purposes of consultation under ESA §7, cumulative effects are those caused by future state, tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future Federal actions that are unrelated to the proposed Action are not considered, because they require separate consultation under §7 of the ESA.

In its request for consultation, NASA did not describe, and the Service is not aware of, any additional non-Federal projects within the Action Area. Thus, the Service does not anticipate additional cumulative effects that must be considered in formulating our opinion for the Action.

5.5. Conclusion for Southeastern Beach Mouse

"*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 C.F.R. § 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 biological opinion 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 SEBM population has remained stable since 2008 (Service 2020d). The Action Area encompasses the majority of currently occupied SEBM habitat (±15,982 acres). This area would be exposed to the effects of operations. The total number of SEBM that may be harmed during operations through the injury to the auditory system is between 745 – 17,351 SEBM individuals (±187 acres of SEBM habitat or 99 – 2,309 SEBM related to static fire tests, launches, landings and ±1,218 acres of SEBM habitat or 646 – 15,042 SEBM related to sonic boom overpressures from landings). Approximately ±187 acres or 99-2,309 SEBM will be exposed to additive effects from exposure to the 140 dBA SEL or greater noise contour and the 10+ psf sonic boom contour and the Service is uncertain how individuals will respond when exposed to overlapping, cumulative stressors. The total number of SEBM that are anticipated to be harmed by entombment or injury during burrow collapse from vibrations is ±21.02 acres of SEBM habitat and between 36-777 SEBM individuals.

The Action will adversely affect ±1,218 acres of SEBM habitat annually through noise associated with launches, landings and static fire tests. Though SEBM is routinely associated with dune systems (frontal dune and scrub dunes), they have also been detected utilizing inland habitats such as coastal strand, oak scrub and ruderal fields (Service 2019e). Though the species might experience high levels of incidental take through the various effects described in the previous sections, it is anticipated that the species will continue to persist across the landscape due to its high productivity and the large areas of contiguous habitat throughout CCSFS, KSC, MINWR and CANA. Habitat within these areas will remain physically unaffected, as the effects of sound will not physically alter or damage the habitat other than the air, and it will continue to be used by SEBM. The effects from sound on SEBM are not anticipated to affect pups within

burrows. The Service does not anticipate reproduction, population numbers, or distribution of SEBM to be reduced to a level preventing the survival and recovery of the species.

6. SEA TURTLES CRITICAL HABITAT

6.1. Status of Proposed Green Sea Turtle Critical Habitat and Designated Loggerhead Sea Turtle Critical Habitat

For more information regarding the status of individual green and loggerhead sea turtle critical habitat (sea turtles) that may be affected by the Action and the factors affecting their conservation status, please refer to proposed and final listing determinations and critical habitat designations at: http://ecos.fws.gov/ecos/indexPublic.do.

6.2. Environmental Baseline for Proposed Green Sea Turtle Critical Habitat and Designated Loggerhead Sea Turtle Critical Habitat

Environmental baseline refers to the condition of the listed species or its designated critical habitat in the Action Area, without the consequences to the listed species or designated critical habitat 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 section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The impacts to listed species or designated critical habitat from Federal agency activities or existing Federal agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 C.F.R. § 402.02). This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the proposed green sea turtle critical habitat and loggerhead critical habitat within the Action Area.

6.2.1. Action Area Numbers and Distribution of Proposed Green Sea Turtle Critical Habitat and Designated Loggerhead Sea Turtle Critical Habitat

The physical and biological feature for proposed green sea turtle critical habitat and the primary constituent element for loggerhead critical habitat (hereafter referred to as a physical and biological feature for continuity with current regulatory definitions) potentially affected by the Action are the amount of sufficient darkness within sea turtle nesting habitat. Green sea turtle proposed critical habitat unit FL-03 and loggerhead critical habitat units LOGG-T-FL-04 and 05 are the units within the Action Area. Both physical and biological features related to sufficient darkness are below.

Green sea turtle proposed critical habitat: “Nesting beach habitat with sufficient darkness such that nesting turtles are not deterred from emerging onto the beach and hatchlings and post-nesting females can orient to the sea” (88 FR 46376).

Loggerhead sea turtle critical habitat: “Suitable nesting beach habitat with sufficient darkness to ensure nesting turtles are not deterred from emerging onto the beach and hatchlings and post-nesting females orient to the sea” (78 FR 18000).

Sea turtle nesting beach is located ±0.22 miles from the LC-39A fence line and ±0.31 miles from the launch pad. Sea turtle nesting and hatching season can occur in Florida between February 15 – December 31, but exact timing can fluctuate and is different for each sea turtle species. Nest laying within the Action Area is most often seen between March and October. Incubation ranges from about 45 to 80 days, depending on the species. There is ±47.6 miles of federally owned nesting beaches between CANA, CCSFS and KSC. No proposed or designate critical habitat occurs within CCSFS as DoD-owned or controlled lands with an integrated natural resources management plan (INRMP) prepared under section 101 of the Sikes Act (16 U.S.C. 670a) and CCSFS currently has an approved INRMP that provides a benefit to the green and loggerhead sea turtles. 6.2 miles of beach is within the KSC Security Beach. Sea turtle nesting within the Action Area is highly productive. From 2015-2022, total sea turtle nesting at CANA averaged 8,949 total sea turtle nests with an average of 4,684 loggerhead and 3,827 green nests. Sea turtle nesting at the KSC Security Beach averaged 1,431 loggerhead and 958 green sea turtle nests over the past 5 years. Figure 10 shows the sea turtle nesting activity at KSC from 1983-2023, taken from the provided biological assessment.

Proposed green sea turtle critical habitat and loggerhead critical habitat is located ±0.22 miles from the closest construction and is ±0.31 and ±0.46 miles from the launch and landing pads, respectively. No proposed or designated critical habitat is within the plume or construction area.

6.2.2. Action Area Conservation Needs of Proposed Green Sea Turtle Critical Habitat and Designated Loggerhead Sea Turtle Critical Habitat

The federal properties affected by the Action provide high quality sea turtle nesting habitat for the Atlantic Coast of Florida. Portions of CCSFS, KSC and CANA have experienced erosion of beach material over the past several decades through violent storm systems and natural erosion. The increase in coastal development on private and federal lands has increased the amount of light spilling onto nesting beaches or observed as “sky glow”.

Additional threats to the Action Area include sea level rise, an increase in space operations apart from the Action and their associated lighting, and natural disaster impacts through tropical storms, hurricanes, and storm surge associated with large storm systems.

6.3. Effects of the Action on Proposed Green Sea Turtle Critical Habitat and Designated Loggerhead Sea Turtle Critical Habitat

This section analyzes the direct and indirect effects of the Action on sea turtle critical habitats, which includes all consequences to listed species or critical habitat that are caused by the proposed Action, including the consequences of other activities that are caused by the proposed Action but that are not part of the Action. A consequence is caused by the proposed Action if it would not occur but for the proposed Action and it is reasonably certain to occur. Effects of the Action may occur later in time and may include consequences occurring outside the immediate

area involved in the Action. (50 C.F.R. § 402.02). Our analyses are organized according to the description of the Action in section 1 of this BO/CO.

6.3.1. Effects of Construction on Proposed Green Sea Turtle Critical Habitat and Designated Loggerhead Sea Turtle Critical Habitat

6.3.1.1. Lighting

Final and proposed sea turtle critical habitat occurs within the Action Area but does not occur within the construction area. Increased roadway traffic from construction and operational activities will not increase risk to sea turtle critical habitat as no construction is proposed on nesting sea turtle beaches and lights from vehicle traffic is expected to be intermittent and blocked from nesting beach habitat by vegetation and natural features. Construction activities including survey and staking, erosion and sediment controls, clearing and grading, site preparation and use, landing zone construction and cleanup and restoration are anticipated to occur during daylight hours, but night-time work will be needed. Construction is expected to take approximately two years to complete.

Lighting associated with construction at night will be needed for human health and safety standards. Construction is expected to occur for up to two years and could occur during the sea turtle nesting season during that time period. Dunes and vegetation located between LC-39A and the beach block some of the light, but lighting from multiple tall structures at the sites, as well as other exterior lighting would reach the beach. SpaceX will work with NASA to update the LC-39A LOM (Conservation Measure 4 in Section 1.4 of this BO/CO) to minimize lighting impacts to the greatest extent possible while still maintaining security and safety. Lighting at night already routinely occurs at all portions of the year at LC-39A due to the Falcon 9 and Falcon Heavy program operating at LC-39A, and construction lighting due directly from the Action is not expected to significantly increase the amount of additional white lighting from construction activities over the course of the Action. Based on the above, lighting produced through construction activities are expected to result in an insignificant effect on proposed green sea turtle critical habitat and designated loggerhead sea turtle critical habitat.

6.3.2. Effects of Operations on Proposed Green Sea Turtle Critical Habitat and Designated Loggerhead Sea Turtle Critical Habitat

6.3.2.1. Noise

Noise is not anticipated to impact the physical and biological features of either species' critical habitat. Therefore, we anticipate there will be no effect to designated or proposed sea turtle critical habitat.

6.3.2.2. Lighting

Visual cues are the primary sea-finding mechanism for hatchling sea turtles (Mrosovsky and Carr 1967, Mrosovsky and Shettleworth 1968, Dickerson and Nelson 1989, Witherington and Bjorndal 1991). When artificial lighting is present on or near the beach, it can misdirect

hatchlings once they emerge from their nests and prevent them from reaching the ocean (Philibosian 1976, Mann 1977). In addition, a significant reduction in sea turtle nesting activity was documented on beaches illuminated with artificial lights (Witherington 1992). Sea turtle hatchlings that do not reach the ocean can become prey for ghost crabs, birds and other predators. Female sea turtles that engage in a false crawl can abandon a nesting attempt while digging an egg chamber or abandon the nesting attempt while ascending the beach. Thus, lights associated with space operations on nesting beaches may deter females from coming ashore to nest, misdirect females trying to return to the surf after a nesting event, or misdirect emergent hatchlings from adjacent stretches of beach.

Launch operations will require additional lighting to ensure the protection and safety of SpaceX personnel and hardware. Leading up to a SS-SH launch, spotlighting may illuminate the launch vehicle at LC-39A for several days, likely involving 3 continuous nights of lighting of launch pad. Additional lighting would also be employed during landings, both at LC-39A and in the ocean. Under non-launch conditions, brighter lights would be turned off or reduced. During standard non-launch ground support operations, daily operations would require varying levels of artificial lighting 7 days a week, throughout the year; however, these routine operations do not require engine ignition or bright spotlighting. Lighting associated with night-time launch activities is expected to occur for up to 22 night launches, 44 night static fire tests, and up to 66 night landings per year. SH night landings would be associated with a night launch and SS landings could occur during the day or night. Lights needed for operations should only be focused on the vehicle and other essential components to achieve successful and safe operations, but it is likely there will be some light trespass into areas that would otherwise be dark. Launches, landings, and static fire tests could occur at night for all operations.

There is currently a LOM for the existing operations at LC-39A. It is expected that the current light fixtures, shielding, bulbs and other lighting infrastructure previously installed for operations will remain the same or need minimal updating. The LOM will be updated and approved by the Service prior to the start of operations. Effects and take associated with lighting and sea turtles were handled under the 2017 KSC Lighting BO (Service 2017). Monitoring associated with effects of lighting on sea turtle critical habitat from the LC-39A Action will be conducted in tandem with the sea turtle monitoring currently in place at KSC for the 2017 Lighting BO (Service 2017).

Disorientation reporting from KSC 2020-2024 show that no disorientations occurred during this 5-year period for the entire KSC Security Beach. Monitoring under this BO/CO includes a subsample of nests are marked based on the Florida Fish and Wildlife Conservation Commission (FWC) Nest Protocol Assessment. Sea turtle nests are marked to track disorientation annually by qualified sea turtle biologists. All reports during this period confirm an amount of incidental take under the 3% per year as indicated in the 2017 KSC Lighting BO/CO. Approximately 132 nights per year would need lighting at night for operations due to an average of 3 nights per launch event. Additional lighting from rocket ignitions during launches, landings, and static fire tests would occur, but this lighting would coincide with operational lighting at LC-39A and be for short durations (12 seconds to <5 minutes). The increases of launches, landings and static fire test operations, along with other support

operations at LC-39A, are anticipated to result in an increased number of sea turtle disorientations occurring within CANA and KSC due to the increase in lighting needed to accommodate operations during the sea turtle nesting season.

It is difficult to determine the exact distance if effects to sea turtle critical habitat. We anticipate that approximately 3.5 miles north and south of LC-39A will experience reduced darkness due to the height of the infrastructure proposed to be constructed in the Action (480 feet tall). Portions of sea turtle critical habitat can have lighting effects reduced by vegetation blocking light from the critical habitat, though the Service cannot predict to what degree that might occur. There have been previous sea turtle disorientations at CCSFS from lighting originating from LC-39A and this is approximately 3.5 miles of sea turtle critical habitat from LC-39A to the boundary of CCSFS. The Service took this measurement (3.5 miles) and applied the same distance north of LC-39A to result in ±7 miles of sea turtle critical habitat. Therefore, We anticipate ±7 miles of sea turtle critical habitat will have effects from lighting and reduced darkness to the extent that nesting turtles and hatchlings will be deterred by the Action. Based on the above, the Service anticipates the Action may affect and will adversely affect ±7 miles or ±42 acres (7 miles * average of 50 feet of nesting beach = ±42 acres) of proposed green sea turtle and designated loggerhead critical habitat as it relates to nesting beach habitat with sufficient darkness such that nesting turtles.

6.3.2.3. Heat

Heat is not anticipated to impact the physical and biological features of either species' critical habitat. Therefore, we anticipate there will be no effect to designated or proposed sea turtle critical habitat.

6.3.2.4. Vibration

Vibration is not anticipated to impact the physical and biological features of either species' critical habitat. Therefore, we anticipate there will be no effect to designated or proposed sea turtle critical habitat.

6.3.3. Summary of the Effects of the Action on Proposed Green Sea Turtle Critical Habitat and Designated Loggerhead Sea Turtle Critical Habitat

As a result of the Action, proposed and final sea turtle critical habitat will be exposed to an increase in lighting. The Service expects a reduction in the amount of critical habitat with sufficient darkness for nesting and hatchling sea turtles deterred from emerging onto the beach and hatchlings and post-nesting females orienting to the sea. The Service anticipates the Action may affect and will adversely affect loggerhead critical habitat and no destruction or adverse modification, with respect to green sea turtle proposed critical habitat.

6.4. Cumulative Effects on Proposed Green Sea Turtle Critical Habitat and Designated Loggerhead Sea Turtle Critical Habitat

For purposes of consultation under ESA §7, cumulative effects are those caused by future state, tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future Federal actions that are unrelated to the proposed Action are not considered, because they require separate consultation under §7 of the ESA.

In its request for consultation, NASA did not describe, and the Service is not aware of additional non-federal actions that must be considered in formulating our opinion for the Action.

6.5. Conclusion for Proposed Green Sea Turtle Critical Habitat and Designated Loggerhead Sea Turtle Critical Habitat

"*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 C.F.R. § 402.02). After reviewing the current status of the proposed and designated critical habitat, the environmental baseline for the Action Area, the effects of the Action and the cumulative effects, it is the Service's biological opinion that the Action is not likely to destroy or adversely modify proposed green sea turtle or loggerhead critical habitat.

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

The Service does not anticipate adverse effects from heat, sound, or vibration from the Action. Lighting associated with the Action will result in an adverse effect to a PBF through additional night lighting on nesting beach critical habitat. Green sea turtle critical habitat has been proposed in acres and not miles like loggerhead designated critical habitat. The amount of potential green sea turtles nesting habitat for affected is ±42 acres out of 8,870 acres proposed and would be <0.1% of the total proposed critical habitat for the green sea turtle and encompass only one of the three PBFs identified for the North Atlantic distinct population segment. The amount of potential loggerhead sea turtle nesting habitat affected is ±7 miles out of 685 miles designated and would be <0.1% of the total designated critical habitat for the Northwest Atlantic Ocean distinct population segment loggerhead sea turtle and encompasses only one of the four PBFs identified.

7. INCIDENTAL TAKE STATEMENT

7.1. Amount or Extent of Take

ESA §9(a)(1) and regulations issued under §4(d) prohibit the take of endangered and threatened fish and wildlife species without 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). In regulations at 50 C.F.R. § 17.3, the Service further defines:

- "harass" as "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal

behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering;"

- "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;" and
- "incidental take" as "any taking otherwise prohibited, if such taking is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity."

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

For the exemption in ESA §7(o)(2) to apply to the Action considered in this BO/CO, NASA 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. NASA has a continuing duty to regulate the activity covered by this ITS. The protective coverage of §7(o)(2) may lapse if NASA fails to:

- assume and implement the terms and conditions; or
- require SpaceX 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, NASA must report the progress of the Action and its impact on the species to the Service as specified in the Incidental Take Statement [50 C.F.R. § 402.14(i)(3)].

7.1.1. Eastern Indigo Snake

The Service anticipates that the Action is reasonably certain to cause incidental take of eastern indigo snakes consistent with the definition of harm resulting from Construction and Operations (see section 2.3.3, Summary of the Effects of the Action on Eastern Indigo Snake).

Anticipated Take of Eastern Indigo Snake

Species	Amount of Incidental Take	Part of Action	Form of Take
Eastern indigo snake	1 individual	Traffic from Construction and Operations	Kill (vehicular mortality)

Instructions for monitoring and reporting take are provided in section 7.4.

7.1.2. Florida Scrub-Jay

The Service anticipates that the Action is reasonably certain to cause incidental take of Florida scrub-jays consistent with the definition of harm resulting from Operations (see section 3.3.3, Summary of the Effects of the Action on Florida Scrub-Jay).

Anticipated Take of Florida Scrub-Jay

Species	Amount of Incidental Take	Part of Action	Form of Take
Florida scrub-jay	1 family group annually (4 individuals)	Sound from Operations (>140dBA SEL)	Harm (temporary auditory threshold shift)
Florida scrub-jay	61 family groups (244 individuals) annually	Sound from Operations (10+ psf)	Harm (temporary auditory threshold shift)
Florida scrub-jay	1 individual annually	Traffic from Construction and Operations	Kill (vehicular mortality)

Instructions for monitoring and reporting take are provided in section 7.4.

7.1.3. Sea Turtles

The Service anticipates that the Action is reasonably certain to cause incidental take of sea turtles consistent with the definition of harm resulting from Lighting (see section 4.3.3, Summary of the Effects of the Action on Sea Turtles).

Anticipated Take of Sea Turtles

Species	Amount of Incidental Take	Part of Action	Form of Take
Green sea turtles	No more than 3% of nests and 3% of nesting females annually will disorient as a consequence of lighting directly attributed to LC-39A SS-SH operations per year.	Lighting from Operations	Harm (disorientation)
Loggerhead sea turtles	No more than 3% of nests and 3% of nesting females annually will disorient as a consequence of lighting directly attributed to LC-39A SS-SH operations per year.	Lighting from Operations	Harm (disorientation)
Hawksbill sea turtles	1 nesting female disorientation and 1 nest disorientation annually as a consequence of lighting directly attributed to LC-39A SS-SH operations per year.	Lighting from Operations	Harm (disorientation)

Species	Amount of Incidental Take	Part of Action	Form of Take
Kemp's ridley sea turtles	1 nesting female disorientation and 1 nest disorientation annually as a consequence of lighting directly attributed to LC-39A SS-SH operations per year.	Lighting from Operations	Harm (disorientation)
Leatherback sea turtles	1 nesting female disorientation and 1 nest disorientation annually as a consequence of lighting directly attributed to LC-39A SS-SH operations per year.	Lighting from Operations	Harm (disorientation)

Instructions for monitoring and reporting take are provided in section 7.4.

7.1.4. Southeastern Beach Mouse

The Service anticipates that the Action is reasonably certain to cause incidental take of southeastern beach mice consistent with the definition of harm resulting from Operations (see section 5.3.3, Summary of the Effects of the Action on Southeastern beach mouse). As described by Federal regulation, "[a] surrogate (e.g., similarly affected species or habitat or ecological conditions) may be used to express the amount or extent of anticipated take, provided that the biological opinion or incidental take statement: describes the causal link between the surrogate and take of the listed species, explains why it is not practical to express the amount or extent of anticipated take or to monitor take-related impacts in terms of individuals of the listed species, and sets a clear standard for determining when the level of anticipated take has been exceeded." (50 C.F.R. § 402.14(i)(1)(i)). Due to the difficulty of determining exact amounts of incidental take for the SEBM because of the wide variation in density estimates, the Service will use a surrogate measure (acres of habitat) to assist in determining the amount of incidental take associated with the Action. Due to the uncertainty and wide range of potential incidental take amounts for the SEBM in Section 5.3.3 of this BO/CO, it is appropriate to use the median amount of anticipated incidental take. Monitoring requirements of incidental take can be found in Monitoring and Reporting Requirements 4, 5, and 6 of this BO/CO.

Anticipated Take of Southeastern Beach Mouse

Species	Amount of Incidental Take	Part of Action	Form of Take
Southeastern beach mouse	±187 acres; ±1,204 adults annually	Noise from Operations (>140 dBA SEL)	Harm (auditory threshold shift)
Southeastern beach mouse	±1,218 acres; ±7,859 adults annually	Noise from Operations (10+ psf)	Harm (auditory threshold shift)
Southeastern beach mouse	±21.02 acres; ±407 individuals annually	Vibrations from Operations	Harm (entombment)

Instructions for monitoring and reporting take are provided in section 7.4.

7.2. Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures (RPMs) are necessary or appropriate to minimize the impact of incidental take caused by the Action on listed wildlife species. RPMs are described for each listed wildlife species in the subsections below.

RPM 1. Conservation, Avoidance and Minimization Measures. NASA will ensure implementation of all conservation, avoidance and minimization measures as identified in Section 1.4 of this BO/CO.

RPM 2. Additional Education. NASA will conduct an education session with the construction and/or environmental point of contact for SpaceX and empower those personnel to educate the rest of their team on all conservation measures within Section 1 of this BO/CO and all relevant items of the Incidental Take Statement of this BO/CO.

RPM 3. Minimize Road Mortalities. NASA and SpaceX will reduce the probability of eastern indigo snake and Florida scrub-jay road mortalities by making staff and contractors aware of the potential presence of these species within the Action Area under federal ownership or management.

RPM 4. Minimize Light Intrusion for Kemp's ridley and Leatherback Sea Turtles. NASA and SpaceX will reduce the amount of light on Kemp's ridley and leatherback sea turtle nests.

7.3. Terms and Conditions

In order for the exemption from the take prohibitions of §9(a)(1) and of regulations issued under §4(d) of the ESA to apply to the Action, NASA must comply with the terms and conditions (T&Cs) of this statement, provided below, which carry out the RPMs described in the previous section. These T&Cs are mandatory. As necessary and appropriate to fulfill this responsibility, NASA must require any permittee, contractor, or grantee to implement these T&Cs through enforceable terms that are added to the permit, contract, or grant document.

T&C 1. Conservation, Avoidance and Minimization Measures (RPM 1). NASA will ensure implementation of all conservation, avoidance, and minimization measures identified in the BCA and reiterated in Section 1.4 of this BO/CO. If a measure is not able to be implemented as described, NASA will coordinate with the Service as soon as practicable to discuss potential alternatives for implementation.

T&C 2. Additional Education (RPM 2). NASA Environmental personnel will educate and train SpaceX points of contact on general wildlife issues, including those related to eastern indigo snake protection measures and all conservation measures within Section 1 of this BO/CO and all relevant items of the Incidental Take Statement of this BO/CO. SpaceX will use this information to educate all on-site staff and contractors. SpaceX will be responsible for educating all new staff and contractors as staff/contract turnover occur. Both SpaceX and NASA are responsible for implementing the most recent *2024 Standard Protection Measures for the Eastern Indigo Snake* (Service 2024a;

USFWS Standard Protection Measures for the Eastern Indigo Snake - May 2024). Appropriate points of contact for NASA Environmental and the Service will be provided prior to the start of the Action and annually, if personnel changes have occurred within SpaceX, NASA or the Service.

T&C 3. Minimize Road Mortalities (RPM 3). NASA and SpaceX will direct all staff and contractors associated with the Action to avoid, to the greatest extent practicable, driving through off-road areas where eastern indigo snakes and Florida scrub-jay could occur within the Action Area under federal ownership or management. All staff will adhere to posted speed limits along all roadways, follow safe driving procedures in low light (early morning, dusk and night-time) or hazardous weather conditions and limit the amount of off-roadway driving (e.g. driving on road shoulders or other unpaved areas) to only that required to accomplish construction or operations, or for safety-related events and activities (e.g., emergency vehicle passing, passing of wide-body loads, vehicle breakdown assistance, etc.).

T&C 4. Minimize Light Intrusion for Kemp's ridley and Leatherback Sea Turtles (RPM 4). All Kemp's ridley or leatherback sea turtle nests located within the KSC Security Beach will have light barriers installed landward of the nest to reduce the potential for disorientation from light generated due to the Action. A qualified biologist from NASA and/or the Service will oversee the installation of any light barriers. This individual will have prior experience with sea turtle monitoring and identification of sea turtle nest clutch center points. If personnel conducting monitoring identify potential issues with lighting barriers being installed, NASA Environmental will discuss with the Service prior to a decision made whether to install a lighting barrier. Kemp's ridley nests light barriers will be installed no earlier than 44 calendar days post the known date the nest was laid, and leatherback nest light barriers will be installed no earlier than 50 calendar days post the known date the nest was laid. Light barriers will be left in place until the nest has fully emerged, until the nest hatches, or until the time of nest inventory.

7.4 Monitoring and Reporting Requirements

In order to monitor the impacts of incidental take, NASA, in coordination with SpaceX, must report the progress of the Action and its impact on the species to the Service as specified in the incidental take statement. (50 C.F.R. § 402.14(i)(4)). This section provides the specific instructions for such monitoring and reporting. If during the course of the action the amount or extent of incidental taking is exceeded, NASA must reinitiate consultation immediately (50 C.F.R. § 402.14(i)(5)).

The Action cannot preclude the ability to complete monitoring related to this Action or related to other activities covered under existing Biological Opinions issued by the Service to NASA or the USSF. This includes, but is not limited to, the NASA Kennedy Space Center Programmatic BO (FWS Log No. 04EF1000-2013-F-0194), KSC Master Plan Revision (FWS Log No: 04EF1000-2016-F-0083), CCSFS Light Management (FWS Log No: 41910-2009-F-0087), Florida scrub-jay monitoring associated with the Skid Strip Modification BO (FWS Log No: 41910-2010-F-

0386) and the Range of the Future Programmatic BO (FWS Log No: 2023-0048779). Any conflicts related to monitoring should be coordinated with NASA Environmental personnel to make reasonable accommodations to complete required monitoring. It is not anticipated that the monitoring below will need additional Section 7 consultation with the Service prior to implementation. All monitoring below is based on the Block 3 version of the SS-SH vehicles and the launch cadence analyzed within this consultation; any future updates, modifications or new designs to the SS or SH vehicles could require additional monitoring. Unless otherwise stated in the individual MRRs below, monitoring and reporting will be compiled into a single report and provided prior to the annual coordination as identified in MRR 1.

The Service recognizes the dynamic nature of the Action Area, which currently hosts a range of space industry initiatives. While future developments in the space sector remain uncertain, the Service has developed the following MRRs to reflect the current landscape of known industry activities. The Service expects these MRRs will be implemented collaboratively by NASA, SpaceX, and other federal agencies with land ownership or management responsibilities in the Action Area. As the Action progresses and new monitoring data becomes available, the MRRs may be updated to ensure continued alignment with evolving conditions and knowledge. Although the timeline for full implementation of the Action described in this BO/CO is not yet defined, the Service does not anticipate monitoring to continue in perpetuity and remains committed to adapting the MRRs as needed to support responsible and reasonable management of the Action Area.

It is not the Service's intent for this BO/CO to result in duplicative monitoring efforts. This Action will leverage existing monitoring to fulfill, or partially fulfill, the monitoring necessary for this Action. If monitoring is currently implemented for purposes that are not connected to this Action, the Service will consider those efforts in potentially satisfying the MRR for this BO/CO. The monitoring can be carried out by any entity as long as the data collected is reliable and satisfies the intent of the MRR as identified below. If a lapse in monitoring or reporting occurs due to unforeseen circumstances or conditions (e.g., lapse in funding, personnel change, natural disaster, etc.), NASA will contact the Service within 7 calendar days to discuss the affected MRR(s) and determine the appropriate course of action for their completion.

MRR 1. Coordination**.** NASA, SpaceX, the FAA, the Service, the NPS and the USSF will meet annually between January 1 and January 31 to determine the current status of the Action and if there are any anticipated changes to the Action. The first meeting will occur in calendar year 2026. This meeting will assist in planning and coordination for any necessary future reinitiations or amendments. This meeting can occur in conjunction with other annual reporting meetings required within separate BOs.

Species monitoring results will be reviewed at this meeting to determine if they are being implemented effectively and if any additional minimization or conservation measures are necessary or monitoring measures can be eliminated or reduced as appropriate . Difficulties and successes in monitoring or the implementation of any RPM, T&C and MRR within this BO/CO will also be discussed. This meeting will provide opportunities to discuss the status of the species, changes to the environmental baseline, any new

information that reveals effects of the Action not considered in this BO/CO, and if consultation must be reinitiated.

A summary of the previous calendar year's launches, landings, and static fire tests will be included. NASA will be responsible for coordination and facilitation of the annual meeting. NASA will provide a review brief, including any relevant maps displaying construction progress and all other monitoring reports unless otherwise stated within their specific MRR to FW4FLESRegs@fws.gov, the MINWR Project Leader and any current Service staff assigned to space industry consultations a minimum of 10 calendar days prior to the meeting for review by the Service. The subject line of the email will be "Starship-Super Heavy Construction and Operations at LC-39A FWS Ecosphere Log Number: 2024-0058364 Annual Coordination 20YY", or a similar subject line. Within 30 calendar days after this meeting, the Service and NASA will exchange written correspondence stating if reinitiating consultation is necessary or not and rationale for the determination.

MRR 2. Florida Scrub-Jay Monitoring**.** FSJ monitoring is currently conducted by NASA at KSC under the NASA Kennedy Space Center Programmatic BO (2013 Kennedy BO; FWS Log No. 04EF1000-2013-F-0194). Monitoring associated with the 2013 Kennedy BO can serve as baseline for FSJ monitoring, which includes changes in distribution and abundance as reasonable surrogates for reproductive, physiological, behavioral, or ecological effects over time. SpaceX will be responsible for additional monitoring efforts, as determined in coordination with NASA, required to successfully implement the established monitoring plan. This will avoid to the greatest degree practicable duplicative efforts by NASA and SpaceX. If the FSJ monitoring identified within the 2013 Kennedy BO ceases, or is modified, at a future date, NASA will contact the Service within 30 calendar days to discuss the need for continued monitoring of FSJ incidental take associated with this Action.

NASA and SpaceX will develop and implement a monitoring plan with the objective of conducting FSJ monitoring where incidental take identified in Section 3 of this BO/CO is expected to be clearly attributed to adverse effects from the Proposed Action. The most effective method of monitoring incidental take identified in the BO/CO is through the observational monitoring of banded individuals. These methods are currently used for this species to monitor changes in distribution and abundance as reasonable surrogates for reproductive, physiological, behavioral, or ecological effects over time. Coordination of monitoring with the USSF is required as a portion of the incidental take occurs within the boundaries of CCSFS.

NASA, in collaboration with SpaceX, will develop the monitoring plan and will coordinate the plan with FAA prior to submission to the Service. NASA will send the monitoring plan to the Service for review within 90 days prior to the first scheduled rocket engine ignition. The monitoring plan shall be implemented by NASA and SpaceX 30 days prior to the first scheduled rocket engine ignition at LC-39A. If NASA and SpaceX choose different dates (30 and 90 days) for the review/approval and implementation of the monitoring plan prior to the first scheduled rocket ignition, NASA

will send written correspondence to the Service identifying the proposed dates, rationale for the timelines chosen, and how the timeline will meet the requirements to monitor incidental take identified within this BO/CO. The Service must approve the new timeline before the changes are implemented.

The monitoring plan will include the following progress points: a minimum of 70% of FSJ individuals within the area where adverse effects to species are expected to occur within the incidental take area as identified in Section 3 of this BO/CO will be banded within 1 year from the issuance of this BO/CO; a minimum of 90% of FSJ individuals within the area where adverse effects to species are expected to occur as identified in Section 3 of this BO/CO will be banded within 3 years from the issuance of this BO/CO to the greatest degree practicable; and a minimum of one breeder from each family group shall be banded. After 3 years, banding will continue to the extent that at least 90% of the population within the area where incidental take will occur as identified in Section 3 of this BO/CO is banded to account for the natural loss of banded FSJ over time. NASA will coordinate with the Service and USSF, as necessary, for any banding that needs to occur within MINWR or CCSFS. All individuals identified to band FSJs will be required to have all necessary permits and authorization through the Department of the Interior and NASA prior to banding beginning.

To monitor incidental take, the monitoring plan should include at least two census periods occurring each year, with one occurring pre-breeding season (approximately February) and one occurring post-breeding season (approximately July). Continual monitoring intervals that gather the same information would be sufficient as well. Monitoring should be focused on FSJ productivity, survival, recruitment, distribution, population density, and habitat use over time. A minimum of one control area (e.g. the Tel 4 area at KSC) will be identified and monitored during the Action. Because of natural annual and seasonal variations in FSJ populations, all metrics should be viewed relative to the control area(s) (i.e., beyond the anticipated spatial extent of adverse effects of launch activities on the species identified in Section 3 of this BO/CO). This is necessary to determine if incidental take identified through monitoring are a result of effects of the Action and account for any perceived effects as a result of natural, seasonal, or otherwise-influenced variations to the population unrelated to the Action.

NASA will provide the Service with an annual report detailing the progress of monitoring within MRR 2. The report will include, at a minimum, the number of individuals, the number of current banded individuals, the current estimated number of family groups, number of current juveniles, challenges faced by NASA for implementing monitoring, a narrative of adverse effects from the Action, productivity of family groups and any other information deemed pertinent by NASA Environmental as related to the Action. NASA will provide the report to FW4FLESRegs@fws.gov, the MINWR Project Leader and any current Service staff assigned to space industry consultations in accordance with MRR 1. The subject line of the email will be “Starship-Super Heavy Construction and Operations at LC-39A FWS Ecosphere Log Number: 2024-0058364 20XX Florida scrub-jay Monitoring Implementation Report”, or a similar subject line. To reduce redundancies,

the report can be combined with FSJ reporting timelines found in previous and future BOs and can be included in the report required for MRR1.

MRR 3. Sea Turtle Monitoring. Sea turtle monitoring is currently conducted by NASA at KSC on the KSC Security Beach under the 2017 NASA KSC Sea Turtle Biological Opinion BO (FWS Log No. 04EF1000-2016-F-0083). Monitoring associated with the 2017 NASA KSC Sea Turtle BO can serve as baseline disorientation monitoring, which includes sea turtle nest marking, and nesting female and hatchling disorientations. SpaceX will be responsible for additional monitoring efforts, as determined in coordination with NASA, required to successfully implement the established monitoring plan. This will avoid to the greatest degree practicable duplicative efforts by NASA and SpaceX. If the sea turtle monitoring identified within the 2017 NASA KSC Sea Turtle BO ceases, or is modified, at a future date, NASA will contact the Service within 30 calendar days to discuss the need for continued monitoring of sea turtle incidental take associated with this Action.

NASA and SpaceX will develop and implement a monitoring plan with the objective of conducting sea turtle monitoring within the KSC Security Beach related to the Action at LC-39A and the effects of lighting and associated sea turtle incidental take described in this BO/CO. Monitoring will be coordinated with the USSF, MINWR and CANA staff to determine the necessary number of personnel needed to conduct monitoring due to the anticipated reduction of access to the KSC Security Beach in the future due to the Action.

NASA, in collaboration with SpaceX, will develop the monitoring plan and will coordinate the plan with FAA prior to submission to the Service. NASA will send the monitoring plan to the Service for review by 90 days prior to the first scheduled rocket engine ignition. The monitoring plan shall be implemented by NASA and SpaceX 30 days prior to the first scheduled rocket engine ignition at LC-39A. If NASA and SpaceX choose different dates (30 and 90 days) for the review/approval and implementation of the monitoring plan prior to the first scheduled rocket ignition, NASA will send written correspondence to the Service identifying the proposed dates, rationale for the timelines chosen, and how the timeline will meet the requirements to monitor incidental take identified within this BO/CO. The Service must approve the new timeline before the changes are implemented.

In addition to standard disorientation monitoring already conducted at KSC under the 2017 NASA KSC Sea Turtle BO, the monitoring plan shall include the following:

- Monitoring will occur from the first observed/reported nest of the calendar year or March 1st, whichever comes first, until the last nest of the nest of the season emerges or October 31st, which ever happens last, for nesting and hatching sea turtle activity.
- Disorientation events and where the light source(s) originated will be reported to NASA Environmental and/or SLD 45 Environmental staff within 24 hours depending on the identified light source.

- A minimum of 8 total light surveys will occur during the sea turtle nesting/hatching season (March – October) with no less than 21 days and no more than 30 days between surveys. At least one survey will occur each month during sea turtle season. Five light surveys are currently conducted to support the 2017 NASA KSC Sea Turtle BO monitoring. An additional 3 light surveys will be needed to satisfy the monitoring required for this Action, for a total of 8 light surveys annually.
- All hatchling disorientations due to lighting directly attributed to the Action will be reported regardless of surveying protocols previously established under the 2017 NASA KSC Sea Turtle BO.
- NASA will work with the Service to determine the appropriate number of nests that should be surveyed annually for green and loggerheads sea turtles prior to the beginning of the calendar year 2026 sea turtle nesting season.
- All hawksbill, Kemp's ridley and leatherback sea turtle nests within the KSC Security Beach will be monitored during sea turtle season by NASA.

NASA will provide the monitoring report to FW4FLESRegs@fws.gov, the MINWR Project Leader and any current Service staff assigned to space industry consultations in accordance with MRR 1. The subject line of the email will be "Starship-Super Heavy Construction and Operations at LC-39A FWS Ecosphere Log Number: 2024-0058364 20XX Sea Turtle Monitoring Implementation Report", or a similar subject line. To reduce redundancies, the report can be combined with sea turtle reporting timelines found in previous and future BOs and can be included in the report required for MRR 1. This report will be discussed during the annual coordination meeting in MRR 1.

MRR 4. Southeastern Beach Mouse Monitoring. NASA and SpaceX will develop and implement a monitoring plan with the objective of conducting monitoring of SEBM to monitor the extent of the effects of the Action on this species. Observational monitoring methods will be used for this species to monitor changes to distribution and abundance as reasonable surrogates for monitoring incidental take as a result of the Action over time. NASA, in collaboration with SpaceX, will develop the monitoring plan and will coordinate the plan with FAA prior to submission to the Service. NASA will send the monitoring plan to the Service for review by 90 days prior to the first scheduled rocket engine ignition. The monitoring plan shall be implemented by NASA and SpaceX 30 days prior to the first scheduled rocket engine ignition at LC-39A. If NASA and SpaceX choose different dates (30 and 90 days) for the review/approval and implementation of the monitoring plan prior to the first scheduled rocket ignition, NASA will send written correspondence to the Service identifying the proposed dates, rationale for the timelines chosen, and how the timeline will meet the requirements to monitor incidental take identified within this BO/CO. The Service must approve the new timeline before the changes are implemented.

The monitoring plan should include the following objectives: determine changes in SEBM habitat use in proximity of launch/landing/static fire test operations including any movement response to launch/landing/static fire test operations, determine spatial extent of variation in survival, determine extent of changes in reproduction, and determine

variation in population densities from effects directly attributable to the Action. Because of natural annual and seasonal variations in SEBM populations, all metrics should be viewed relative to a spatial gradient or control area(s) (i.e., beyond the anticipated spatial extent of adverse effects of launch activities on the species). This is necessary to determine if population and habitat use fluctuations are a result of the Action, or if observed effects are a result of natural, seasonal, or otherwise-influenced variations to the population unrelated to the Action. Control area(s) will be identified through coordination with NASA Environmental, SpaceX, CANA, SLD 45 Environmental and the Service within the monitoring plan for this MRR and might be located outside of NASA lands.

Monitoring techniques can include, but are not limited to, a combination of camera and track tube surveys, live trapping, mark-recapture, and radio telemetry or other movement tracking methods. Camera trap and track tube monitoring are passive methods used to identify species presence or absence from an area. Generally, it is more difficult to determine absence as substantially more effort is needed to support this conclusion. Additionally, information related to the effects to individuals is not feasible using these passive methods alone. Live trapping and mark-recapture requires expertise in small mammal handling and adherence to standard trapping protocols. Radio telemetry and other (e.g., GPS, RFID/PIT) movement-tracking methods require handling of live animals and the fitment of an appropriate collar or insertion of a comparable tracking device. All individuals identified to handle SEBMs will be required to have all necessary permits and authorization through the Department of the Interior and NASA prior to initiation of live-trapping. Radio telemetry or similar methodology should be investigated as a preferred method to reduce additional stress related to handling from repeated intensive mark-recapture and live trapping methods.

NASA will provide the monitoring report to the Service annually and include, at a minimum, the number of monitoring locations, a figure showing the monitoring locations within the Action Area, the monitoring techniques employed during the previous calendar year, the dates and times of launches, landings and static fire tests that coincided with monitoring, a summarization of the monitoring findings related to the effects of the Action and monitoring of incidental take within this BO/CO, difficulties in implementing monitoring and a discussion of the Action operations related to small mammals. The report will be provided to FW4FLESRegs@fws.gov, the MINWR Project Leader and any current Service staff assigned to space industry consultations in accordance with MRR 1 at least 10 days prior to the coordination meeting identified in MRR 1. The subject line of the email will be “Starship-Super Heavy Construction and Operations at LC-39A FWS Ecosphere Log Number: 2024-0058364 20XX Southeastern beach mouse Monitoring Implementation Report”, or a similar subject line. To reduce redundancies, the report can be combined with SEBM reporting timelines found in previous and future BOs and can be included in the report required for MRR1. This report will be discussed during the annual coordination meeting in MRR 1.

MRR 5. Noise Monitoring**.** NASA and SpaceX will develop and implement a monitoring plan with the objective of monitoring noise occurring from SS-SH launches, static fire tests, and landings at LC-39A to correlate actual noise levels with species effects and ensure

minimal deviations from what was presented during the consultation process and analyzed within this BO/CO. This information is necessary to confirm whether the amount of incidental take identified within this BO/CO is exceeded. NASA, in collaboration with SpaceX, will develop the monitoring plan and will coordinate the plan with FAA prior to submission to the Service. NASA will send the monitoring plan to the Service for review by 90 days prior to the first scheduled rocket engine ignition. The monitoring plan shall be implemented by NASA and SpaceX on the day of the first scheduled rocket engine ignition at LC-39A. If NASA and SpaceX choose a different timeline for the review/approval and implementation of the monitoring plan, NASA will send written correspondence to the Service identifying the proposed dates, rationale for the timelines chosen, and how the timeline will meet the requirements to monitor incidental take identified within this BO/CO. The Service must approve the new timeline before the changes are implemented.

The monitoring plan shall be implemented by NASA and SpaceX beginning with the first scheduled engine ignition (SS or SH) at LC-39A. A minimum of 3 monitoring events for SS static fire tests, SH static fire tests, SS-SH launches, SH landings and SS landings (15 total) to account for factors that affect sound contours (e.g., weather, trajectory, etc.). Areas monitored will be identified within the monitoring plan and are expected to fall within the area where incidental take will occur as identified in Section 3 and 5 of this BO/CO. If NASA, FAA, and SpaceX choose different monitoring locations or amounts for this MRR, NASA will send written correspondence to the Service identifying the different locations and/or amounts, the rationale for the changes, and how the changes meet requirements to monitor incidental take identified within this BO/CO. The Service must approve the changes before the changes are implemented. Coordination with the USSF may be required if monitor placement is anticipated outside NASA-owned boundaries.

The monitoring plan should include metrics for noise monitoring such as unweighted and A-weighted values presented as Lmax, SEL and psf scales. Monitoring results and completion of this MRR will be discussed during the annual coordination meeting in MRR 1. NASA will provide the monitoring report to FW4FLESRegs@fws.gov, the MINWR Project Leader and any current Service staff assigned to space industry consultations in accordance with MRR 1, at least 10 days prior to the coordination meeting identified in MRR 1. The subject line of the email will be “Starship-Super Heavy Construction and Operations at LC-39A FWS Ecosphere Log Number: 2024-0058364 20XX Sound Monitoring Implementation Report”, or a similar subject line.

MMR 6. Vibration Monitoring. NASA and SpaceX shall develop and implement a monitoring plan with the objective of monitoring vibration as it relates to operations from the SS-SH program. Vibration monitoring will record vibration from launch. Data should be collected in a manner that can be easily translated or explained as to the effects to SEBM burrow collapse associated with incidental take. Monitoring will proceed only until sufficient data is collected to ensure that incidental take is not exceeded due to vibration. The monitoring plan shall be implemented by NASA and SpaceX beginning with the first scheduled rocket (SS or SH) engine ignition at LC-39A.

The monitoring plan shall satisfy the intent of monitoring indicated above and could include:

- Vibration data loggers placed at 0.3 miles. This distance will be measured from the launch tower of LC-39A. If a different monitoring distance is chosen by NASA Environmental or SpaceX, coordination with the Service is required prior to implementing monitoring.

- Vibration data logger sensors placed at a minimum depth of 15 inches to mimic a SEBM burrow.
    a. If NASA determines data loggers are not the appropriate method of monitoring incidental take for this MRR, NASA will send written correspondence to the Service describing an alternative monitoring method and how the alternative method meets the requirements to monitor incidental take identified within this BO/CO. The Service must approve the alternative method before the change is implemented.

- Vibration monitoring occurring for a minimum of 3 separate SS-SH launches.
    a. If NASA and SpaceX choose to implement more or less than 3 monitoring events, NASA will send written correspondence to the Service describing the rationale for the amount of monitoring events chosen and how the change will meet requirements to monitor incidental take identified within this BO/CO.

NASA, in collaboration with SpaceX, will develop the monitoring plan and will coordinate the plan with FAA prior to submission to the Service. NASA will send the monitoring plan to the Service for review by 90 days prior to the first scheduled rocket engine ignition. The monitoring plan shall be implemented by NASA and SpaceX on the first scheduled rocket engine ignition at LC-39A. If NASA and SpaceX choose different dates for the review/approval and implementation of the monitoring plan, NASA will send written correspondence to the Service identifying the proposed dates, rationale for the timelines chosen, and how the timeline will meet the requirements to monitor incidental take identified within this BO/CO. The Service must approve the new timeline before the changes are implemented.

NASA will provide the monitoring report to FW4FLESRegs@fws.gov, the MINWR Project Leader and any current Service staff assigned to space industry consultations in accordance with MRR 1 at least 10 days prior to the annual coordination meeting identified in MRR 1. The subject line of the email will be “Starship-Super Heavy Construction and Operations at LC-39A FWS Ecosphere Log Number: 2024-0058364 20XX Vibration Monitoring Implementation Report”, or a similar subject line.

MRR 7. Disposition of Dead or Injured Species**.** Upon locating a dead, injured, or sick threatened or endangered species, notification must be made to the Service by email to FW4FLESRegs@fws.gov within 24 hours. The subject line of the email will be “Starship-Super Heavy Construction and Operations at LC-39A FWS Ecosphere Log Number: 2024-0058364 Disposition of Dead or Injured Listed Species”, or a similar

subject line. A description of how the individual(s) was found should be provided at this time, including if a SpaceX employee, associated contractor or Federal employee was involved in the incident. This will assist in the proper tracking of incidental take associated with the Action.

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 (defined as construction areas, areas within the LC-39A lease boundary or along roadways), 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 Service or Florida Fish and Wildlife Conservation Commission Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

8. 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. The Service offers the following recommendations that are relevant to the listed species addressed in this BO/CO and that we believe are consistent with the authorities of NASA.

1. The Service recommends NASA and SpaceX develop and implement potential solutions to further reduce the use of white light necessary for launch, landing and static fire test activities and other required uses. NASA should determine if other technologies (e.g., infrared, thermal, etc.) could be implemented to obtain the information currently gathered by using white light to illuminate hazardous areas, including the launch vehicle. The Service recommends NASA and SpaceX work with other Federal agencies, including the FAA to evaluate procedures when white light is required for human health and safety and if these procedures can be accomplished without white light.

2. The Service recommends NASA and SpaceX work with the private space industry and the lighting and construction industry to develop temporary construction light carts that can use narrow-wavelength amber LEDS and shielding to minimize effects to sea turtles and other nocturnal species (e.g., SEBM and bats).

3. The Service recommends NASA and SpaceX evaluate the potential costs and logistics of implementing a sea turtle nest movement program within the boundaries of NASA, CANA, MINWR and CCSFS.

4. The Service recommends participation from NASA, NPS, the USSF and the Service in the future Space Projects Science Fund, facilitated through the Fish and Wildlife

Foundation of Florida, which leverages funds from public and private partners with the objective of better understanding the potential impacts to listed species and their habitats related to space industry activities.

5. The Service recommends NASA and SpaceX review remote sensing data throughout the Action Area to identify potential unknown effects to vegetation from launches and landings.

6. The Service recommends NASA work with the Service, other federal agencies and the commercial space industry to develop a holistic and comprehensive adaptive management and monitoring framework as it relates to effects from space operations, within and outside of NASA boundaries.

7. The Service recommends NASA work with the Service to investigate the feasibility of a supplemental feeding program for FSJ within the boundaries of KSC and MINWR to further enhance productivity within the focal landscape.

8. The Service recommends NASA work with other Federal agencies to investigate the feasibility and need for a research experiment on the effects of acoustic energy on avian species eggs.

9. The Service recommends NASA, the USSF, the NPS, the Service, the FAA and representatives from the private space industry form a working group to address current and on-going natural resources challenges within KSC and CCSFS, and the surrounding properties. The working group should meet regularly and prioritize discussions related to current and future natural resource challenges.

10. The Service recommends NASA conduct monitoring of light from the Action on green and loggerhead sea turtle proposed and designated critical habitat. A baseline lighting survey would be conducted prior to the start of construction and operations within the Action from the KSC Security Beach and CANA Playalinda Beach. Coordination with the NPS is recommended as CANA is currently managed by the NPS. Monitoring under this conservation recommendation is not required at USSF-owned nesting beaches as proposed and designated critical habitat has not been identified at CCSFS. Lighting surveys would be conducted at the same time as light surveys identified in MMR 4, if possible. Monitoring would be coordinated with NASA Environmental, the USSF, MINWR and CANA staff to determine the necessary number of personnel needed to conduct monitoring. Monitoring after the baseline lighting survey will begin in calendar year 2026 prior to the beginning of sea turtle nesting. Reporting of results should include a discussion of any increase in lighting associated with the Action from the baseline established prior to construction commencing. Results should be shared annually at the annual coordination meeting in accordance with MRR 1.

11. The Service recommends that NASA annually report all land and habitat management activities within the NASA portions of the Action Area throughout the length of the Action. This should include, but not be limited to, prescribed burning, fire break

maintenance or creation, mechanical habitat management and invasive and nuisance species control. Reporting should begin for calendar year 2026. This should be discussed during the annual coordination meeting in MRR 1.

12. The Service recommends that NASA coordinate vegetation monitoring within the Action Area with the NPS and the Service throughout the length of the Action to ensure that NASA and MINWR effectively continue to conduct management activities on NASA property at a level that maintains habitat for continued use by federally listed species as identified in Section 1.4 of this BO/CO and included in the Action. Monitoring should include vegetation parameters needed for the continued habitat management including but not limited to vegetation height, vegetation species composition and amount of open sand. Species subject matter experts at NASA should be engaged to assist in determining the appropriate vegetation monitoring to implement. Monitoring should begin no later than February 1, 2026. Monitoring results should be discussed during the annual coordination meeting in MRR 1.

13. The Service recommends NASA and SpaceX conduct monitoring of the heat plume as it relates to operations from the SS-SH program. This is to ensure that the predicted modeling of the untested bifurcated divertor system is confirmed through real-world data collection and to collect information for future 7(a)(2) consultations related to the SS-SH platform. Monitoring should begin with the first operation involving ignited engines of SS or SH at LC-39A. Monitoring would be expected to proceed only until sufficient data is collected to accurately understand the extent of heat. Monitoring results should be discussed during the annual coordination meeting in MRR 1. Monitoring should include, but is not limited to:

    - Heat data loggers located at (1) the LC-39A fence line, (2) 0.1 miles from the launch mount and landing tower, (3) 0.2 miles from the launch mount and landing tower and (4) 0.3 miles from the launch mount and landing tower.
    - If heat measured at the 0.3-mile data logger is not equal to the ambient temperature of the surrounding area prior to launch, further discussion with the Service should occur to determine locations at increased distances until the heat from launches and landings is determined.
    - Heat data loggers should be placed in natural habitat where federally listed species could occur. Areas such as roads, concrete pads and other infrastructure not representative of natural habitat will be avoided.
    - Heat plume monitoring should occur during a minimum of 3 separate SS-SH static fire test, launch and landing events, with the landing events occurring at LC-39A. This would equate to a total of 15 discrete events to be monitored (3 SS static fire tests, 3 SH static fire tests, 3 SS-SH launches, 3 SH landings and 3 SS landings).
    - Heat data logger sensors should be placed at ground level, 6 feet above ground level and 10 feet above ground level to mimic the approximate locations of where federally listed species could occur.

14. The Service recommends NASA and SpaceX implement lighting measures year-round intended to reduce adverse effects to federally-listed species. Where lighting is not

essential for construction or operation of the Action or for human safety, SpaceX should not use lighting. If lighting is essential for construction or operation of the Action or for human safety, SpaceX should make all efforts to not utilize short wavelength lighting and to utilize sea turtle-friendly lighting. SpaceX should install timers, motion sensors, and dimming where possible to further reduce artificial lighting when not required. SpaceX should use shielding on light fixtures and treatments on windows to minimize light trespass into areas outside of the LC-39A lease boundary. Further information on sea turtle lighting can be found at the following links (FWC Sea Turtle Lighting Guidelines; Certified Wildlife Lighting | FWC). NASA should provide an updated LC-39A LOM incorporating the additional launch cadence, new facilities and SS-SH operations to the Service for review and approval prior to the beginning of construction or SS-SH operations at LC-39A covered under this BO/CO. The Service will complete a full review of the LOM within 30 days of receiving the updated LOM post-issuance of this BO/CO.

9. REINITIATION NOTICE

This concludes formal consultation on the Action(s) outlined in the consultation request. As written in 50 C.F.R. § 402.16, reinitiation of consultation is required and shall be requested by the Federal agency, where discretionary Federal involvement or control over the Action has been retained or is authorized by law and if:

(1) If the amount or extent of taking specified in the incidental take statement is exceeded;
(2) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered;
(3) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion or written concurrence; or
(4) If a new species is listed or critical habitat designated that may be affected by the identified action.

Thank you for your cooperation and effort in protecting federally listed species, critical habitat and fish and wildlife resources.

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