Federal Aviation Administration

Final Tiered Environmental Assessment for SpaceX Starship/Super Heavy Vehicle Increased Cadence at the SpaceX Boca Chica Launch Site in Cameron County, Texas

April 2025

Final Tiered Environmental Assessment for SpaceX Starship/Super Heavy Vehicle Increased Cadence at the SpaceX Boca Chica Launch Site in Cameron County, Texas

AGENCIES: Federal Aviation Administration (FAA), lead federal agency; the National Park Service (NPS), U.S. Fish and Wildlife Service (USFWS), the U.S. Coast Guard (USCG), and the National Aeronautics and Space Administration (NASA), cooperating agencies.

This final tiered Environmental Assessment (EA) was prepared in accordance with FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures* (July 16, 2015), to meet the agency's obligations under Section 102(2)(C) of the National Environmental Policy Act of 1969 (NEPA), § § 4321-4336, as Amended through P.L. 118–5 (June 3, 2023); Section 4(f) of the Department of Transportation Act (49 U.S.C. § 303); Section 106 of the National Historic Preservation Act (16 U.S.C. § 470); and, Executive Order 11988, *Floodplain Management*; DOT Order 5650.2, *Floodplain Management and Protection.*.

DEPARTMENT OF TRANSPORTATION, FEDERAL AVIATION ADMINISTRATION: The FAA is evaluating SpaceX's proposal to increase the cadence of the Starship/Super Heavy launch program at the Boca Chica vertical launch area (VLA) in Cameron County, Texas. SpaceX must obtain a new license or modification of their existing vehicle operator license from the FAA to operate Starship/Super Heavy at an increased cadence. Issuing a permit or license is considered a major federal action subject to environmental review under NEPA. This tiered EA evaluates the potential environmental impacts of activities associated with the federal action of modifying SpaceX's vehicle operator license (see Section 2.2 for a more detailed description). The completion of the environmental review process does not guarantee that the FAA will issue a license modification to SpaceX for the Proposed Action. SpaceX's license application must also meet FAA safety, risk, and financial responsibility requirements per 14 CFR Chapter III. The FAA's Federal Action also includes the FAA's issuance of temporary airspace closures.

PUBLIC REVIEW PROCESS: In accordance with the applicable requirements, the FAA initiated a public review and comment period for the revised draft tiered EA. The 58-day public comment period began on November 20, 2024 and ended on January 17, 2025.

CONTACT INFORMATION: Questions regarding the tiered EA can be addressed to Ms. Amy Hanson, Environmental Protection Specialist, Federal Aviation Administration, 1902 Reston Metro Plaza, Reston, VA 20190; project email address SpaceXBocaChica@icf.com.

This tiered EA becomes a federal document when evaluated, signed, and dated by the responsible FAA Official.

Responsible FAA Official:

DANIEL P MURRAY Digitally signed by DANIEL P MURRAY
Date: 2025.04.24 13:53:28 -04'00'
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Dan Murray
Executive Director, Office of Operational Safety

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ACRONYMS AND ABBREVIATIONS

AHAs	Aircraft Hazard Areas
APE	Area of Potential Effects
BCO	Biological Conference Opinion
BMP	Best Management Practice
CDNL	C-weighted Day-Night Average Noise Level
CFR	Code of Federal Regulations
CO	Carbon Monoxide
CO2e	Carbon Dioxide Equivalent
dB	Decibels
DNL	Day-Night Average Sound Level
DOD	Department of Defense
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
F	Fahrenheit
FAA	Federal Aviation Administration
FONSI	Finding of No Significant Impact
GHG	Greenhouse Gas
KSC	Kennedy Space Center
L_{aMax}	Maximum A-Weighted Noise Level
LNG	Liquified Natural Gas
LOC	Letter of Concurrence
LOX	Liquid Oxygen
LRGV NWR	Lower Rio Grande Valley National Wildlife Refuge
MGD	Million Gallons Per Day
MMPA	Marine Mammal Protection Act
MT	Metric Tons
NAQS	National Ambient Air Quality Standards
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NHL	National Historic Landmark
NMFS	National Marine Fisheries Service
NOTAM	Notice to Airmen
NOTMAR	Notice to Mariners
NOx	Oxides of Nitrogen
NPS	National Park Service
OSHA	Occupational Health and Safety Administration
PA	Programmatic Agreement
PEA	Programmatic Environmental Assessment
psf	Pounds Per Square Foot
psi	Pounds Per Square Inch
ROD	Record of Decision
SEL	Sound Exposure Level
SH4	State Highway 4
SHA	Ship Hazard Area
SpaceX	Space Exploration Technologies Corporation
SWCA	SWCA Environmental Consultants
SWPPP	Stormwater Pollution Prevention Plan
TCEQ	Texas Council on Environmental Quality
TCMP	Texas Coastal Management Plan
TGLO	Texas General Land Office
THC	Texas Historical Commission
TPDES	Texas Pollutant Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
TXDOT	Texas Department of Transportation
U.S.C.	United States Code
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
UTRGV	University of Texas Rio Grande Valley
VLA	Vertical Launch Area
VSFB	Vandenberg Space Force Base
WR	Written Re-Evaluation

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1. INTRODUCTION

The Federal Aviation Administration (FAA) is evaluating Space Exploration Technologies Corporation's (SpaceX) proposal to increase the launch and landing cadence of the Starship/Super Heavy launch vehicle at its existing Boca Chica Launch Site in Cameron County, Texas. SpaceX must obtain a new license or a license modification from the FAA in order to launch and land Starship and Super Heavy, and to use associated launch systems at a higher cadence than analyzed in the 2022 *Final Programmatic Environmental Assessment* (PEA) *for the SpaceX Starship/Super Heavy Launch Vehicle Program at the SpaceX Boca Chica Launch Site in Cameron County, Texas* (2022 PEA; FAA 2022). The FAA considers the issuance or modification of a license to be a major federal action in accordance with FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures* (July 16, 2015), to meet the agency's obligations under Section 102(2)(C) of the National Environmental Policy Act of 1969 (NEPA), §§ 4321-4336, as amended through P.L. 118–5 (June 3, 2023),[1] and requires an environmental review.

The FAA is the lead federal agency for this Environmental Assessment (EA), which is tiered from the 2022 Final Programmatic Environmental Assessment for the SpaceX Starship/Super Heavy Launch Vehicle Program at the SpaceX Boca Chica Launch Site in Cameron County, Texas (FAA 2022). This tiered EA evaluates the potential environmental impacts of activities associated with the federal action of modifying SpaceX's vehicle operator license (see Section 2.2 for a more detailed description). The completion of the environmental review process does not guarantee that the FAA will issue a license modification to SpaceX for the Proposed Action. SpaceX's license application must also meet FAA safety, risk, and financial responsibility requirements per 14 CFR Chapter III, Parts 400–460.

The affected environment and environmental impacts of Starship/Super Heavy operations at the Boca Chica Launch Site were analyzed in the 2022 PEA. The FAA issued a Mitigated Finding of No Significant Impact (FONSI) and Record of Decision (ROD) based on the 2022 PEA on June 13, 2022. Subsequent to that decision, the FAA issued a Written Re-evaluation (WR) in April 2023 that evaluated additional information concerning SpaceX's Starship/Super Heavy ocean landings and launch pad detonation suppression system (FAA 2023a). In November 2023, the FAA issued a WR that evaluated additional information about the operation of the deluge system, the addition of a forward heat shield to the Starship/Super Heavy vehicle, and the expansion of the area of potential effects for cultural resources (November 2023 WR; FAA 2023b). In March of 2024, the FAA issued a FONSI based on an EA tiered from the PEA evaluating the potential environmental impacts of the Starship's proposed landings in the Indian Ocean (FAA 2024a). In October 2024, the FAA issued a WR that evaluated updates to the Forward Heat Shield Interstage Landing Area, Sonic Boom Coverage, Use of the Deluge System During Return to Launch Site Landings, and use of US Coast Guard Safety Zones (FAA 2024c).

The proposed launch operations analyzed in the 2022 PEA consisted of launch and landing activities: up to five annual Starship launches, up to five annual Super Heavy launches (with Starship attached as the second stage of the launch vehicle), up to ten annual Starship landings, and up to five annual Super Heavy landings.

[1] On January 20, 2025, President Trump issued Executive Order (EO) No. 14154, *Unleashing American Energy*, which revoked EO 11991, *Relating to Protection and Enhancement of Environmental Quality* (May 24, 1977), and instructed the Chair of the CEQ to rescind its NEPA-implementing regulations. On February 25, 2025, the CEQ issued an interim final rule to remove the existing implementing regulations for NEPA (90 Fed. Reg. 10610 (Feb. 25, 2025), effective April 11, 2025. The Draft Tiered EA was prepared in accordance with CEQ's National Environmental Policy Act Implementing Regulations Revision Phase 2, 89 Fed. Reg. 35442(May 1, 2024) (Phase 2 final rule).

SpaceX is proposing to modify the Starship/Super Heavy operations described in the 2022 PEA as detailed below.

1.1. Background

The FAA issued the 2022 PEA, which analyzed the potential environmental impacts of constructing launch-related infrastructure and operating the Starship/Super Heavy launch vehicle at the Boca Chica Launch Site. SpaceX's operations include launches originating from this site, as well as landings at this site, in the Gulf of America, in the Pacific Ocean, or in the Indian Ocean. The 2022 PEA analyzed up to five annual Starship launches, up to five annual Super Heavy launches (with Starship attached as the second stage of the launch vehicle), up to ten annual Starship landings, and up to five annual Super Heavy landings.

Since the publication of the 2022 PEA, SpaceX has decided to no longer launch Starship by itself and has instead launched Starship/Super Heavy from the Boca Chica Launch Site in April and November 2023, and March, June, October, and November 2024, and January and March 2025.[2] While maturation of the vehicle has eliminated the need for suborbital test flights, SpaceX continues to iterate Starship/Super Heavy operations based on data collected through continued launches and attempted landings. Starship/Super Heavy is designed to be a fully reusable rocket capable of rapid flight rate (meaning minimal time between launches). Frequent launches and landings in the early phase of the program are critical in developing Starship/Super Heavy's rapid launch capability because it allows for iterative testing of the core design that supports a rapid flight rate. To achieve this need, SpaceX is proposing to increase the number of Starship/Super Heavy orbital launches and landing operations per year to continue to develop the vehicle's flight-rate capability.

This tiered EA analyzes the impacts of the activities associated with SpaceX's proposal to increase launch and landing cadence. This EA tiers from the 2022 Final PEA, which analyzed the construction of the launch site and less frequent operations (including launches and landings) of the Starship/Super Heavy launch vehicle program in Boca Chica, Texas. The operations considered in this tiered EA include up to 25 annual Starship/Super Heavy orbital launches, up to 25 annual landings of Starship, up to 25 annual landings of Super Heavy, and vehicle upgrades. All launches considered in this tiered EA would originate from the Boca Chica Launch Site; landings could occur at this site, on a floating platform or expended in the Gulf of America, in the central Pacific Ocean and in the southeast Pacific, or in the Indian Ocean. Depending on the operational phase of the program, for landings at sea, both Starship and Super Heavy could have: (1) a hard landing at terminal velocity and break up on impact resulting in an explosive event at the surface of the water (2) a soft water landing and tip over and sink or explode on impact at the surface of the water and (3) breakup during reentry resulting in debris falling into the ocean. As mentioned previously, increased flight rate is critical to continually develop the core design of the launch vehicle, which is rapid reusability. The launch and landing operations analyzed in the 2022 PEA and in this tiered EA are summarized in Table 1.

[2] Recent Starship/Super Heavy Flights 7 and 8 experienced anomaly events following stage separation. SpaceX launched Starship/Super Heavy Flight 7 on January 16, 2025, and Flight 8 on March 6, 2025. The flights both progressed through stage separation and the nominal startup of all six Starship Raptor engines. Following stage separation, Super Heavy Booster returned to the launch site and successfully completed a landing burn and tower catch on both flights. Following stage separation, Starship experienced a vehicle malfunction and breakup on Flights 7 and 8. SpaceX lost telemetry communication with Starship and based on video evidence of both flights, Starship re-entered the atmosphere and experienced a breakup with debris landing near Turks & Caicos for Flight 7 and near the Bahamas for Flight 8. The anomaly events led to mishap investigations pursuant to FAA regulations.

Table 1. Comparison of Activities in the 2022 PEA and Current Proposed Action

Activity	2022 PEA Proposed Action	Current Proposed Action
Starship Static Fire Engine Testa	150 seconds	90 seconds (daytime)
Super Heavy Static Fire Engine Testa	135 seconds	70 seconds (daytime)
Starship Suborbital Launch	5 (4 daytime/1 nighttime)	0
Super Heavy Launch	5 (4 daytime/1 nighttime)	25 (22 daytime/3 nighttime)
Starship Landing	10 (8 daytime/2 nighttime) Starship landing at the VLA, on a floating platform in the Gulf of America or the Pacific Ocean, or expended in the Gulf of America or Pacific Ocean	22 daytime Starship landings at the VLA, on a floating platform or expended in the Gulf of America, Pacific Ocean or Indian Ocean 3 nighttime Starship landings on a floating platform or expended in the Gulf of America, Pacific or Indian Ocean
Super Heavy Landing	5 (4 daytime/1 nighttime) Super Heavy landing at the VLA, on a floating platform in the Gulf of America, or expended in the Gulf of America	22 daytime Super Heavy landings at the VLA, on a floating platform, or expended in the Gulf of America. 3 nighttime Super Heavy landings on a floating platform or expended in the Gulf of America.
Nominal Operational Access Restrictions	SpaceX anticipates the proposed operations would require 500 hours of annual access restriction	No change
Anomaly Response Access Restrictions on Adjacent Properties	If an anomaly occurred on adjacent properties, SpaceX anticipates it could require up to 300 hours of annual access restriction	No change

Notes: [a] Static fire engine tests are an activity requiring a license from the FAA if the Autonomous Flight Termination System is functionally installed prior to the activity.

Daytime refers to 7:00 a.m. to 7:00 p.m., nighttime refers to 7:00 p.m. to 7:00 a.m.

1.2. Federal Agency Roles

1.2.1. Federal Aviation Administration

As the lead federal agency, the FAA is responsible for analyzing the potential environmental impacts of the Proposed Action. The Commercial Space Launch Act of 1984, as amended and codified at 51 U.S.C. §§ 50901–50923, authorizes the Secretary of Transportation to oversee, license, and regulate commercial launch and reentry activities, and the operation of launch and reentry sites within the United States or as carried out by U.S. citizens. Section 50905 directs the Secretary to exercise this responsibility consistent with public health and safety, safety of property, and the national security and foreign policy interests of the United States. In addition, Section 50903 requires the Secretary to encourage, facilitate, and promote commercial space launches and reentries by the private sector. As codified at 49 CFR § 1.83(b), the Secretary has delegated authority to carry out these functions to the FAA Administrator.

The regulatory requirements pertaining to commercial launches and individual launch operators are described in 14 CFR Chapter III, Parts 400–460. SpaceX is the exclusive user of the Boca Chica Launch Site. Therefore, SpaceX is not required to apply for and obtain a launch site operator license for that site.

The FAA is also responsible for creating airspace closure areas in accordance with FAA Order 7400.2R, *Procedures for Handling Airspace Matters*, to ensure public safety.

Regarding potential environmental impacts in Mexico, the FAA coordinated with the U.S. State Department and Mexico in accordance with FAA Order 1050.1F, Paragraph 8-6, and Executive Order 12114, *Environmental Effects Abroad of Major Federal Actions*, 44 *Fed. Reg.*1957 (January 9, 1979) (See Appendix C).

1.2.2. Cooperating and Participating Agencies

The following agencies accepted the FAA's request to participate in the NEPA process as cooperating agencies due to their special expertise or jurisdiction by law over the launch facility or maritime environment: the National Park Service (NPS), U.S. Fish and Wildlife Service (USFWS), the U.S. Coast Guard (USCG), and the National Aeronautics and Space Administration (NASA). An agency has "special expertise" if it has statutory responsibility, agency mission, or related program experience regarding a proposal (42 U.S.C. § 4332; FAA Order 1050.1F Para. 2-4.2.).).

The NPS provides special expertise with respect to historic properties, including National Historic Landmarks (NHLs) and National Historic Parks. The Palmito Ranch Battlefield NHL (referred to as the "NHL" in this tiered EA) and the Palo Alto Battlefield National Historical Park are located approximately 3 and 19 miles, respectively, from the Boca Chica Launch Site. There are also other historic properties located near the launch site.

The USFWS provides special expertise with respect to threatened and endangered species and national wildlife refuges. There is suitable habitat, including federally designated critical habitat, for species listed under the Endangered Species Act (ESA) located near the Boca Chica Launch Site. The Lower Rio Grande Valley National Wildlife Refuge (LRGV NWR) is located adjacent to the launch site.

The USCG provides special expertise with respect to providing maritime safety and security during launch operations.

NASA provides special expertise with respect to potential environmental impacts from space launches and the operation of a launch site. NASA also has special expertise and interest in the operation of reusable suborbital and orbital launch vehicles through its programs, which are intended to help foster the development of the commercial reusable suborbital and orbital space transportation industry. Additionally, NASA uses Space Act Agreements and contracts, as well as competitions to promote technology development and demonstration. NASA's partnerships with commercial suppliers and private enterprises are expanding such that NASA may have a direct or indirect contribution to a commercial or government payload. For these reasons, NASA requested to be a cooperating agency in the development of this EA.

The FAA also invited the Texas Parks and Wildlife Department (TPWD), Texas Historical Commission (THC), Texas General Land Office (TGLO), and Texas Department of Transportation (TxDOT) to be participating agencies due to the location of the launch site relative to state-managed properties and due to special expertise of the agencies. These agencies participated in the NEPA process through activities such as attending project calls and reviewing and providing comments on administrative versions of this tiered EA.

1.3. Purpose and Need

The purpose of SpaceX's proposed action is to provide greater mission capability to NASA and the Department of Defense (DOD). SpaceX's activities would continue to fulfill the U.S. expectation that increased capabilities and reduced space transportation costs will enhance exploration (including within the Artemis and Human Landing System programs), support U.S. national security, and make space access more affordable. The Space Transportation section of the National Space Transportation Policy of 1994 addressed the commercial launch sector, stating that "assuring reliable and affordable access to space through U.S. space transportation capabilities is a fundamental goal of the U.S. space program." Additionally, the 2021 Space Priorities Framework's Mission states, "The United States will bolster the health and vitality of our space sectors – civil, commercial, and national security – for the benefit of the American people and leverage that strength to lead the international community in preserving the benefits of space for future generations" (White House 2021).

SpaceX's proposed action is needed to facilitate frequent launch and landing operations to allow iterative development of Starship/Super Heavy vehicles to achieve rapid launch capability and increase operational efficiency, capabilities, and cost effectiveness of the Starship/Super Heavy program. Satisfaction of these needs benefit government and public interests and reduces operational costs. Public interests largely intersect with the government interests identified, including greater mission capability for space exploration and advancing reliable and affordable access to space which in turn advances the scientific and national security benefits of the U.S. space program as a whole. Demand for launch services has continued to increase over the past 20 years, and the space industry's growth projections indicate this will continue into the foreseeable future. By providing a reusable launch vehicle that returns to its launch site, the proposed action would reduce the cost of launch and increase efficiency, delivering greater access to space and enabling cost-effective delivery of cargo and people to the Moon and Mars. SpaceX's proposed action would satisfy requirements for more efficient and effective space transportation methods and continue the U.S. goal of encouraging activities by the private sector to strengthen and expand U.S. space transportation infrastructure.

1.4. Documents Incorporated by Reference

In accordance with FAA Order 1050.1F Para. 6-2.1(e), agencies shall incorporate relevant material into environmental documents by reference when the effect is to cut down on bulk without impeding agency and public review of the action. Accordingly, the following documents are incorporated by reference:

- FAA. 2014a. Final Environmental Impact Statement SpaceX Texas Launch Site. Volume I, May 2014. (As incorporated by FAA. 2022).
- FAA. 2014b. Final Environmental Impact Statement SpaceX Texas Launch Site. Volume II-Appendices, May 2014. (As incorporated by FAA. 2022).
- FAA. 2022. Final Programmatic Environmental Assessment for the SpaceX Starship/Super Heavy Launch Vehicle Program at the SpaceX Boca Chica Launch Site in Cameron County, Texas. June. (Incorporates by reference FAA. 2014a and FAA. 2014b)
- FAA. 2023a. Written Re-evaluation of the 2022 Final Programmatic Environmental Assessment for the SpaceX Starship/Super Heavy Launch Vehicle Program at the Boca Chica Launch Site in Cameron County Texas. Starship/Super Heavy Vehicle Ocean Landings and Launch Pad Detonation Suppression System. April.

- FAA. 2023b. Written Re-evaluation of the 2022 Final Programmatic Environmental Assessment for the SpaceX Starship/Super Heavy Launch Vehicle Program at the Boca Chica Launch Site in Cameron County Texas. Starship/Super Heavy Deluge System Operation, Addition of a Forward Heat Shield Interstage, and Expansion of the Area of Potential Effects for Cultural Resources. November.
- FAA. 2024c. Written Re-evaluation of the 2022 Final Programmatic Environmental Assessment for the Starship/Super Heavy Launch Vehicle Program at the Boca Chica Launch Site in Cameron County. Texas. Updates to the Forward Heat Shield Interstage Landing Area, Sonic Boom Coverage, Use of the Deluge System During Return to Launch Site Landings, and use of US Coast Guard Safety Zones. October.
- FAA. 2024. Tiered Environmental Assessment for SpaceX Starship Indian Ocean Landings. March.
- NASA. 2019. Environmental Assessment for the SpaceX Starship and Super Heavy Launch Vehicle at Kennedy Space Center (KSC)
- NMFS (National Marine Fisheries Service). 2022. Programmatic Concurrence Letter for Launch and Reentry Vehicle Operations in the Marine Environment and Starship/Super Heavy Launch Vehicle Operations at SpaceX's Boca Chica Launch Site, Cameron County, TX. January.
- NMFS. 2023a. Concurrence Letter for the Endangered Species Act Section 7 Consultation for FAA's Proposed Licensing of SpaceX Starship/Super Heavy Early Developmental Phase Launch and Reentry Operations for First Three Flights in the Gulf of Mexico and North Pacific Ocean. April 2023.
- NMFS. 2024. Reinitiation and Conference of the Amended Programmatic Concurrence Letter for Launch and Reentry Vehicle Operations in the Marine Environment and Starship-Super Heavy Launch Vehicle Operations at SpaceX's Boca Chica Launch Site, Cameron County, Texas.
- NMFS. 2025. Conference and Biological Opinion on SpaceX Starship-Super Heavy Increased Launch Cadence and Operations in the North Atlantic Ocean, Gulf of Mexico, North Pacific Ocean, South Pacific Ocean, and Indian Ocean Authorized by the Federal Aviation Administration.
- USFWS. 2022. Final Biological and Conference Opinion of the SpaceX Starship/Super Heavy Launch Vehicle Program at the Boca Chica Launch Site in Cameron County Texas.
- USFWS. 2023. Addendum to the 2022 Biological and Conference Opinion.
- USFWS. 2024. Flight 5 Informal Consultation Written Concurrence. 02ETCC00-2012-F-0186-R001, 2025-0000669. October 11, 2024.
- USFWS. 2025. Final Amended Biological and Conference Opinion Addendum #2 of the SpaceX Starship/Super Heavy Launch Vehicle Program at the Boca Chica Launch Site in Cameron County Texas.

1.5. Public Involvement

A 30-day public comment period began on July 29, 2024, with the publication of the Draft EA, and ended on August 29, 2024; FAA received 112 public, state, and federal government agency comments during that period. FAA initiated a new 45-day public comment period for the Revised Draft EA that began on November 20, 2024, and ended on January 17, 2025; FAA received 12,303 public, state, and federal government agency comments during that period. The Final EA considers all input provided on the Draft

and Revised Draft EAs and addresses comments received, as appropriate. Appendix C details the methods used to review the comments received and summarizes the responses by topic.

1.6. Other Licenses, Permits and Approval

The FAA has identified the following additional environmental approvals needed for this SpaceX proposal, but others may be required.

- **Endangered Species Act (ESA).** In accordance with ESA Section 7, the FAA reinitiated consultation with USFWS and NMFS. NMFS concurred with the FAA's determination that the Proposed Action is not likely to adversely affect most ESA-listed species and critical habitat under NMFS jurisdiction. The only species that the FAA and NMFS agreed would likely face adverse effects from the Proposed Action would be sea turtles in the event of a shear horizontal explosion. ESA-listed species and critical habitat that would be affected are listed in Table 6. The NMFS Biological and Conference Opinion and USFWS Amended Biological and Conference Opinion are included in Appendix A. The 2022 USFWS Biological Conference Opinion (BCO), 2023 Addendum to the BCO, and the 2025 Addendum to the BCO issued by USFWS, concluded the Proposed Action is not likely to jeopardize the continued existence of any federally listed species or adversely modify designated critical habitat. The prior BCO and Addendums contain Reasonable and Prudent Measures and associated Terms and Conditions to avoid, minimize, and mitigate the effects on listed species and critical habitat.
- **Magnuson-Stevens Fishery Conservation and Management Act.** The FAA determined there may be temporary adverse effects to Essential Fish Habitat (EFH), particularly in the event of launch failure involving the spread of debris. The FAA consulted NMFS regarding potential adverse effects to EFH, and NMFS provided Conservation Recommendations pursuant to 50 CFR § 600.920, which SpaceX and the FAA have agreed to implement as stated in the 2022 PEA and mitigated FONSI/ROD.
- **Marine Mammal Protection Act (MMPA).** The FAA evaluated the MMPA-protected marine mammals that have the potential to be disturbed during ocean landing operations. SpaceX would coordinate with NMFS prior to any landing activity that may impact species protected under MMPA. During coordination with the FAA, NMFS determined the Proposed Action did not warrant an Incidental Harassment Authorization.
- **Clean Water Act (CWA).** The CWA, 33 U.S.C. §§ 1251 *et seq.*, addresses water quality by prohibiting the unpermitted discharge of pollutants from point sources to waters of the United States. SpaceX previously obtained coverage for discharges from the site's water deluge system, which the FAA previously evaluated in the PEA and the November 2023 Written Re-evaluation (WR), under the Texas Multi-Sector General Permit administered by the Texas Commission on Environmental Quality (TCEQ). The U.S. Environmental Protection Agency (EPA) and TCEQ subsequently found that the deluge water discharges require an individual Texas Pollutant Discharge Elimination System (TPDES) permit. The TECQ issued the final industrial wastewater discharge permit for operation of the deluge system on February 18, 2025.

2. DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

2.1. Proposed Action

The FAA's federal action is to modify SpaceX's existing vehicle operator license to authorize SpaceX's proposed action to increase the cadence of the Starship/Super Heavy launch program (see Section 1.1) at the Boca Chica vertical launch area (VLA) in Cameron County, Texas to up to 25 annual launches and 50 total annual landings (25 of the Starship and 25 of the Super Heavy), and make vehicle and operational upgrades identified below in Table 2. Up to three launches (of the total 25) would occur during nighttime hours from the VLA. Landings at the VLA would only take place during the daytime, with up to 22 Starship and 22 Super Heavy landings at the VLA. Daytime landings of either vehicle may also take place offshore as well. Up to three landings of Starship and three landings of Super Heavy may occur at night, only offshore. SpaceX would also conduct up to 90 seconds of licensed daytime Starship static fire tests and 70 seconds of licensed daytime Super Heavy static fire tests a year. The federal action also includes the FAA's issuance of temporary airspace closures.

The following aspects of SpaceX's operations remain unchanged and are assessed by the existing environmental documentation supporting the program:

- Pre-flight Operations (Section 2.1.3.2 of the PEA)
- Nominal Operational Access Restrictions (Section 2.1.3.5 of the PEA)
- Personnel Levels (Section 2.1.3.6 of the PEA)
- Anomalies (Section 2.1.3.7 of the PEA)

The FAA's authority under the Commercial Space Launch Act only extends to licensed launch activities. Additional activities in and around the Boca Chica Launch Site, such as production and manufacturing, engine, stage, and tank testing that are not within the scope of the license and will occur regardless of whether a license is issued are not included in this analysis. The effects of such activities are considered as part of the environmental baseline and in conjunction with the effects of the Proposed Action (see Section 3.3).

2.2. Launch Operations

Since the publication of the 2022 PEA, SpaceX has changed the location of Pad B within the VLA as described in the 2022 PEA. Figure 1 shows the new location of Pad B with Orbital Launch Mount 2. The Orbital Launch Mount 2 is a subset of the area described in the 2022 PEA as Pad B. SpaceX plans to expand the VLA into the full SpaceX owned parcel, as contemplated in the 2022 PEA, which will require permitting under Section 404 of the Clean Water Act in order to fill jurisdictional wetlands. Operations on Pad B for FAA-licensed activity would remain as previously analyzed in the 2022 PEA. SpaceX proposes to increase Starship/Super Heavy operations as described in Table 1. As Starship/Super Heavy continues to iterate towards rapid reusability, SpaceX is proposing potential launch vehicle modifications, including increasing thrust of both the Starship and Super Heavy vehicles that are pertinent to the impact analysis. Launch vehicle upgrades are summarized in Table 2.

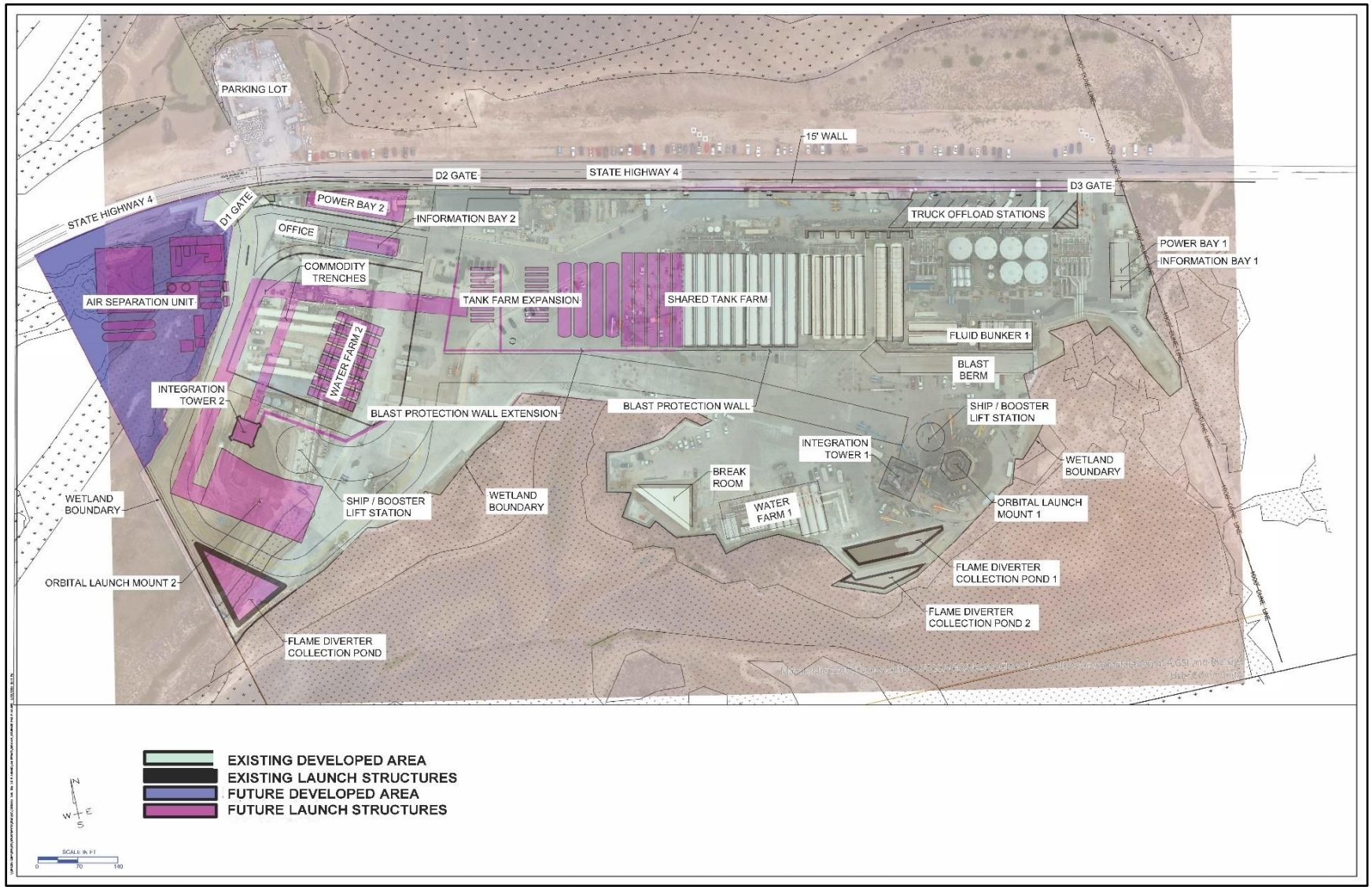

Figure 1 Current Vertical Launch Area Layout

Table 2. Launch Vehicle Specifications

Specification	2022 PEA Starship	2022 PEA Super Heavy	Upgraded Starship	Upgraded Super Heavy
Length (meters; m)	50	71	70	80
Diameter (m)	9	9	9	9
Number of Engines	6	37	9	35
Thrust	12 MN	74 MN	28.7 MN	103 MN
Propellant quantity (metric ton; MT)	1,500	3,700	2,650	4,100

As described in the 2022 PEA, Starship/Super Heavy missions would continue to include lunar and Mars missions and satellite payload missions. Approved trajectories would be based on specific launch vehicle performance and characteristics and would satisfy 14 CFR Part 400 regulations.

As Table 2 details, the upgrades to Starship/Super Heavy will increase the amount of thrust produced by the vehicle. The 2022 PEA assumed the heat plume generated from Starship/Super Heavy orbital launches would travel away from the existing Orbital Launch Mount 1 at the launch pad (described as Pad A in the 2022 PEA), with temperatures of about 300 degrees Fahrenheit (°F) reaching the edge of the VLA[3], 212°F approximately 0.3 mile from the launch mount, and temperatures reaching ambient temperature (90°F) approximately 0.6 mile from the launch mount.[4] The heat plumes and increased temperatures would only occur during engine ignition and dissipate within 30 to 60 seconds. However, the data collected from two flights showed the plume extending approximately 0.2 to 0.3 miles (SpaceX 2024a, 2024b), less than half of what was analyzed in the 2022 PEA. Additionally, SpaceX measured the temperature during the third launch event at five locations- 0.2, 0.4, 0.6, 0.8, and 1 mile from the launch mount. At 0.2 miles from the launch mount, a temperature change from ambient temperature (72°F)) to a maximum of 90°F was recorded 30 seconds after engine ignition and stayed at 90°F for five seconds before decreasing. No changes from ambient temperature were recorded at any other location. Conservatively assuming linear scaling of temperature from the increased thrust, based on the data recorded from flight 3, the heat plume would be anticipated to reach 90°F at 0.28 miles from the launch mount. Even with the increased thrust, SpaceX anticipates the plume to be less than what was analyzed in the 2022 PEA. However, this tiered EA retains the same assumptions as a conservative approach for this analysis.

SpaceX plans to add additional water tanks to the site to store the increased quantities of water, increasing the maximum volume of water from 361,000 gallons to 422,000 gallons, and would operate the deluge system during a Super Heavy landing at the VLA. SpaceX may use up to the maximum amount of deluge water per Super Heavy static fire, launch, or landing under the Proposed Action.[5] During a Super Heavy landing at the VLA, the deluge system would be reactivated and would run for approximately 30 seconds. At this time, Starship landings at the VLA are not anticipated to require deluge water.

It is anticipated that the Proposed Action would increase vehicle traffic and human presence from an estimated 6,000 total trucks per year in the 2022 PEA to 23,771 trucks under the Proposed Action for

[3] For context, the existing launch mount is located approximately 125 feet from the edge of the VLA, and the new launch mount site is located approximately 150 feet from the existing edge of the VLA.

[4] These temperature and distance estimates do not consider a deluge system, which may decrease estimates.

[5] During flights two and three, during which the deluge system was operated, 180,0000 gallons of water was applied during each launch.

transportation of water and commodities. Brownsville Public Utilities Board is contemplating the installation of a public water line from Brownsville to Boca Chica that will remove trucks transporting water along State Highway 4 (SH 4). Site groundwater quality is unsuitable for use due to high levels of total dissolved solids (FAA 2022 pp.108). The additional volume is to facilitate recycling of applied and recaptured water, provide water for cooling the launch mount deck after vehicle lift-off, and suppress sound. Refer to the Biological Assessment in Appendix A for additional analysis of the increase in trucks due to the Proposed Action.

SpaceX is not proposing any additional operational access restrictions as described in the 2022 PEA and would continue to adhere to the terms outlined in Section 2.1.3.5 of the 2022 PEA. In the beginning of the program, SpaceX estimated needing approximately 500 hours of temporary access restrictions annually for nominal operations. However, since the 2022 PEA, SpaceX has dramatically reduced the duration of operations and the number of access restrictions through engineering analysis and improvements. There has been an 95% reduction in the number of access restrictions from Flight 1 to Flight 3. Additionally, a majority of the testing that required access restrictions has been moved to SpaceX's Massey's Test Site, approximately 4 miles away from the VLA, and will not require SH 4 access restrictions from this location. SpaceX is expected to need less than 20 hours of access restrictions per launch campaign, including landings, but retains the same assumptions concerning access restrictions for a conservative analysis. Please refer to Section 3.2.6 for additional details.

2.3. Landings

SpaceX proposes to increase Starship/Super Heavy landings from up to 10 annual Starship landings and up to 5 annual Super Heavy landings to up to 25 Super Heavy landings and up to 25 Starship landings annually.

SpaceX plans to land the reusable Super Heavy and Starship back on land at the VLA or on floating platforms in the ocean. As SpaceX continues to develop the capability to perform a return to launch site landing of Super Heavy and the Starship, some vehicles may not be reused and are instead expended in the ocean in the following three conditions depending on the stage of development of the program:

1. Hard water landing at terminal velocity and break up on impact resulting in an explosive event at the surface of the water;
2. Soft water landing and tip over and sink or explode on impact at the surface of the water;[6] or
3. In-flight breakup – Breakup during reentry resulting in debris falling into the ocean (up to 25 times per year of each vehicle stage).

Of the above scenarios, SpaceX anticipates no more than 20 explosive events at the surface of the water (Scenario #1) for each vehicle for the life of the program. These three scenarios would only occur within the first five years of the program.

SpaceX currently lands Super Heavy in the Gulf of America and Starship in the Pacific Ocean and the Indian Ocean. SpaceX is proposing to expand the potential landing sites of Starship. For ocean landings, Super Heavy would land on a droneship or continue to be expended in the Gulf of America (Figure 2). Starship could land on a droneship (floating platform) or be expended in any of the following landing areas shown in Figure 2, Figure 3, Figure 4, and Figure 5. The landing area in the Pacific Ocean was adjusted to be

[6] A soft water landing is when the launch vehicle intentionally slows its speed to land in the water.

located outside the U.S. Exclusive Economic Zone (EEZ) in response to public comments (see Appendix C). The droneship operations and specifications were assessed in the 2022 PEA and 2022 NMFS consultation (NMFS 2022). Additionally, a Starship near-shore contingency landing zone in the Gulf, beginning 1 nautical mile or more from the coast and covering a distance of up to 100 miles north of the VLA near Corpus Christi, and up to 100 miles south of the VLA near El Carrizo, Tamaulipas, Mexico, is included in the Tiered EA.

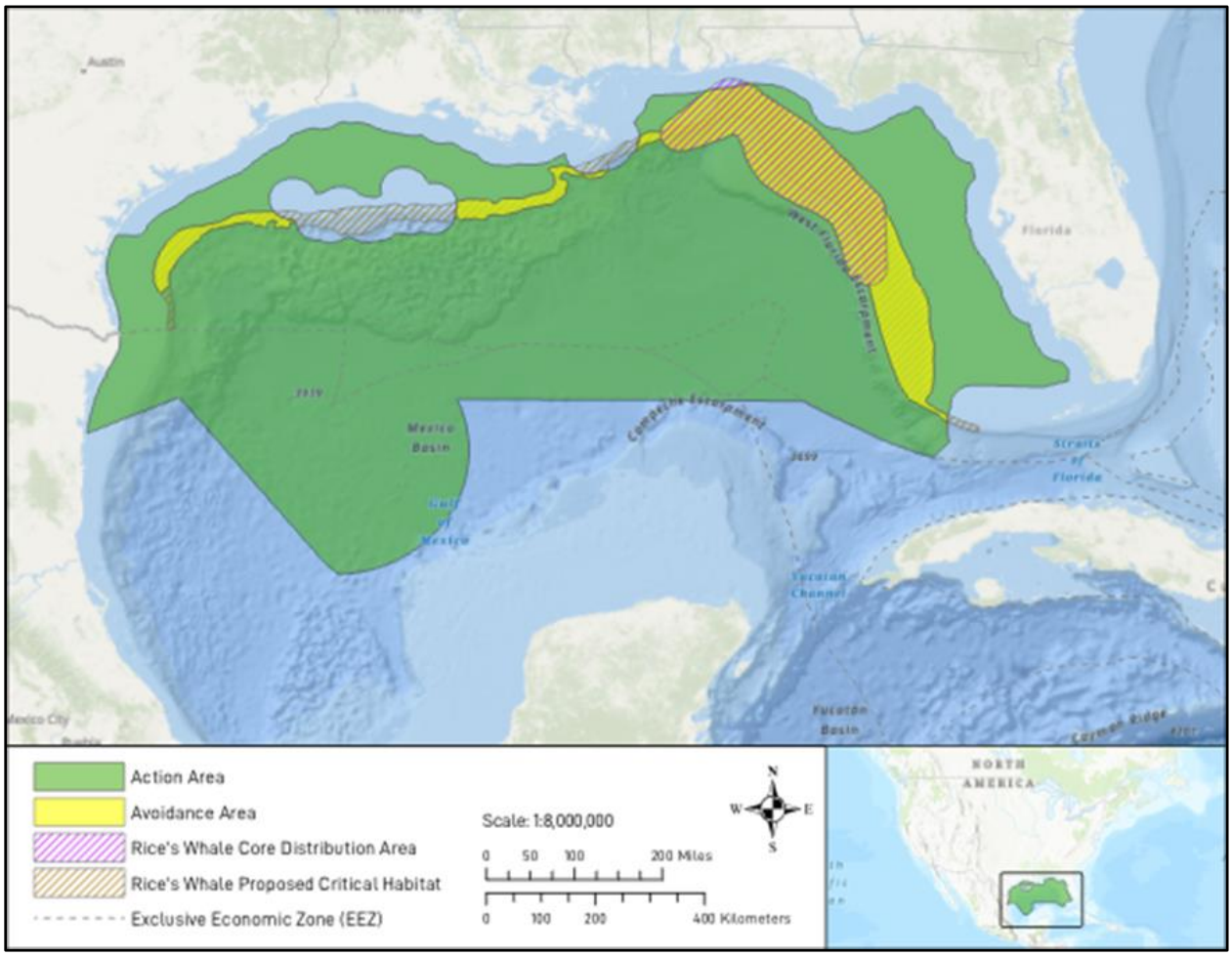

Figure 2 Gulf of America Landing Area

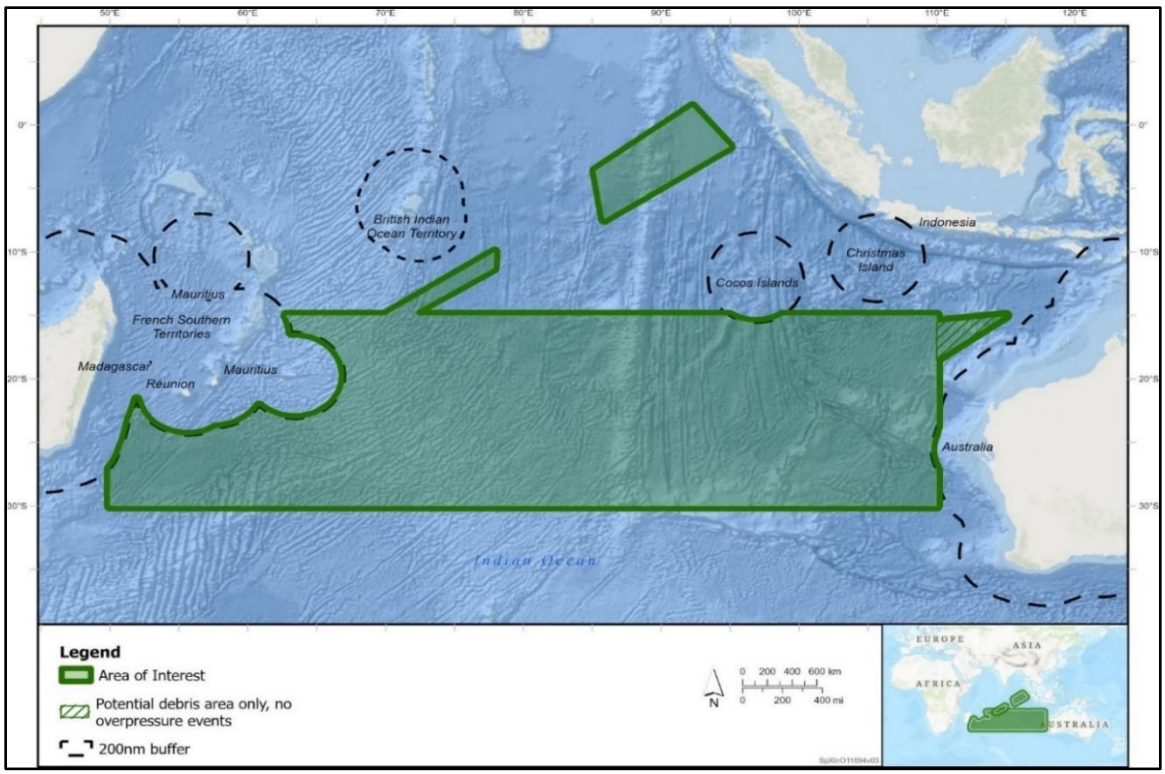

Figure 3 Indian Ocean Starship Landing Area

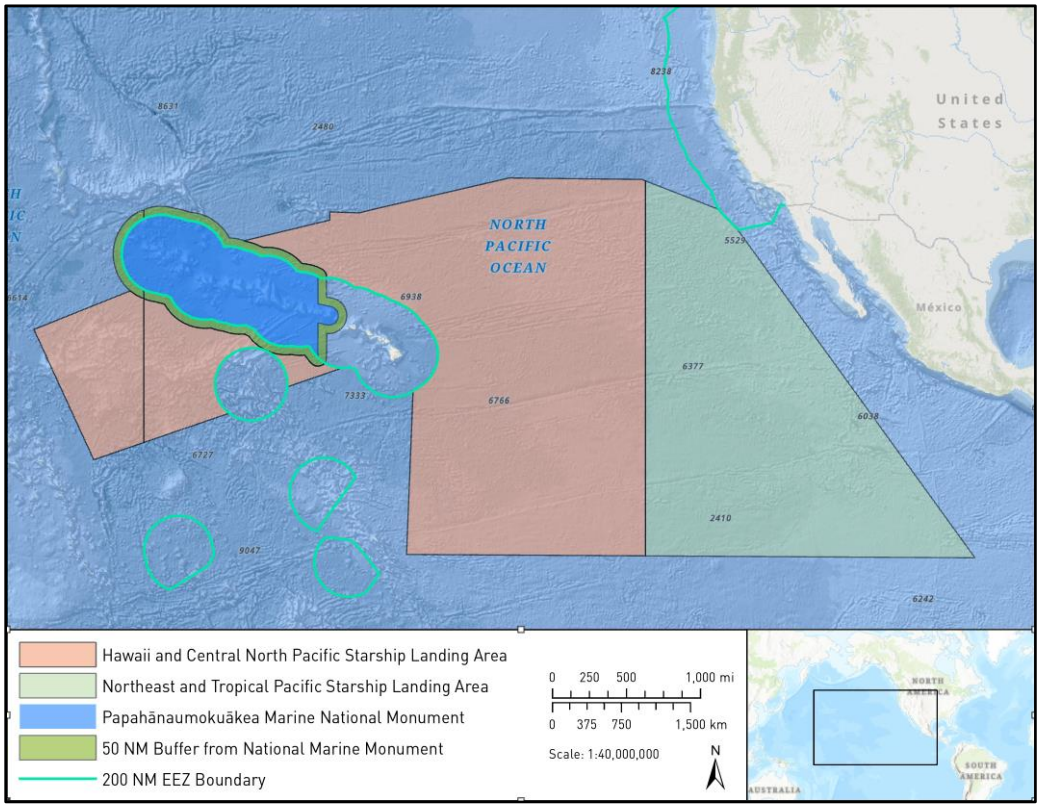

Figure 4 North Pacific Starship Landing Area (Hawaii and Central North Pacific Landing Area and Northeast and Tropical Pacific Ocean Landing Area)

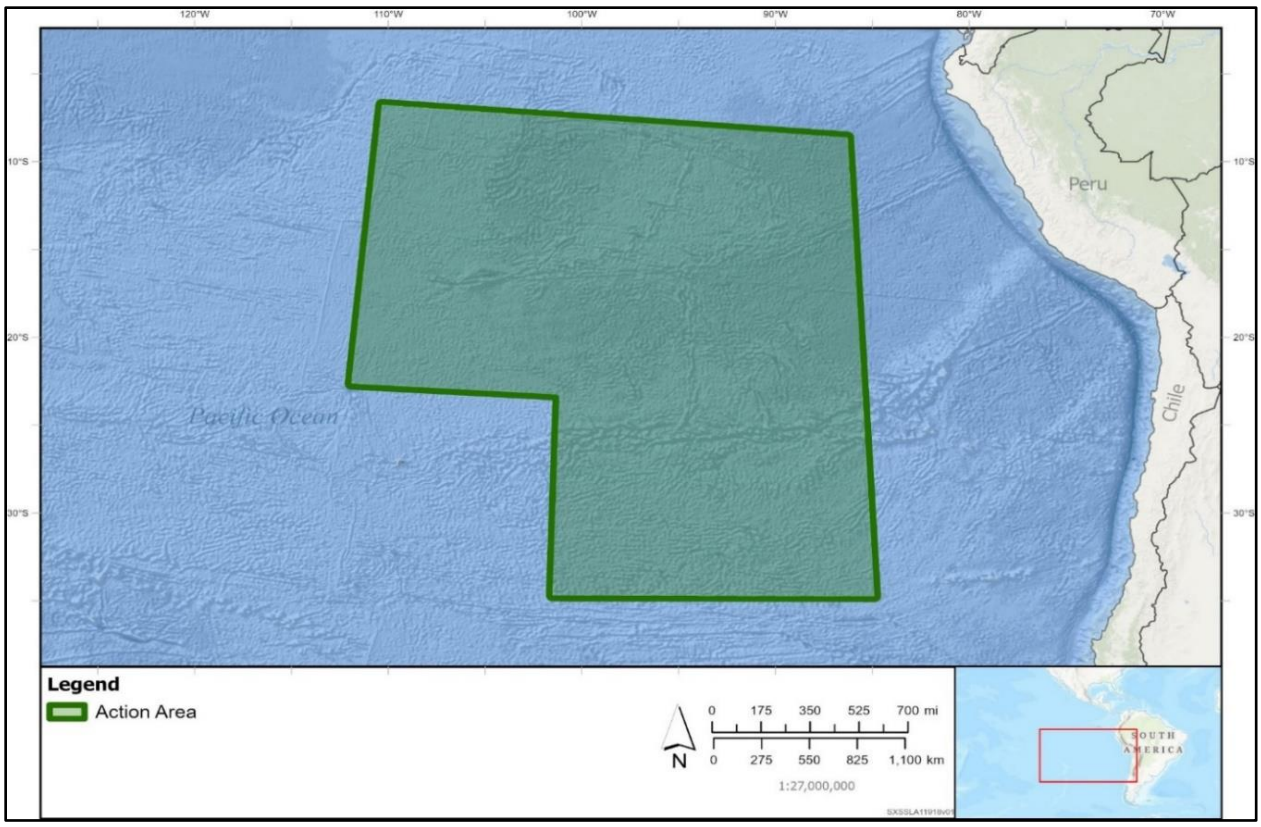

Figure 5 Southeast Pacific Starship Landing Area

Consistent with the 2022 PEA, landings that occurred downrange on a floating platform would continue to be delivered by barge to the Port of Brownsville and transported the remaining distance to the Boca Chica Launch Site over roadways.

Under the Proposed Action, the remaining propellant on both Starship and Super Heavy would increase over the amounts previously assessed. Up to approximately 101 metric tons (MT) of residual propellant is projected to remain on the Starship launch vehicle for downrange landing, including expenditures. Up to approximately 74 MT of residual propellant is projected to remain on the Super Heavy vehicle for downrange landing, including expenditures, and would be vented following landing.

2.4. Airspace Closures

In Section 2.1.3.5 of the 2022 PEA, the FAA concluded that the Proposed Action would not require the FAA to alter the dimensions (shape and altitude) of the airspace to accommodate the then Proposed Action, comprising 5 suborbital launches, 5 orbital launches, and 10 reentries annually. The FAA also concluded in 2022 that temporary closures of existing airspace may be necessary to ensure public safety during the proposed operations. As of the date of this Final EA, SpaceX has implemented the 2022-contemplated Proposed Action twice in 2023, four times in 2024, and two times in 2025. The FAA temporarily closed airspace to permit these operations.

The FAA Air Traffic Organization (ATO) Space Operations Office completed a generic National Aerospace System (NAS) impact analysis in accordance with the FAA "Notice of Updated Factors for Optimizing Use of the National Aerospace System," dated April 13, 2023. This analysis was generic because SpaceX has

yet to identify potential dates for its launch and landing operations. However, based on past practice, the FAA concluded that it would similarly expect to close existing airspace to permit SpaceX to launch or land the Starship/Super Heavy vehicles contemplated in this Proposed Action.

SpaceX proposes to increase the number of launch and reentry operations at the Site as set forth in Section 2.1. The FAA Air Traffic Organization Space Operations Office uses the Aircraft Hazard Area (AHA) information (described in Section 2.1.3.5 of the 2022 PEA) to produce an airspace management plan, which describes the launch/reentry information and analyzes the effect of each operation on airspace efficiency, capacity, and any other associated effect to the NAS from each licensed launch and reentry operation. The airspace management plan is disseminated to the operators and various impacted ATO facilities. This information helps the FAA determine whether the proposed launch or reentry (programmatically or individually) would result in an unacceptable limitation on air traffic. If that were the case, the FAA would work with the operator to identify appropriate mitigation strategies, such as shortening the requested launch/reentry window or shifting the launch/reentry time if possible. The FAA may also approve fewer launch or reentry operations or shorter launch and reentry windows. The FAA may prioritize operations with a national security purpose or favor launch and reentry windows or favor launch or reentry dates that fall outside of seasonal travel patterns.

The FAA often provides data to launch operators to avoid operations during days with high aviation traffic volume and identifies times with minimal impact to the NAS, such as overnight hours between 10:00 p.m. and 07:00 a.m. CT. FAA acknowledges, however, that while these operating windows would minimize disruption to the NAS, they are likely to increase disruptions to the traveling public in the vicinity of the proposed launch or landing operations.

It has been determined AHAs could require larger airspace usage, potentially resulting in increased rerouting to other users of the NAS in the area, compared to other existing launch systems. To optimize the use of the NAS for the benefit of all users, the FAA considers the totality of all relevant factors in making a determination on a commercial space operation. Consistent with 49 U.S.C. § 40103(b) and FAA joint Order (JO) 7610.4, Special Operations, the FAA will exercise its authority to modify or revoke an airspace assignment when space operations may adversely impact the safety and/or efficiency of the NAS. As part of this coordination, the FAA will ensure that interested parties are taking steps to ensure the safe, efficient, and equitable use of the NAS.

2.5. Waterway Closures

As described in the Section 2.1.3.5 of the PEA, all launch and reentry operations would comply with necessary notification requirements, including issuance of Notice to Mariners (NOTMAR)s, as defined in agreements required for a launch license issued by the Federal Aviation Administration (FAA). A NOTMAR provides a notification regarding a temporary hazard within a defined area (a Ship Hazard Area [SHA]) to ensure public safety during proposed operations. A NOTMAR itself does not alter or restrict vessel movement; rather, the NOTMAR disseminates relative information regarding maritime activity and temporary hazards within a defined area to ensure public awareness and safety during the proposed operations.

To comply with FAA's licensing requirements, SpaceX has agreed through a Letter of Intent (LOI) with the United States Coast Guard (USCG) to establish procedures for the issuance of a NOTMAR prior to a launch or reentry, as well as other measures necessary to protect public health and safety, promoting safe operations over navigable waters. The LOI would describe the required responsibilities and procedures

for both SpaceX and USCG during the event, which may include a launch, landing, and/or reentry operation resulting in the issuance of a NOTMAR.

USCG publishes NOTMARs through multiple media platforms to include Local Notice to Mariners (LNM), Broadcast Notice to Mariners (BNM), and Navigational Telex (NAVTEX) as needed to inform the maritime community of temporary changes in condition, Limited Access Areas (LAA), Regulated Navigation Areas (RNA), and/or hazards on navigable waterways. Notices in international areas are published by the National Geospatial Intelligence Agency. Advance notice via NOTMAR and the identification of SHAs assists mariners in voyage planning and scheduling around any temporary operation.

In addition to publishing NOTMARs, USCG has broad authority to establish Limited Access Areas (LAA), which may include Safety and/or Security Zones, and RNAs on Navigable Waters subject to U.S. authority and schedule in advance to minimize interruption to the maritime community.

All landing operations would comply with necessary notification requirements, including issuance of NOTMARs and use of LAAs and RNAs by the USCG, as defined in agreements required for a vehicle operator license issued by the FAA. USCG maintains authority to establish and enforce LAAs and RNAs as needed to support public health and safety during these events.

The use of USCG LAAs and RNAs may require the redirection of vessels to waters outside of the LAA during launch and landing events. The USCG uses all available data and information to provide a level of safety to the maritime community during prescribed launch/landing events.

2.6. Selection Standards and Criteria

The FAA's authority with respect to SpaceX's license application is stated in Section 1.2.1. SpaceX's purpose and need are identified in Section 1.3. Under NEPA, an agency must include reasonable alternatives, that are technically and economically feasible and meet the purpose and need for the proposed action (42 U.S.C. § 4332(2)(C)(iii))). An alternative that does not meet the stated purpose of and need for the proposed action is not reasonable. To meet the purpose and need of the Starship/Super Heavy launch program, SpaceX presented to the FAA certain criteria that the action alternatives must meet. FAA reviewed and approved the use of these criteria:

1. Ability to meet necessary launch rate/frequency demanded by DOD and NASA contractual obligations by 2025, including the Human Landing System and Rocket Cargo contracts.
2. Ability to support both low Earth orbit and geostationary transfer orbit trajectories. To reach these trajectories, the launch site must have the ability to support launches towards the east to avoid a "dogleg," a bent trajectory which severely compromises the performance to orbit.
3. Location must be at a low latitude in order to maximize the payload mass that the launch vehicle can place into orbit.
4. Ability to provide geographic diversity from existing or proposed launch facilities in Florida to diversify risk and operations. Geographical diversity is necessary to allow the program to continue to operate/exist/provide capability if one site is disabled (e.g., terrorist attack, natural disaster, vehicle anomaly). SpaceX must diversify risk and operations by operating from multiple locations located in different geographic regions.

2.7. Alternatives Considered but Eliminated from Further Analysis

Using the criteria above, the FAA dismissed Vandenburg Space Force Base (VSFB) based on criteria 2 and 3. SpaceX also evaluated its existing facilities at KSC and a new launch site on CCSFS for reasonableness. However, FAA dismissed these launch sites from detailed review based on the following reasons.

- Existing Facilities on NASA's Kennedy Space Center (LC-39A): The existing launch pad at LC-39A does not currently support the technological improvements that are required for continued development of the Starship/Super Heavy development program and would need to undergo upgrades as well as the FAA/NASA NEPA process prior to operation of the site. LC-39A is proposed as a Starship/Super Heavy launch pad and currently undergoing FAA/NASA NEPA review as part of this pursuit, the FAA published a Notice of Intent to prepare an EIS on May 10, 2024. However, in addition to potential Starship/Super Heavy operations in Florida, redundancy is required. If LC-39A was not available due to a hurricane, fire, anomaly, or other event, SpaceX would require another location to ensure the Starship/Super Heavy program can continue to operate, including from the required trajectories and latitudes, as outlined above. This location therefore does not provide the necessary diversification of risk and operations by operating from multiple sites.
- New Launch Site on CCSFS (SLC-37 or SLC-50): SLC-37 is vacant and was previously leased to United Launch Alliance. SLC-50 is currently undeveloped. Either of these sites would need to undergo the FAA/Department of the Air Force NEPA process, design, and development to accommodate construction of a Starship/Super Heavy launch and landing pad. An Environmental Impact Statement (EIS) would need to be issued prior to establishing lease agreements for SpaceX from the U.S. Space Force. It is anticipated that it would take until late 2025 for the Department of the Air Force to issue a ROD. Thus, SpaceX could not begin constructing until late 2025 and would not meet the criteria listed above for the Proposed Action.
- Flight cadence alternatives have not been evaluated in detail because the FAA and SpaceX have determined that a lower cadence alternative would not meet the Proposed Action's purpose and need. Under the CSLA, the FAA reviews licenses for compliance with the requirements of the CSLA and its implementing regulations, which are primarily focused on health and safety, and must issue a license within 180 days of receipt of a license application if those requirements are met. Here, SpaceX seeks authorization for the minimum number of launches necessary to meet the needs for the Proposed Action, including the need to develop and operationalize Starship/Super Heavy as a launch vehicle that is fully and rapidly reusable. The proposed launch cadence is necessary to advance the vehicle's design and operationalize rapid reuse to support national space policies and other priorities, including under the Artemis and Human Landing System programs, which are currently set to be complete before the end of the decade. The proposed launch cadence is needed to allow for development and operationalization of Starship/Super Heavy as a rapidly usable launch system that will allow for the creation and maintenance of in-orbit refueling stations; transportation of astronauts to the Moon; and eventually development and support of a base on the Moon and ultimately Mars. A lower cadence increase would not allow for the annual launch capacity needed to fully develop Starship/Super Heavy to support these uses.
- Daytime only alternatives have not been evaluated in detail because the FAA and SpaceX have determined that daytime only launch operations would not meet the purpose and need of the Proposed Action. Due to the physics which govern orbital mechanics, the launch window to achieve a trajectory required for a mission, including trajectories used for refueling of Starship as required by the NASA HLS mission plan, requires the launch be precisely timed. In addition, SpaceX

expects launches to land at various points around the world, and some missions require daylight at the landing location, which in turn, necessitates a launch in nighttime hours from Boca Chica, TX. Finally, daytime only launches would likely increase effects on mariners and the airline industry as there is more marine and air traffic during the day than at night. Thus, daytime only launch operations do not meet the criteria listed above for the Proposed Action.

- SpaceX considered other areas for water landings in alignment with the Purpose and Need. Alternative locations outside of the areas identified in the Proposed Action would fail to meet operational needs, increase public safety risks, and reduce the feasibility of recovery efforts.

2.8. No Action Alternative

Under the No Action Alternative, the FAA would not modify a license to SpaceX to allow for increased launch and landing cadence from the Boca Chica launch site. As assessed in the 2022 PEA and subsequent Written Re-evaluations (WR), SpaceX could conduct up to five annual Starship and up to five annual Super Heavy launches (with Starship attached as the second stage of the launch vehicle), up to ten annual Starship landings, and up to five annual Super Heavy landings. The Starship/Super Heavy launch vehicles would not be modified and would remain the same as assessed in the 2022 PEA.

Under the No Action Alternative, there would be no new impacts on the environmental impact categories analyzed in this EA. The no-action alternative provides the basis for comparing the environmental consequences of the Proposed Action.

3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1. VLA

The VLA is located on SpaceX-owned land in Cameron County, Texas, near the cities of Brownsville and South Padre Island. The site is located in a sparsely populated coastal area adjacent to the Gulf of America, characterized by marsh and barrier island plant communities, shallow open water, algal flats, and unvegetated tidal flats. The VLA is surrounded by Boca Chica State Park and is adjacent to the LRGV NWR. The larger area includes several private and public industries, including the SpaceX production and manufacturing facility, the Port of Brownsville, liquified natural gas (LNG) facilities at the Port of Brownsville, the City of Port Isabel, San Roman Wind Farm, and developments on South Padre Island. Boca Chica Village includes support infrastructure such as housing, restaurants, and offices used in connection with SpaceX's production and manufacturing facility near Boca Chica Village, as well as some private houses not affiliated with SpaceX.

For almost all environmental resource categories, the affected environment near the VLA remains the same as discussed in the 2022 PEA. While the number of orbital launches and landings authorized by the license would change, the spatial extent of impacts from each orbital launch/landing would generally be the same as in the 2022 PEA. The geographic extent of modeled noise contours did slightly increase under the Proposed Action due to the increase in thrust and updated modeling for sonic booms caused by landings at the VLA; the impact on this extended noise area is incorporated into resource analyses as applicable.

3.2. Issues Evaluated in this EA

The analysis in this tiered EA is focused on the environmental impact categories with the potential to be affected by an increase in launch cadence, and changes to the launch vehicles, including: air quality; biological resources (terrestrial and marine wildlife); climate; cultural resources; Department of Transportation Section 4(f); hazardous materials; land use; natural resources and energy supply; noise and noise-compatible land use; socioeconomics,[7] and children's health; visual resources; and water resources. There are no potential impacts that could affect farmlands or wild and scenic rivers; therefore, these environmental impact categories are not analyzed in this EA.

The 2022 PEA and FONSI/ROD included mitigation measures to ensure that the potential impacts of SpaceX's launch program would not have significant impacts to the environment. SpaceX maintains ongoing compliance with all mitigation measures. In addition to SpaceX providing regular status updates to the FAA, to date SpaceX has completed or maintains ongoing compliance with 90% of the mitigation measures. SpaceX would be required to continue to adhere to these mitigation measures, as well as any additional mitigation measures identified by the Final Tiered EA and imposed by any new or modified license. Pertinent mitigation requirements are further addressed below.

3.2.1. Air Quality

Air quality impacts, taking into account the new information related to the Proposed Action, would be comparable to those discussed in the 2022 PEA and would not be significant. The 2022 PEA concluded that operational activities would not significantly impact air quality. Air quality impacts from generators, vehicles, and nontoxic substances are often associated with ground processing activities, such as moving or integrating the launch vehicle or maintenance on the ground systems. Typical ground processing operations of the size proposed at the VLA are estimated to require small capacity storage and use of fuel and are not expected to produce emissions above the potential to emit threshold levels established as major sources of pollution listed in the Texas Administrative Code (TAC) Title 30 Chapter 116. For that reason, the ground processing activity emissions are estimated to have minimal air quality impacts. Based on emission estimates under the scenario considered in the 2022 PEA, emissions of oxides of nitrogen (NOx) and carbon monoxide (CO) (45 and 98 tons per year of CO and NOx, respectively) were both found to be under the conformity de minimis threshold. However, they are higher than anticipated in the 2022 PEA; Table 3 compares the differences.

Additionally, Cameron County, Texas, was at the time designated as being in attainment for all criteria pollutants. As a result, the project as proposed in the 2022 PEA would not have been subject to a conformity analysis had emissions of any criteria pollutant exceeded the de minimis threshold. Based on the estimated emission rates, it was determined that the project would not contribute to an exceedance of the National Ambient Air Quality Standards (NAAQS). The Texas Commission on Environmental Quality (TCEQ) has adopted the NAAQS as promulgated by the U.S. Environmental Protection Agency (EPA). As a

[7] On January 21, 2025, President Trump issued EO 14173, *Ending Illegal Discrimination and Restoring Merit-Based Opportunity*. At that time, the NEPA process for this project was already underway, and FAA's Revised Drafted Tiered EA reflected the expected scope and content of analysis in this NEPA process to include analysis of environmental justice. Due to the rescission of prior executive orders regarding environmental justice, and the recent action by the CEQ to rescind the NEPA implementing regulations, it is no longer the policy of the federal government to conduct environmental justice analysis and it is no longer a legal requirement to do so. Any prior data gathering, analysis, or discussion regarding environmental justice is not relevant for purposes of evaluating the NEPA significance of this project, nor will it play any role in agency decision-making. As a result, this Final Tiered EA has removed the prior discussion of, and data/analysis related to, environmental justice.

result, no Texas ambient air quality standards were expected to be exceeded by the project. TCEQ received a complaint in April 2023 regarding concerns over health impacts due to particulate matter (dust) following the first Starship/Super Heavy launch. No notice of violation or notice of enforcement issues were issued by TCEQ as a result of the complaint. SpaceX's installation and use of a reinforced launch pad capped with a steel plate and deluge water system have successfully suppressed dust and debris during subsequent launches and SpaceX at this time is unaware of any further complaints made to TCEQ by the public.

Table 3. Proposed Action Emission Rates Compared to 2022 PEA Emission Rates

Emission Generating Activity	2022 PEA Estimated Emissions* (tons/year)		Proposed Action Estimated Emissions (tons/year)		Difference of Proposed Action Estimated Emissions vs 2022 PEA Estimated Emissions (tons/year)	
	CO	NOx	CO	NOx	CO	NOx
Starship/Super Heavy Launches	6.60	14.37	34.99	76.22	28.39	61.85
Starship Suborbital Launches	0.93	2.02	0	0	-0.93	-2.02
Starship Landings	0.65	1.41	2.42	5.27	1.77	3.86
Super Heavy Landings	0.68	1.48	3.39	7.38	2.71	5.90
Starship Static Test Fires	1.35	2.95	1.04	2.28	-0.31	-0.67
Super Heavy Static Test Fires	5.75	12.52	3.16	6.88	-2.59	-5.64
Total	**15.96**	**34.75**	**45.00**	**98.03**	**29.04**	**63.28**
Conformity de minimis Threshold	100	100	100	100	100	100

Note: Emission estimates in the 2022 PEA were based on up to five (5) Starship/Super Heavy launches, five (5) Starship suborbital launches, ten (10) Starship landings, five (5) Super Heavy landings, 150 seconds of Starship static test fires, and 135 seconds of Super Heavy static test fires. Additionally, Starship emissions were estimated assuming that it would employ up to six (6) raptor engines, and Super Heavy was expected to be equipped with up to 37 Raptor engines. The Proposed Action includes up to twenty-five (25) Starship/Super Heavy launches, twenty-five (25) Starship landings, twenty-five (25) Super Heavy landings, 90 seconds of Starship static test fires, and 70 seconds of Super Heavy static test fires. Additionally, the number of engines per vehicle is being increased to up to nine (9) Raptor engines on the Starship and decreased to thirty-five (35) Raptor engines on the Super Heavy.

* These would be considered the "No Action" emissions.

Estimated emission rates for CO and NOx are below the EPA de minimis thresholds, with estimated rates of 45 and 98 tons per year of CO and NOx, respectively. Ambient air quality in Cameron County remains relatively unchanged since 2022, with the county still being designated as being in attainment for all criteria pollutants. As a result, general conformity is not applicable to the Proposed Action.

According to the 2020 Annual Emission Inventory (EPA 2023a), total emissions for Cameron County totaled 47,424.7 and 4,829.2 tons per year for CO and NOx, respectively. Emission estimates indicate that the increase in emissions due the Proposed Action would account for approximately 0.1% of CO emissions and 0.21% of NOx emissions on an annual basis. The Proposed Action is not expected to contribute to an exceedance of the NAAQS.

Hazardous air pollutants from mobile sources, known as mobile source air toxics, are described in the 2022 PEA. Sources of mobile source air toxics would be similar to those assessed in the 2022 PEA, including from vehicles and non-road equipment. The vessels and boat used during SpaceX's operations would likely vary in age and have a range of emission controls. SpaceX anticipates that recovery equipment and

vehicles would be operated for approximately five days for each launch with a recovery and would produce negligible ambient pollutant emissions in a widely dispersed area. Hazardous air pollutants from the combustion of fossil fuel, which is the cause of emissions from mobile sources, are emitted in quantities anywhere from one to three orders of magnitude less than criteria pollutant emissions from these sources. Because of the small scale of the emissions and the context of the minimal mobile source operations required by the Proposed Action, hazardous air pollutant emissions would have low potential effects and are not assessed quantitatively.

The Federal Highway Administration considers projects to have a low potential for effect for mobile source air toxics when design year traffic is below 140,000 – 150,000 vehicles per day (Federal Highway Administration 2023). The increase in truck traffic associated with the Proposed Action would be substantially lower than these volumes, and Cameron County is an attainment area for all pollutants (EPA 2023). This project would not result in meaningful increases in mobile source air toxic impacts. Moreover, EPA regulations for vehicle engines and fuels will cause overall mobile source air toxic emissions to decline significantly over the next several decades. Accordingly, emissions from vehicular traffic would have low potential effects from mobile source air toxics and are not assessed quantitatively.

Similar to the 2022 PEA, it is expected that airspace restrictions linked to the Proposed Action could lead to increased emissions from aircraft due to rerouting and greater fuel consumption. Any resulting aircraft departure delays from impacted airports would be of short duration. Consequently, any increase in emissions from aircraft kept on the ground would likely be insubstantial. Moreover, it is probable that grounded planes would not keep their engines running during anticipated delays, further reducing potential emissions. Hence, it is not anticipated that these increased emissions would be significant, and they would not surpass the NAAQS standards for any specific pollutants. Emissions from rerouted aircraft would take place above 3,000 feet (within the mixing layer) and are unlikely to influence the surrounding air quality.

During all landing attempts, SpaceX expects residual Liquid Oxygen (LOX) and methane to remain on Starship during descent and landing. Unlike other launch vehicle propellants and fuels, LOX and methane are not hazardous air pollutants and residual liquid methane (LCH4) and LOX would be vented to the atmosphere following the landing. After landing and safing, the breakover fixture assembly (controlled supported drop from vertical to horizontal) of the Starship would commence. Because of the small scale of the emissions and the context of the minimal mobile source operations required by the Proposed Action, air pollution emissions are not expected to have a significant impact on Air Quality.

Accordingly, consistent with the data and analyses contained in the 2022 PEA, the Proposed Action would not result in significant air quality impacts.

3.2.2. Climate

Climate impacts, taking into account the new information related to the Proposed Action, would be comparable to those discussed in the 2022 PEA. The PEA determined that greenhouse gas (GHG) emissions would not be considered significant and would not contribute to any appreciable addition of GHGs into the atmosphere. Similarly, GHG emissions associated with the Proposed Action would not be considered to be significant or contribute to any appreciable addition of GHGs into the atmosphere. A summary of the carbon dioxide equivalent (CO2e) emission rates associated with the Proposed Action compared to the 2022 PEA is provided in Table 4.

Table 4. Proposed Action GHG Emission Rates Compared to 2022 PEA GHG Emission Rates

Summary Table	2022 PEA CO2e Total (metric tons)	Proposed Action CO2e Total (metric tons)	Increase in Emissions Over 2022 PEA (metric tons/year)
Starship Launches[1]	393	0	-393
Starship/Super Heavy Launches	16,650	58,450	41,800
Starship Landings	273	928	655
Super Heavy Landings	573	1,300	727
Starship Static Test Fires	573	401	-172
Super Heavy Static Test Fires	2,430	1,212	-1,218
Methane Venting	23,000	35,051	12,051
Total	**43,892**	**97,342**	**53,450**

[1] The Proposed Action is not seeking authorization for suborbital Starship launches, where the 2022 PEA authorized up to five a year (FAA 2022). This resulted in a net decrease in emissions for this activity.

As noted in Table 4, the projected methane vented will increase from the 2022 PEA. The climate impacts of GHGs, including methane, are analyzed in this section. The transportation of hazardous materials, including methane, would continue to occur in a manner consistent with applicable federal, state, and local environmental, public, and occupational health and safety regulations. This is further described in Section 3.2.10.

It is important to note that the FAA has not set a significance threshold for climate, nor has it pinpointed specific factors to consider when determining the significance of GHG emissions. Currently, there are no universally accepted methods to determine significance for commercial space launch projects due to their minimal contribution to global GHG emissions. As such, FAA guidance will evolve in line with the maturing science or if new federal mandates are introduced. To provide context, the Proposed Action's annual GHG emission rates are compared to the annual GHG emission rates for the world, the United States, and the state of Texas in terms of CO2e in Table .

Table 5. Proposed Action CO_2e Increase vs. Regional, National, and Global Emissions

Summary Table	Annual CO2e Emission Rates (metric tons/year)
World[1]	3.29×10^{10}
United States[2]	5.75×10^{9}
State of Texas[2]	7.92×10^{8}
Total Proposed Action Increase in CO2e Emissions	97,342

[1] International Energy Agency 2022.

[2] EPA 2023b. Values presented here represent gross CO2e values for the reporting year 2021.

Based on the values presented in Table , the Proposed Action would account for less than 0.0003% of worldwide GHG emissions, approximately 0.002% of US GHG emissions, and approximately 0.012% of the State of Texas GHG emissions, on an annual basis.

Airspace closures associated with the Proposed Action would lead to increased emissions from airplanes. This is mainly because planes would need to take pre-established alternative flight routes, which

themselves are assessed by the FAA under NEPA. This would result in the usage of more fuel. Increases in GHG emissions would result from the additional fuel usage. While rerouting would be a short-lived scenario for affected planes, the emissions from each launch, considering the number of planes impacted, would not be substantial enough to notably influence the climate. Additionally, since the 2022 PEA, airspace closures are becoming more efficient. SpaceX and the FAA have also established an approach for aircraft during Starship/Super Heavy launches that keeps more air routes open, so that less aircrafts are rerouted.

Based on the above findings, the data and analyses are consistent with those discussed in the 2022 PEA, and the Proposed Action would not result in significant impacts to climate change.

3.2.3. Noise and Noise-Compatible Land Use

Noise and noise-compatible land use impacts, taking into account the new information related to the Proposed Action, would be different than those discussed in the 2022 PEA. The 2022 PEA contemplated the noise associated with Starship/Super Heavy orbital launches and landings, ultimately determining that no residents or members of the public would experience noise above Occupational Safety and Health Administration's (OSHA's) 115-dBA threshold[8] for the maximum A-weighted noise contours during an orbital launch and there was no significant risk of structural damage (See Section 3.5.4 of the PEA). A discussion of other noise data affected by the Proposed Action associated with static fire engine tests, launches, landings, and potential for structural damage is provided below, and an updated Noise Assessment for the Proposed Action is provided in Appendix B.

3.2.3.1. Static Fire Engine Tests

The 2022 PEA evaluated a scenario where Starship and Super Heavy static fire engine tests would occur with up to 6 and 37 engines, respectively. The 2022 PEA found that the Maximum A-Weighted Noise Level (L_{Amax}) 90 dB contour for a Starship static fire engine test would extend approximately 2.5 miles to the west of the launch site, while the Sound Exposure Level (SEL) 90 dBA contour would extend approximately 7 miles to the west of the launch site, including some populated areas of Port Isabel and South Padre Island. The L_{Amax} 90 dB contour for a Super Heavy static fire engine test would extend approximately 4 miles to the west of the launch site, while the SEL 90 dBA contour would extend approximately 10 miles to the west of the launch site. Contours extended further to the east of the launch site due to sound propagation over water, though no human noise receptors are present in that direction. The 2022 PEA determined that intermittent and temporary FAA-licensed static fire tests would not result in significant noise impacts.

Updated static fire engine testing noise modeling results for the increased thrust of the Raptor engines indicate that the 90 dB L_{Amax} contours would increase slightly, while the SEL contours would decrease due to improvements in modeling. The modeling indicates that the 90 dB L_{Amax} contour for a Starship static fire engine test would extend approximately 3.5 miles to the west of the launch site, an increase of about 1 mile, while the SEL 90 dBA contour would extend approximately 6 miles to the west of the launch site, a decrease of about 1 mile. The updated noise modeling results also indicate that the L_{Amax} 90 dB contour

[8] Chapter 11 of the FAA Order 1050.1F Desk Reference (FAA 2024b) states the FAA should evaluate whether the Occupational Safety and Health Administration (OSHA) hearing damage criteria from 29 CFR § 1910.95 and the National Academy of Sciences' guidelines for structural damage (National Academy of Sciences 1977) may be exceeded for a project. Guidelines on permissible noise exposure limits from OSHA (OSHA 2020) are designed to protect human hearing from long-term, continuous exposures to high noise levels and aid in the prevention of noise-induced hearing loss.

for a Super Heavy static fire engine test would extend approximately 4.5 miles to the west of the launch site, an increase of approximately 0.5 miles, while the SEL 90 dBA contour would extend approximately 8 miles to the west of the launch site, a decrease of approximately 2 miles. The Proposed Action would slightly increase the area located within the 90 dB L_{Amax} contours to include additional area near the VLA. Though the noise levels would increase slightly from the increase in thrust, the noise from static fires would continue to be infrequent due to the limited duration of these tests and it is not anticipated that the Proposed Action would result in significant noise impacts. The 2022 PEA determined there would be no significant impacts due to noise from static fires. SpaceX is proposing to reduce licensed static fire time for both Starship and Super Heavy, resulting in less frequent impacts described in the 2022 PEA.

3.2.3.2. Launch (Takeoff) Noise

The 2022 PEA found that the higher L_{Amax} contours (100–140 dBA) extended up to approximately 7 miles from the launch site. Portions of South Padre Island, Port Isabel, Laguna Vista, eastern Brownsville, and eastern Tamaulipas, Mexico, were anticipated to experience L_{Amax} levels of 90-100 dBA. During daytime operations with background noise levels ranging from 50 to 60 dBA, residents of Brownsville and Harlingen were modeled to perceive launch noise levels reaching 70 to 90 dBA. 2022 PEA SEL contour levels also ranged from 90 dBA to 150 dBA for each orbital launch. If the same launch occurs during the night, when background levels are lower than during the day (e.g., below 40 dB to 50 dB range), these residents may notice launch noise levels that exceed 60 dB. A prevailing onshore or offshore breeze may also influence noise levels in these communities. The 100 dBA SEL contour extended west into Brownsville and south into Tamaulipas, Mexico, while the 90 dBA SEL contour extended further west and north into Harlingen and Raymondville, and further southwest into Tamaulipas, Mexico.

The 90 dBA L_{Amax} contour for launch operations in the 2022 PEA overlapped Brazos Island State Park, Boca Chica State Park, portions of the NHL, parts of the LRGV NWR, Isla Blanca Park on South Padre Island, and Boca Chica Village. Isla Blanca Park is not within the access restriction area and visitors at Isla Blanca Park during a launch were expected to experience close to 100 dBA during an orbital launch and closer to 90 dBA during a suborbital launch. Due to the intermittent and temporary nature of noise level resulting from launches, however, noise impacts were deemed to be not significant.

Following the launches of the Starship/Super Heavy from Boca Chica, SpaceX collected noise data which was used to verify and improve the noise modeling efforts completed in the 2022 PEA. The data collected showed the modeling results were within the predicted modeling results in the 2022 PEA.

Updated noise modeling for the Proposed Action, which includes vehicle thrust increase, indicates that the higher L_{Amax} contours (100–140 dBA) would extend up to approximately 8 miles from the launch site. Port Isabel, parts of South Padre Island, and parts of Tamaulipas, Mexico are expected to experience L_{Amax} levels of 100 to 110 dBA, while Laguna Vista and parts of eastern Brownsville are expected to experience L_{Amax} levels of 90 to 100 dBA. The rest of South Padre Island and parts of Tamaulipas, Mexico, are expected to experience L_{Amax} levels of 90 to 100 dBA.

Proposed Action SEL contour levels range from 90 dBA to 150 dBA for each orbital launch. The 2022 PEA determined that the 100 dBA SEL contour from launches would extend approximately 45 miles from the launch site, while the 90 dBA SEL contour would extend approximately 25 miles from the launch site. Under the Proposed Action, the 100 dBA SEL contour is anticipated to extend approximately 8 miles west into Brownsville and south into Tamaulipas, Mexico, while the 90 dBA SEL contour is anticipated to extend further west and north into Harlingen, and further southwest into Matamoros, Mexico, to a total of approximately 15 miles from the launch site. Due to improved accuracy of the dBA SEL modeling, the

contours for the Proposed Action are smaller than those analyzed in the 2022 PEA, accordingly, significant noise impacts are not expected. Although the frequency of noise impacts is higher than what was presented in the 2022 PEA, an increase from 10 launch events to 25 launches would still be considered intermittent, temporary, and infrequent over the course of a year. As stated above, no residents or members of the public will experience noise above OSHA's 115-dbA threshold during an orbital launch. Accordingly, significant noise impacts are not expected.

3.2.3.3. Landings

The 2022 PEA presented modeled sound levels for Super Heavy booster and Starship landings at the VLA during orbital missions. For Super Heavy landings, Port Isabel was modeled to experience an approximately 90 dB L_{Amax}, and the southern portion of South Padre Island was modeled to experience approximately 90–95 dBA. All other populated areas were modeled to experience 90 dBA or below. For Starship orbital landings at the VLA, the 2022 PEA indicated that a portion of Port Isabel and the southern part of South Padre Island would experience 90 dB L_{Amax}. Residents of Brownsville were expected to possibly hear noise levels above 60 dBA, but noise during offshore Super Heavy or Starship landing events was not expected to be noticed by residents along the coast.

Based on the Proposed Action's updated noise modeling for Super Heavy landings at the VLA, the southern portions of Port Isabel and South Padre Island are expected to experience between a 90 and 100 dB L_{Amax}. All other populated areas are expected to experience 90 dBA or below. For Starship landings, the 90 dB L_{Amax} contour extends about 6 miles from the VLA. Residents of Port Isabel may hear Starship landing events above 60 dB, particularly during nighttime landings. The 115 dB L_{Amax} contour, which is used as a conservative limit for hearing conservation, is located approximately 1 mile from the landing pad and does not contain private residences. For a near-shore landing of Starship in the Gulf in a contingency zone, beginning 1 nautical mile or more from the coast, for a distance up to 100 miles north of the VLA, near Corpus Christi, and up to 100 miles south of the VLA, near El Carrizo, Tamaulipas, Mexico, inland areas up to 5.5 miles from the coast may experience sound events between 90 - 115 dB. Exposures from coastal landings would be brief (less than one minute), infrequent, and would not exceed OSHA hearing conservation thresholds.

Although the updated modeling indicates that landings would be slightly louder than modeled in the 2022 PEA, these differences would be small and would not be meaningfully noticeable. The noise from landings would be short in duration. As described in the 2022 PEA, noise from landings is expected to last approximately one minute, with the peak exposure for a single location lasting approximately 20 seconds. The Super Heavy booster would land approximately 10 minutes after launch, and the timing of Starship landings would vary based on the mission. The noise between launches and landings would be spread out over time, and landing noise would not result in significant impacts.

3.2.3.4. Cumulative Noise

For the Proposed Action, cumulative noise levels were estimated for projected launch, landing, and static fire test operations at the VLA using the Day-Night Average Sound Level (DNL) metric. FAA's threshold of project-related noise change is measured in DNL. This calculation does not include noise from sonic booms from landing events. Cumulative noise from sonic booms is discussed in 3.2.3.5 below. Noise from nighttime landings receives a DNL 10 dBA penalty. DNL is intended to measure the effect of cumulative sound on humans and accounts for the time of day during which the noise occurs, how long the noise lasts, how loud it is, and the frequency that it occurs. For the Proposed Action, the DNL 65 contour for the Proposed Action is located within about 3.5 miles of the VLA entirely in areas that are unpopulated, except

for Boca Chica Village. SpaceX would enforce the access restriction area during launch operations, as discussed in the 2022 PEA (FAA 2022 Section 2.1.3.5). Thus, no visitors or village residents would be present at noise sensitive areas within the 4-mile radius and the proposed project changes would not result in significant noise impacts.

3.2.3.5. Sonic Booms

A sonic boom is the sound associated with the shock waves created by a vehicle traveling through the air faster than the speed of sound. A sonic boom trace is an impulsive event that lasts for less than 300 milliseconds. Noise from ascent is consistent with the 2022 PEA and the sonic boom would occur over water, not impacting land. A sonic boom would also be generated during orbital Starship/Super Heavy launches and Starship and Super Heavy landings as the vehicle approaches the landing location. SpaceX used PCBOOM to estimate single event sonic boom levels during Starship and Super Heavy descent. SpaceX's sonic boom analysis via PCBOOM is located in Appendix B. Sonic boom modeling contours are approximate and actual exposure at any particular location or time during a sonic boom event can vary depending on a number of different atmospheric, physical, and operational parameters. The location of maximum overpressure from a sonic boom would vary with weather conditions, and it is unlikely that any given location would experience the maximum estimated overpressure level more than once over multiple events. Impacts to human health are not anticipated, studies have shown human exposure to up to 100 psf sonic booms with no adverse consequences (Benson 2013, Maglieri 2014).

Starship/Super Heavy Orbital Launches

Sonic boom impacts from Starship/Super Heavy launches are consistent with the information contained within the 2022 PEA, Section 3.5.4.6.

Super Heavy Booster Landings

Updated sonic boom modeling for the booster landings under the Proposed Action predict overpressure events of 15 psf and 21 psf in areas located within the area where only SpaceX personnel are allowed during launches (public hard checkpoint[9]). Boca Chica Village is within the public hard checkpoint, which is evacuated during launch/landing activities. The predicted overpressure for the area surrounding the public hard checkpoint indicate overpressure events up to 15 psf, with contours extending just beyond the U.S. / Mexico Border.[10] Predicted overpressure levels at the southern tip of South Padre Island and Port Isabel, Tarpon Bend, as well as northeast regions of Tamaulipas, Mexico would be expected to reach 10 psf. The 6 psf sonic boom contour is predicted to extend approximately 10 miles from the launchpad, and encompass portions of South Padre Island, all of Port Isabel, Laguna Heights, and portions of Laguna Vista. Portions of northeastern Tamaulipas, Mexico, including La Burrita and El Conchillal, would also be encompassed in the 6 psf sonic boom contour. The 4 psf boom contour is expected to extend approximately 15 miles from the launchpad, and would encompass northern portions of South Padre Island, Laguna Vista, eastern portions of Brownsville, and La Bartolina and El Huisachal in Tamaulipas, Mexico. The 2 psf sonic boom contour is predicted to extend approximately 27 miles, and would overlap Laguna Atascosa, Los Fresnos, Brownsville; and in Mexico, Matamoros and San José. The 1 psf sonic boom contour is predicted to extend approximately 28 miles, and would impact Rio Hondo, San Benito, as well as Santa Adelaida, La Venada, and San José in Mexico.

[9] The public hard checkpoint is located at State Highway 4 and Richardson Avenue. Only SpaceX personnel and FAA launch support personnel are able to pass this checkpoint.

[10] Because the FAA is required to analyze transboundary impacts, areas in Mexico are also considered in the analysis.

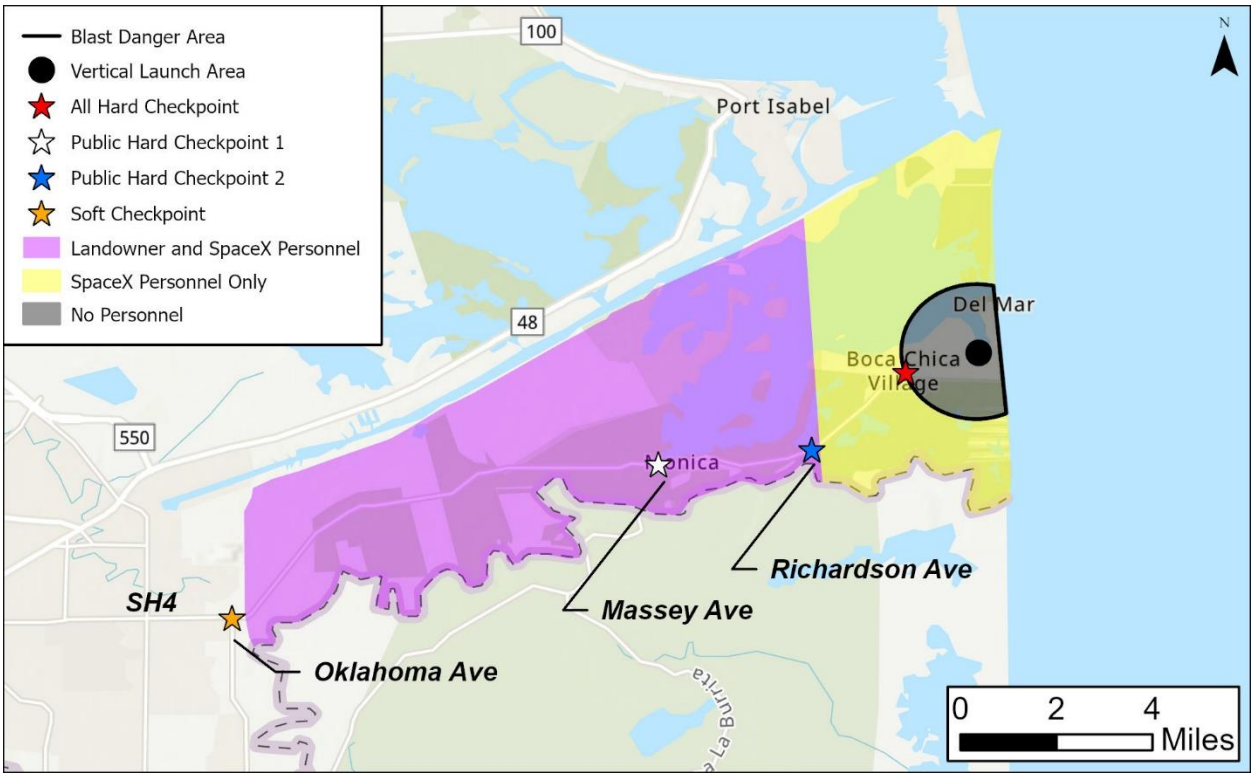

Figure 6 Access Restriction Area

Starship Landings

For Starship landings at the VLA, the 2022 PEA predicted overpressure levels ranging from 1.2 to 2.2 psf. The 2.2 psf contour was estimated to be offshore and not impact land. Overpressures between 2 and 1 psf were predicted to impact the southern part of South Padre Island. For the Proposed Action, sonic booms are predicted to range between 4 psf and less than 1 psf. The 4 psf sonic boom is predicted to occur on southernmost part of South Padre Island and the jetty at Boca Chica Beach. The 2 psf contour is predicted to reach portions of South Padre Island, as well as Port Isabel, Boca Chica, and northeast portions of Tamaulipas, Mexico. The 1 psf contour is predicted to extend approximately 24 miles, and impact Brownsville, South Padre, Port Isabel, Laguna Heights, Laguna Vista, and other south Texas communities, as well as El Huisachal and Rancho Santa Isabel in Mexico.

In general, sonic booms in the 0.2 to 0.3 psf range could be heard by someone who is expecting them and listening for them, but usually would not be noticed. Sonic booms of 0.5 psf are more likely to be noticed, and sonic booms of 1.0 psf and above are certain to be noticed (1 psf is similar to a clap of thunder). Sonic booms of 1 to 2 psf are produced by supersonic aircraft flying at normal operating altitudes.

A Starship near-shore contingency landing zone in the Gulf, beginning 1 nautical mile or more from the coast and covering a distance of up to 100 miles north of the VLA near Corpus Christi, and up to 100 miles south of the VLA near El Carrizo, Tamaulipas, Mexico, is included in this Tiered EA. SpaceX may land the Starship vehicle anywhere within the revised boundary (Figure 2). Onshore sonic boom impacts outside of the VLA Action Area were not previously considered in the 2022 PEA. The approximate extent of the 1 psf sonic boom contour associated with a near-shore landing of Starship in the Gulf (i.e., approximately 20 miles inland for a distance of approximately 100 miles north and south of the VLA Action Area) is the

Starship Contingency Action Area. A sonic boom measurement of 1 psf is similar to a clap of thunder; significant impacts are not expected from sonic booms in the Starship Contingency Action Area.

Cumulative Day-Night Level

Noise exposure from sonic booms that exceeds the significance threshold of C-weighted day-night average noise level (CDNL) 60 dBC for impulsive noise sources (equivalent to DNL 65 dBA) is a significant impact (FAA 2020, FAA 2022, Galloway et. al 1981). To determine the significance of sonic boom exposure on surrounding communities, the FAA converted psf data to CDNL as specified in the FAA Order 1050.1F Desk Reference. The FAA uses CDNL to assess cumulative annoyance from impulsive noise like sonic booms, while using other metrics to evaluate hearing loss and other noise-related health effects (FAA 2024b). Given unique characteristics of commercial space operations, the FAA's guidance recommends that other supplemental noise metrics may also be used in conjunction with DNL "to describe and assess noise effects for commercial space operations" (FAA 2024b). The FAA does not use these supplemental metrics to make decisions. Rather, the FAA has established a system of noise measurement that comprises a single, core decision-making metric, the A-weighted DNL. Under FAA Order 1050.1F, significant noise impacts would occur if the Proposed Action would increase noise by DNL 1.5 dB or more for a noise sensitive area that is exposed to noise at or above the DNL 65 dBA noise contour, or that will be exposed at or above the DNL 65 dB level due to a DNL 1.5 dB or greater increase in noise exposure, when compared to the No Action alternative for the same timeframe. FAA's NEPA implementing policies and procedures did not exempt commercial space transportation from this threshold. See FAA Order 1050.1F at Exhibit 4-1. Until the FAA revises its noise policy, all actions including commercial space transportation actions, are subject to this metric and significance threshold.[11]

The 60 dB CDNL contour extends approximately 5 miles from the VLA. No noise-sensitive areas are within the 60 dB CDNL contour, accordingly no noise-sensitive areas would experience significant noise impacts under the FAA's current 60 dB CDNL significance threshold.

[11] The FAA determined that changes in transportation use, public expectations, and technology warrant a review of its civil aviation noise policy. On January 13, 2021, the FAA published in the Federal Register a notice entitled, "*Review of FAA Aircraft Noise Policy and Research Efforts: Request for Input on Research Activities to Inform Aircraft Noise Policy"*,86 FR 2722, which described the FAA's noise research portfolio and a first of its kind nationally scoped survey that updated FAA's understanding of the dose-response relationship between exposure to aircraft noise and community annoyance (Neighborhood Environmental Survey or NES). FAA also requested input on the FAA's research activities that would inform the FAA's noise policy and would inform the future direction of the FAA noise research portfolio. The NES showed that a higher percentage of people were "highly annoyed" by aircraft noise across all levels of noise exposure that were studied. In addition to setting forth the FAA noise policy and research efforts, this Notice described the results of research into the societal benefits and costs of noise mitigation measures. On May 1, 2023, the FAA published in the Federal Register a notice entitled "*Request for Comments on the Federal Aviation Administration's Review of the Civil Aviation Noise Policy, Notice of Public Meeting.*" In this notice, the FAA announced that it intends to consider how changes to the FAA civil aviation noise policy may better inform agency decisions and the types of impacts FAA considers in making decisions (e.g., community annoyance, certain types of adverse health impacts highly correlated with aviation noise exposure). The FAA requested suggestions of potential improvements to how the FAA analyzes, explains, and presents changes in exposure to civil aviation noise. 88 FR 26641. In this notice, the FAA specifically sought public comments on whether it should establish noise thresholds for low-frequency events, such as those associated with the launch and reentry of commercial space transportation vehicles authorized by the FAA Office of Commercial Space Transportation, which metrics should be used to establish these noise thresholds, and the appropriate noise exposure level to define the threshold of significant noise impacts. As part of this policy review, FAA is also examining the body of scientific and economic literature to understand how aviation noise correlates with annoyance as well as environmental, economic, and health impacts. The FAA is also evaluating whether any of these impacts are statistically significant and the metrics that may be best suited to disclose them. Until this policy development process is concluded, the FAA will continue to rely on DNL to make decisions regarding the significance of potential noise impacts as set forth in FAA Order 1050.1F at Exhibit 4-1.

As described in the 2022 PEA, SpaceX would continue to implement their public notification plan to educate the public and announce when a launch or landing event would occur in order to reduce potential startle responses from high-noise activities and thus mitigate the potential effects of high-noise activities by increasing public awareness. Announcements of upcoming Starship/Super Heavy launches and landings would serve to warn people about these noise events. The plan would involve issuing statements to news outlets and law enforcement so that when noise is heard, the public would understand what has occurred. Sonic booms from Starship landings could occur days or weeks after the launch mission; however, these booms are substantially less noisy than Super Heavy landings. Due to these notifications and that the 60 dB CDNL contour does not reach noise-sensitive areas, significant impacts are not expected due to exceedance of 60 dB CDNL.

3.2.3.6. Structural Damage Potential

Based on the updated noise modeling for the Proposed Action, the 140 dB L_{max} contour[12] for launch events would extend approximately 1.2 miles to the west and to the north, consistent with what was analyzed in the 2022 PEA. There are no third-party structures in the 150-dB contour, and with the exception of the two historical resources assessed in the 2022 PEA, there are no third-party structures in the 140 dB contour. Additionally, the historical resources have been stabilized since the publication of the 2022 PEA to protect the resources against vibrations from launch operations and the vibration monitoring reports for Flight 1-3 have shown no damage to structural resources. Consistent with the 2022 PEA, Boca Chica Village would be contained within the 130 dBA L_{max} contour, which extends approximately 3.5 miles. Port Isabel, South Padre Island, and Tamaulipas, Mexico are predicted to be within the 120 dB L_{max} contour, with the southeastern part of Laguna Vista being within this contour as well. This contour extends approximately 9.5 miles, slightly further than the 8 miles analyzed in the 2022 PEA. The entirety of Brownsville and most of Matamoros, Mexico would be contained within the 111 dBA L_{max} contour, which extends approximately 22.5 miles, compared to the 19 miles in the 2022 PEA. Although recent modeling predicted that noise contours would extend slightly further than predicted in the 2022 PEA, no structural damage or significant impact to third-party structures is anticipated.

For sonic booms, at approximately 2 psf there is a 1/10,000 probability of breakage for a large window, and at approximately 4 psf there is a 1/10,000 probability of breakage for a small window (USACE 1989). At 6 psf, audibility is effectively guaranteed. Laboratory and field testing shows that pre-damaged or poor condition windows could possibly exhibit progression of damage over multiple exposures to this magnitude of boom (Higgins 1965). At 10.0 psf the likelihood of superficial (e.g., plaster, bric a brac) damage and window damage becomes more plausible but is generally still expected to be very low probability and predominantly due to poor existing conditions such as pre-cracked, pre-stressed, older and weakened, or poorly mounted windows (Benson 2013, White 1972, Fenton 2016, Maglieri 2014). Finally, SpaceX presents sonic boom exposures up to 21 psf for booster landings. This represents a threshold where prevailing literature indicates window breakage becomes possible for standard condition windows, though the prediction of specific window breakage still depends on size, age, orientation, surrounding structure, and other effects (NOAA 2019, Maglieri 2014). The areas that would be exposed to this level are generally limited and would be evacuated during launch and when reentering vehicles may fly supersonic at the lowest altitude before landing. Please refer to the Appendix B Noise Assessment for additional information on sonic booms.

[12] As indicated in the 2022 PEA, there is consensus that damage becomes improbable below 140 dB. See Fenton and Methold 2016.

FAA requires SpaceX to maintain insurance in the unlikely event of claims of structural damage resulting from flight of the Starship/Super Heavy launch vehicle. Property owners may contact SpaceX directly (insurance@spacex.com) to submit claims and evidence in support of the damage claim. Based on data measured during the April, November 2023, and March 2024 Starship/Super Heavy test flights, and summarized in the vibration monitoring reports, extrapolation of launch data suggests that peak responses should remain below a widely used damaging threshold of 2 inches per second for most well-maintained structures beyond 0.7 miles from the VLA (U.S. Bureau of Mines 1989). Additionally, the analysis found that the increased launch cadence in the Proposed Action would not pose a substantial concern for fatigue for most residential and commercial buildings beyond 0.7 miles of the VLA. In accordance with the 2022 PEA, the PA, and the SpaceX Boca Chica Vibration Monitoring Plan, SpaceX would continue to monitor the launch vibrations for a total of 5 orbital launches at various locations 2, 3, 5, and 8 miles from the VLA to confirm that vibration does not pose a risk of structural damage.

3.2.3.7. Hearing Conservation

As discussed above, no residents or members of the public would experience noise above OSHA's 115-dBA threshold for the maximum A-weighted noise contours. Additionally, the modeled sonic boom levels would not cause human health or safety risks. Surveys of residents have found that startle, rattle, and vibrations and the possibility of damage to be the most disturbing aspects of sonic booms (Maglieri et al. 2014). Human exposure in tests of sonic booms up to 144 psf have been documented with no adverse consequences (Benson 2013, Maglieri et al. 2014, Nixon 1968, Maglieri 1966). A study of the long-term effects of exposures to sonic booms from supersonic military flight operations on human health conducted on residents of Nevada between 1969 to 1983 found no convincing evidence of the existence of adverse health effects due to sonic booms (Sutherland and Plotkin 1986, Anton-Guirdis et al. 1986). Therefore, no significant health effects from launch related noise or sonic booms are expected to occur.

3.2.4. Visual Resources

Visual resource impacts, taking into account the new information related to the Proposed Action, would be comparable to those discussed in the 2022 PEA except for the additional proposed nighttime launches. The PEA determined that the most impactful effect on visual resources would be associated with nighttime launches, which would result in increased light emissions during those events.

Nighttime launches would increase from one orbital and one suborbital under the 2022 PEA, to up to three nighttime launches under the Proposed Action. This would result in an increased frequency of Proposed Action impacts on nighttime views as identified in the 2022 PEA. However, SpaceX has increased the efficiency of vehicle preparations, requiring less time to prepare per launch event (decreased by 140% from Flight 1 to Flight 4), and less nighttime activity requiring lighting, and thus the amount of lighting on a per launch basis has decreased, and overall impacts are anticipated to remain similar to those assessed in the 2022 PEA. Effects from nighttime launch events would be lessened through conformance with the conditions and mitigation including following the Lighting Management Plan. This Plan includes minimizing spotlights when not launching and directing light downward, low, and using amber lights to the greatest extent possible. Therefore, the Proposed Action would result in less frequent impacts on nighttime views and less lighting impacts in total compared to the 2022 PEA, the type and magnitude of impacts associated with the single proposed nighttime launch event was considered in the 2022 PEA.

Accordingly, consistent with the data and analyses contained in the 2022 PEA, the Proposed Action would not result in significant visual resource impacts as briefly discussed in subsequent sections (3.2.5 Cultural Resources and 3.2.6 Department of Transportation Act Section 4(f)).

3.2.5. Cultural Resources

Cultural resource impacts, taking into account the new information related to the Proposed Action, would be comparable to those discussed in the 2022 PEA. The PEA determined that the area of potential effects (APE) was a 10-mile area centered on the VLA and encompassed where ground-disturbing activities and/or engine noise levels up to 120 decibels (dB) were predicted to be experienced.

As explained in the PEA, the FAA made a finding of *adverse effect* for the following 17 historic properties (i.e., historic sites, objects, structures, and buildings), because they could experience visual, auditory, and vibration effects or falling debris from an anomaly directly striking the historic properties that could diminish their integrity: Alta Vista Apartments; Former Bahia Mar and Bahia Grande Condominiums; Charles Champion Building; Del Mar; Long Island Swing Bridge; Palmetto and Cypress Bridge Pilings ; Palmetto Pilings Historical Marker; Palmito Ranch Battlefield NHL; Point Isabel Coast Guard Building; Point Isabel Lighthouse and THC Marker; Port Isabel Cemetery; Port Isabel Firemen's Hall; Queen Isabel Inn; Queen Isabella Memorial Causeway; Sea Island Resort Hotel; Former Ship Café Building; and the White Sands Motel (FAA 2022:78–79). It was noted in the PEA that the Palmetto and Cypress Bridge Pilings and Palmetto Pilings Historical Marker would potentially be most affected (i.e., potentially physically damaged) by high noise levels and the associated vibrations caused by vehicle launches.

To resolve these adverse effects, the FAA, THC, NPS, USFWS, TPWD, the Advisory Council on Historic Preservation, and SpaceX executed a Programmatic Agreement (PA) in April 2022 that stipulated the process for minimizing and mitigating adverse effects for these 17 historic properties. With the resolution of adverse effects on historic properties, the Proposed Action documented in the PEA would not result in significant impacts on historical, architectural, archaeological, or cultural resources. The following measures were identified in the PA to avoid, minimize, or mitigate adverse effects associated with auditory and vibration effects and/or falling debris from an anomaly directly striking the historic properties (FAA 2022:85–86):

- Implementing measures to reduce noise levels generated by construction equipment.
- Implementing measures to minimize noise from truck (construction, tanker, concrete, water, delivery) traffic.
- Conducting a vibration monitoring program to gather data on the effects of launches on the Palmetto Pilings Historical Marker, Palmetto Pilings, Port Isabel Lighthouse, and at the 2-, 3-, and 8-mile distances from the VLA. The program will also include a structural assessment from vibration data to assess any impacts and address any structural damage given any impact from launch operations.
- If an anomaly affects a historic property, SpaceX will hire a qualified professional to make recommendations for restoration of the historic property. Upon review and approval, SpaceX will hire a qualified professional to restore the historic property.
- An Unanticipated Discoveries Plan was prepared to outline the processes to be followed in the event previously unknown cultural resources or human remains are discovered during construction or operation of the Proposed Action.

No additional visual impacts from the Proposed Action would result in a change to the 10-mile APE used in the 2022 PEA. Additionally, the modeled 120 dB contour for the Proposed Action stays within the APE evaluated in the 2022 PEA. With regard to the 120-dB contour, the Starship and Super Heavy static fire test contours would extend up to approximately 3 miles and 6 miles, respectively, from the VLA, while the Starship/Super Heavy launch contours would extend up to approximately 9.5 miles from the VLA.

The Proposed Action would not include construction for launch operations beyond the boundary analyzed in the 2022 PEA; therefore, there would be no changes regarding the avoidance, minimization, or mitigation recommendations for the previously recorded historic properties in the 2022 PEA.

In accordance with the 2022 PEA, the PA, and the SpaceX Boca Chica Vibration Monitoring Plan, SpaceX's contractor STRAAM monitored the April and November 2023, as well as the March, June, and October 2024 launch events and all vibration minimizing measures described above were in place. STRAAM individually monitored the Palmetto Pilings 1936 Centennial Marker (Historic Marker), Palmetto and Cypress Bridge Pilings site (the Pilings), and the Port Isabel Lighthouse, including the replica Fresnel Lens. In addition, ground vibration monitors were placed 2, 3, 5, and 8 miles from the launch pad. The vibration monitoring determined that the majority of the energy transmitted by the launch was distributed through the air and not through the ground. During the first test flight, the sensor on the Historic Marker appeared to only record background noise and may have malfunctioned, however no damage was observed to the structure following the launch. For the following launch events, the equipment at the marker functioned correctly, and STRAAM determined that the marker is less dynamically sensitive and found no signs of damage to the structure. STRAAM determined that the mitigation efforts implemented at the Pilings worked, no damage was visible to the structures and elevated vibration thresholds were not triggered on the monitors. The overall dynamic signature of the Lighthouse and the Lens were both unchanged after the launch. The level of energy measured at the Lighthouse during launch was small and did not excite the Lighthouse to damaging levels. The response of the Lens during the launch was very similar to the response of the dome, indicating that the lens protection was successful in mitigating free motion of the lens. Finally, ground motion at the Lighthouse was minimal, and similar to the vibration intensity caused by normal truck traffic in the area. No damage to the Lighthouse was observed. The PEA and FONSI/ROD determined the Proposed Action may have adverse effects to historic properties, but determined adverse effects would be resolved through the PA. The vibration monitoring program demonstrates conformance to the Starship/Super Heavy program evaluated in the FONSI/ROD, consistent with the findings in the PEA and FONSI/ROD regarding potential damage due to vibration, there would be no significant impacts due to vibration.

SpaceX also continues to mitigate impacts to cultural resources by implementing other mitigation measures established in the 2022 PEA and the 2022 PA. For example, the Historical Context Report has been reviewed by the agency consulting parties in accordance with the PA during development and is scheduled to be finalized in 2025. SpaceX has worked with a qualified firm to develop the Scope of Work for the Level Historic American Landscapes Survey in coordination with the FAA, which was provided to the consulting parties for review and comment on October 27, 2023, in accordance with the PA. SpaceX submitted the final scope of work to the FAA on December 14, 2023, and anticipates starting the project in 2025.

SpaceX is not proposing any additional access restrictions that would impact visitation to the cultural resources. No additional effects to cultural resources would result from the Proposed Action beyond those described in the 2022 PEA and analyzed above. The avoidance, minimization, or mitigation

recommendations in the PA (as currently stands or modified under this EA, if applicable) would continue to be implemented.

Although the Proposed Action would result in increased sonic boom levels from landings at the VLA, the sonic booms would not result in significant impacts to cultural resources. Noise due to sonic booms from Super Heavy landings at the VLA would increase from up to 15 psf in the 2022 PEA to within the 21 psf contour in this EA. Although overpressure levels would increase, as described in Section 3.2.3.5, the sonic booms are not predicted to cause structural damage to cultural resources within the APE. The two resources located within the 21 psf contour are the Cypress Bridge Pilings and Palmetto Pilings Historical Marker. The Palmetto Pilings Historical Marker had foundations reset in 2022 by THC and SpaceX, and the Cypress Bridge Pilings and Palmetto Pilings Historical Marker would continue to remain braced surrounding launch events to prevent damage due to elevated vibration, as agreed to by the consulting parties to the 2022 Programmatic Agreement.

SpaceX anticipates launching Starship/Super Heavy from Pad B and Orbital Launch Mount 2 (OLM 2) beginning in 2025. While no additional effects to cultural resources would result from the Proposed Action beyond those previously described in the 2022 PEA, SpaceX will monitor vibration levels at the Palmetto Piling, 1936 Centennial Marker, Palmetto and Cyprus Bridge Pilings site, the Port Isabel Lighthouse, and at locations 2 miles, 3 miles, and 8 miles from the launch site, as described in the Vibration Monitoring Plan for each of the first three launches from OLM 2.

The Faro Bagdad Lighthouse, approximately 3 miles south of the VLA in Bagdad, Tamaulipas Mexico, is located within the 10 psf contour. As described in the PEA, at 10.0 psf the likelihood of superficial (e.g., plaster, bric a brac) damage and window damage becomes more plausible but is generally still expected to be very low probability and predominantly due to poor existing conditions such as pre-cracked, pre-stressed, older and weakened, or poorly mounted windows (Benson 2013, White 1972, Fenton 2016, Maglieri 2014). Structural damage to this lighthouse is not anticipated due to the concrete makeup of the structure.

FAA requires SpaceX to maintain insurance in the event a sonic boom results in claims of structural damage. Property owners may contact SpaceX directly to submit claims and evidence in support of the damage claim.

To mitigate potential effects on cultural resources, the FAA has revised the EA to remove the U.S. Exclusive Economic Zone (EEZ) from the Pacific Ocean action area and establish a buffer zone around the Papahānaumokuākea Marine National Monument.[13] The removal of the U.S. EEZ from the Pacific Ocean action area helps to ensure that operations avoid areas of cultural significance, such as World Heritage Sites.

Based on the above findings, consistent with the data and analyses that were discussed in the 2022 PEA, the Proposed Action would not result in significant impacts to cultural resources.

[13] Presidential Proclamation – Papahanaumokuakea Marine National Monument; Designated by Proclamation 8031 (June 15, 2006) and amended by Proclamation 8112 (February 28, 2007), and 50 CFR part 404 and Presidential Proclamation 9478 – Papahanaumokuakea Marine National Monument Expansion (August 31, 2016).

3.2.6. Department of Transportation Act Section 4(f)

The study area for Section 4(f) was adjusted after the 2022 PEA to include noise contours associated with the Starship near-shore contingency landing zone in the Gulf, beginning 1 nautical mile or more from the coast, and covering a distance of up to 100 miles north of the VLA, near Corpus Christi, and up to 100 miles south of the VLA, near El Carrizo, Tamaulipas, Mexico. Protected Section 4(f) resources include school playgrounds, public parks, recreation areas, wildlife or waterfowl refuges of national, state, or local significance, and land of an historic site of national, state, or local significance. Within the adjusted study area, several additional (i.e., not listed in the 2022 PEA) publicly owned schools, parks, recreation areas, and refuges qualify as Section 4(f) properties:

- Seashore Middle Academy
- Port Isabel Junior High
- Derry Elementary
- Garriga Elementary
- Seashore Learning Center
- Dunn Ranch, Novillo Line Camp
- Palmito Ranch Battlefield
- Bryan Beach State Recreation Park
- Padre Island National Seashore
- Aquarius Park
- Padre Balli Park
- Sandy and Don Billish Park
- Doudon Park
- Packery Channel Park
- Mustang Island State Park
- Ulberg Park
- Commodore Park
- Isla Blanca Park

The Proposed Action would not result in a *use* via permanent incorporation of any Section 4(f) property. Therefore, the only possible Section 4(f) use of the 4(f) properties in the study area would be through temporary occupancy or constructive use. Many schools, parks, recreation areas, and refuges were not evaluated in detail because of the limited potential for noise or other proximity-related impacts to substantially impair the attributes, activities, or features that qualify these resources for protection under Section 4(f). Detailed analysis was reserved for those resources which could be affected by both operational noise and access restrictions as a result of the implementation of the proposed action.

The 2022 PEA determined that the study area for Section 4(f) is the 90 dB L_{Amax} noise contour for Starship/Super Heavy orbital launch operations. Following the 90 dB L_{Amax} contour, the 2022 PEA identified 26 publicly owned parks, recreation areas, and refuges, and 17 historic properties. In the 2022 PEA, the FAA determined that the Proposed Action:

- would not result in the use of any Section 4(f) properties through permanent incorporation.
- would have no *constructive use* of historic properties, Boca Chica State Park, Brazos Island State Park, the LRGV NWR, the South Bay Coastal Preserve, Isla Blanca Park, Laguna Atascosa National Wildlife Refuge, Trail Park, and Laguna Madre Nature Trail under Section 4(f) resulting from visual effects.
- would have no *constructive use* under Section 4(f) due to temporary access restrictions from launch operations or anomalies.
- would have no *constructive use* under Section 4(f) due to noise from launch or daily operational activities.

- would have no *constructive use* of historic properties, the Isla Blanca Park, Laguna Atascosa National Wildlife Refuge, or Laguna Madre Nature Trail from vibrations or sonic booms for launch operations under Section 4(f).
- would constitute a use under Section 4(f) for temporary occupancy of some historic properties and Boca Chica State Park and Brazos Island State Park resulting from anomalies, but any such impacts are expected to be *de minimis*.

The Proposed Action would not change limits on access restrictions for launch operations or in the event of an anomaly. Since the first launch in April 2022, SpaceX has increased the efficiency of launch operations and reduced the projected duration of access restrictions on a per operation basis. The 2022 PEA assumed approximately 100 hours of access restrictions for each orbital launch event and 500 hours of access restrictions annually. For the April 20, 2023 launch, there were approximately 24.5 access restriction hours for the launch, and 48 hours of access restriction for anomaly response activities. For the second test flight on November 18, 2023, there were approximately 10.5 access restriction hours for launch and none for anomaly response activities, Flight 3 used approximately 8.75 restriction hours, and Flight 4 used approximately 7.75 access restriction hours. Although the number of orbital launches and landings would increase under the Proposed Action, the total duration of access restrictions would still not exceed 500 hours annually. As the number of launches increases, the reliability of the vehicle would increase and the risk of an anomaly would be below what was described in the 2022 PEA. No additional hours of anomaly-related access restrictions beyond the 300 analyzed in the 2022 PEA are proposed. SpaceX has implemented ongoing mitigation measures, including not restricting access on holidays and weekends during summer months, as required in the 2022 PEA, and relocating certain testing operations to Massey's Test Site, reducing the need for extended closures of Boca Chica Beach. The FAA and SpaceX continue to implement measures to minimize closure durations, including implementing precise scheduling to reduce public access disruptions, advance notice to allow for better planning around closures, and efforts to consolidate activities to minimize the frequency of closures. Additionally, SpaceX would continue to implement mitigation measures for access restrictions as described in the 2022 PEA. Therefore, the FAA has determined that the increase in operational activities would not constitute a *constructive use* due to temporary access restrictions of these Section 4(f) properties.

During operations, the Proposed Action would include increased launch cadence and increased thrust, which would increase the 90 dB L_{Amax} contour from the contour assessed in the 2022 PEA by approximately 2 miles for launches and 1 mile for landings. No additional 4(f) resources were identified within modeled noise contours, however additional parts of the Laguna Atascosa National Wildlife Refuge and of the LRGV NWR would be exposed to the 90 dB L_{Amax} contour. A quiet setting was noted as an important attribute to both these wildlife refuges. However, noise effects would be intermittent and short-term in duration (minutes). At all other times, the quiet setting of the Section 4(f) properties would persist. Therefore, the FAA determined that noise from operational activities would not constitute a *constructive use* of these Section 4(f) properties.

The FAA determined there would not be significant impacts to 4(f) resources within the 60 CDNL contour, see Section 3.2.3 for more information on the 60 CDNL contour. The FAA determined that significant sonic boom impacts are not caused by the Proposed Action. While the Proposed Action may cause sonic booms of higher magnitude and over a greater area than was evaluated in the 2022 PEA, the effects would still be temporary and of short duration, and would not result in a *constructive use* of Section 4(f) resources.

The Proposed Action would also result in a small increase in noise levels from increased commodity and water truck trips. It is anticipated that the Proposed Action would increase vehicle traffic and human

presence from an estimated 6,000 total trucks per year in the 2022 PEA to 23,771 trucks under the Proposed Action. The location and timing of these trips would be as described in the 2022 PEA and would not constitute a *constructive use* of affected Section 4(f) properties due to their intermittent nature and rapid noise attenuation over distance. This would represent approximately five additional trucks along SH4 an hour if trucks operate 12 hours per day.

The FAA is ensuring SpaceX continues to mitigate impacts to Section 4(f) resources by means including but not limited to: issuing notifications in accordance with its Access Restriction Notification Plan, collaborating with USFWS to meet environmental education goals, collaboration with Fishing's Future (an organization dedicated to bringing youth closer to nature), implementing the SpaceX Lighting Management Plan, and undertaking research on restoration of algal flats with Texas A&M University (TAMU). SpaceX continues to implement existing measures to reduce noise levels generated by construction equipment and from truck traffic, including placing generators in baffle boxes and the use of mufflers on equipment.

As described above, the reliability of the vehicle would increase as more launches occur and the risk of an anomaly, including anomalies affecting adjacent properties, would be below what was described in the 2022 PEA. In the unlikely event of an anomaly, impacts from such an event would continue to be *de minimis*. SpaceX would continue to implement the measures specified in the Memorandum of Agreement with TPWD described in the 2022 PEA to mitigate and restore any impacts from anomalies at Boca Chica State Park, Brazos Island State Park, and other TPWD land. SpaceX will also notify TGLO for any anomalies, as appropriate. Approximately 90 percent of debris from the Flight 1 anomaly has been removed; debris from all subsequent flights has been removed. SpaceX continues to work with TPWD and USFWS to remove debris in accordance with the 2022 MOU with TPWD and to minimize environmental impacts from debris activity, including only conducting debris removal outside of nesting bird season and during dry conditions, and as conditions allow will remove all debris while protecting the environmental resources during the process. SpaceX continues to fund algal flat restoration with researchers at TAMU to determine appropriate methods of restoring damaged algal flats in the area. The debris will be removed and the algal mats will be restored, so debris impacts would be short-term and not permanent. Therefore, the FAA has determined that the increase in operational activities would not lead to a corresponding increase in anomalies affecting the adjacent properties. Impacts resulting from anomalies would continue to constitute a temporary occupancy, but any such impacts are expected to be *de minimis* on Section 4(f) properties. As required by Section 4(f), the FAA received concurrence on this *de minimis* finding from the proper officials with jurisdiction over the affected properties.

THC, TPWD, USFWS and TGLO concurred with the FAA Section 4(f) determinations. The Section 4(f) consultation letters for this Tiered EA are included in Appendix A.

Based on the above findings, consistent with the data and analyses that were discussed in the 2022 PEA, the Proposed Action would not result in significant impacts to 4(f) properties.

3.2.7. Water Resources (including Wetlands, Floodplains, Surface Waters, Groundwater, Ocean Waters)

The FAA previously evaluated the effects of deluge water discharges in the PEA and confirmed the validity of the PEA's findings given updated information about the deluge water system in the November 2023 WR; both documents concluded no significant impacts would occur. SpaceX installed the deluge water

system after Flight 1 to protect the launch system, reduce fire risk, and suppress dust and debris. SpaceX has run the deluge water system on nineteen occasions to date.

Each use of the deluge system to date discharged potable water supplied from the Brownsville Public Utilities Board. During each use, the deluge water was either vaporized by the heat of the engines or left the launch pad as overland sheet flow, where it either collected in retention ponds near the launch site or left the launch site through outfalls. After each launch, SpaceX tested the deluge water after the operation and found that the water complied with all effluent limits under the Texas Multi-Sector General Permit. SpaceX has provided test results to the FAA and TCEQ. In accordance with the 2023 BCO Addendum, SpaceX also provided the test results from flights 2, 3, and 4 to the FAA and USFWS.

SpaceX sought coverage for the deluge water discharges under the Texas Multi-Sector General Permit administered by Texas Commission on Environmental Quality (TCEQ) in July 2023. However, as addressed in a March 13, 2024 Administrative Order (AO) issued by the U.S. Environmental Protection Agency (EPA) and an August 2, 2024 investigation report by TCEQ, the EPA and TCEQ found that prior deluge water discharges were not permitted and thus violated the Clean Water Act (CWA) (33 U.S.C. § 1251 et seq.) and Texas environmental quality and water control laws (30 TEX. ADMIN. CODE § 305.42(a) and TEX. WATER CODE § 26.121(a)(1)). The agencies found that SpaceX must apply to TCEQ for an individual Texas Pollutant Discharge Elimination System (TPDES) permit covering the deluge water discharges. SpaceX submitted a permit application on July 1, 2024, and has since entered into agreements with TCEQ and EPA to resolve the alleged violations, as detailed below.

On August 13, 2024, SpaceX and TCEQ entered into an Agreed Order, which was under public notice and comment until October 1, 2024. The Agreed Order requires SpaceX to obtain an individual TPDES permit, comply with specified effluent limitations, and perform sampling of discharges. TCEQ specified that future deluge water discharges in compliance with the order are authorized and that the order will remain in effect until SpaceX is issued an individual TPDES permit. In an August 10, 2024 letter, TCEQ also advised the FAA that it determined that operation of the deluge water system has not caused an adverse risk to the environment. The TCEQ issued the final industrial wastewater discharge permit to SpaceX on February 18, 2025.

On September 5, 2024, SpaceX and the EPA entered into a Consent Agreement and Final Order (CAFO) (Docket No. CWA-06-2024-1768). The CAFO recognizes that SpaceX applied for an individual TPDES permit and is subject to certain measures pursuant to the Agreed Order with TCEQ. The CAFO is also subject to public review. On September 12, 2024, the EPA sent a letter to SpaceX stating SpaceX "met the requirements in the above-referenced Administrative Order, and it is hereby closed."

Taking into account the new information related to the Proposed Action discussed above, water resource impacts would be comparable to those discussed in the 2022 PEA.

SpaceX conducted water sampling of deluge water discharges on March 14, 2024, April 5, 2024 and May 8, 2024, and provided test results to TCEQ. The results show that all constituents in the deluge water are below effluent limits in the Texas Multi Sector General Permit. Consistent with these monitoring results and prior environmental review of the deluge water system, TCEQ has also determined that the deluge water discharges addressed in SpaceX's application for a Texas Pollutant Discharge Elimination System (TPDES) permit would not cause adverse risk to the environment.

In accordance with the environmental mitigation measures in the FONSI/ROD incorporated by reference as terms and conditions of SpaceX's license, the FAA requires SpaceX to manage any deluge water

according to state and local water quality requirements. Therefore, the FAA requires that SpaceX provide the FAA a copy of the TCEQ agreed order after it is approved and signed by TCEQ; TPDES permit No. WQ0005462000, when it is issued; and the Final CAFO for Docket No. CWA-06-2024-1768 when it is signed by EPA.

On July 11, 2022, oxygen was vented after an anomaly during testing of Booster 7 (B7). The vent/release was required to create a safe condition for B7. Specifically, B7 was not designed for indefinite storage of cryogenics on-board, and extended duration at very-cold temperatures would eventually cause failure of onboard control computers and could result in an explosive build-up of pressure in the main propellant tanks. Future vehicles are designed to mitigate this hazard. All venting and liquid oxygen accumulation occurred within SpaceX-owned property. The majority of oxygen release was to the northwest of the launch mount onto the concrete launch pad surface. SpaceX vents oxygen as part of its standard test and launch operations. Typically, residual liquid propellant is returned to storage tanks for re-use. During this B7 test, safety concerns prevented return of the oxygen to ground tanks and resulted in a direct vent to the atmosphere.

Following the B7 test anomaly and associated oxygen vent/release, SpaceX constructed an 83,000-gallon concrete containment basin on the pad to contain vented liquid oxygen. Construction of this concrete containment basin was completed on August 31, 2022. Shortly after the B7 test anomaly, a representative of SpaceX Environmental Health & Safety and its environmental consultant, SWCA, surveyed the area and determined that no restoration work was necessary. All vented oxygen evaporated and fully rejoined the atmosphere within 4hr 29min. While there was minor loss of vegetation observed in connection with the oxygen vent/release due to the cold temperature of the oxygen, new growth was identified a little over a week later, on July 15, 2022. No permanent damage has since been identified as a result of the incident. Taking into account the new information related to the Proposed Action discussed above, water resource impacts would be comparable to those discussed in the 2022 PEA.

In addition to requirements under Clean Water Act authorizations, SpaceX has also prepared a Spill Prevention, Control, and Countermeasures Plan and Hazardous Materials Management Plan, and continues to implement stormwater best management practices (BMPs), while conducting all FAA-permitted or -licensed operations. Implementation of BMPs identified in the Project's current permits would prevent or minimize indirect impacts from erosion and sedimentation to the nearby surface water bodies. In July 2024, SpaceX submitted an application for an Industrial Treated Pollution Discharge Elimination System permit to TCEQ for use of the deluge system. The permit has been declared administratively and technically complete by TCEQ. A draft industrial wastewater discharge permit has been provided to SpaceX and underwent public review. SpaceX received the final industrial wastewater discharge permit on February 18, 2025, and carries out the Proposed Action pursuant to its terms and conditions. Under the Proposed Action, SpaceX would continue to adhere to these plans and permits to reduce the potential for adverse impacts to water resources. The Spill Prevention, Control, and Countermeasures Plan and Hazardous Materials Management Plan would also be implemented to minimize the potential for accidental releases of polluting substances from equipment and would require that material handling and spill response BMPs be implemented at the VLA to prevent the potential contamination of groundwater.

As described in the November 2023 WR of the 2022 PEA, SpaceX installed steel plates over the launch pad foundation. These features are designed to prevent the potential of a pad breakup and associated debris and dust. The steel plates include a water-cooling element (i.e., deluge system) that would be activated

to protect the steel plates during a launch event, allow reusability of the steel plates, and help suppress fire, heat, and dust. The deluge system would also be used for booster landings at the VLA.

The Proposed Action would increase the volume of deluge water used annually; however, all water would be managed in accordance with the Agreed Order, pending individual TPDES permit, and Texas Multi-Sector General Permit, which authorizes the discharge of stormwater associated with industrial activity and specific non-stormwater discharges. Retention ponds would continue to capture launch pad water and would continue to be lined to prevent potential percolation of contaminants into the groundwater. Retention ponds would continue to be maintained and monitored by SpaceX in accordance with TCEQ's Texas Surface Water Quality guidance.[14]

The operation of the deluge system would apply a maximum of approximately 422,000 gallons per operation (booster static fire, launch, or landing). Although the quantity of deluge water evaluated for each launch would increase, the number of licensed Super Heavy static fires per launch would decrease as the program matures over time. Most of the water would be collected in the containment structures or vaporized, although the specific amount in either volume or relative percentage is unknown and may vary across ignition events. For the purposes of this analysis, SpaceX assessed the deluge operations to date in order to estimate that approximately 316,500 gallons of water would be vaporized during engine ignition, 17,600 gallons would be detained at the VLA, and approximately 87,900 gallons is assumed to be dispersed outside the constructed portion of the VLA as overland sheet flow, push out, or condensation. The water that would be dispersed outside the constructed area would mainly be from the water that is released prior to engine ignition and the water released after engine shutdown or launch. It is estimated that 17% of the total water would be used prior to engine ignition, 75% would be used during the launch, and 8% would be used post-launch.

Although approximately 87,900 gallons of the deluge water may leave the paved area of the VLA per operation, it is not expected that this water will cause significant impacts to water resources. An average summertime thunderstorm at Boca Chica would deposit more water over the projected 0.6 mile radius impact area than any single or all combined activations of the deluge system. Brownsville receives about 27 inches of rain a year on average (National Weather Service 2023). The operation of the deluge system and detonation suppression system combined would be roughly equivalent to a rainfall event of 0.004 inch across the area of the 0.6-mile heat/vapor plume area occurring two times per month on average. Since the amount of water that is anticipated to reach the mudflats from a maximum of the operation of the deluge system is expected to be less than significant in comparison to an average summer rainfall event, this amount of water would be unlikely to alter the habitat and cause adverse alterations to water resources.

As described in the November 2023 WR, during engine ignition of the Starship/Super Heavy, surfaces of the steel infrastructure could experience ablation. 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. Samples were collected in the soil, air, and deluge water for components of stainless steel (chromium and zinc) following Flight 2 and Flight 3 and showed negligible results well below effluent limits for stainless steel components in all soil, air, and deluge water results (SpaceX 2024c, 2024d). The Proposed Action is anticipated to continue to have no significant impacts to soil, air, and water during launch operations from potential ablation.

[14] Texas Administrative Code, Title 30 Environmental Quality, Part 1 Texas Commission on Environmental Quality, Chapter 307: Texas Surface Water Quality

As analyzed in the USFWS Biological Assessment (USFWS 2023), the amount of liquid water that would escape the VLA during each use of the deluge system would be equivalent to a rainfall of 0.004 inch across the impact area, annually, the estimated cumulative discharge of 4,395,000 gallons of liquid water through use of the deluge system would be the equivalent of an additional 0.22 inch of rain if distributed across the impact area. Therefore, the operational changes presented in this EA would not alter existing wetlands or floodplains beyond what was analyzed in the 2022 PEA and the impacts would not be significant. Additionally, the changes would not result in dewatering or drawdown from adjacent areas, as deluge water would continue to be brought in from off-site. Furthermore, it is anticipated that most deluge water would be vaporized during the launch sequence and not have adverse effect on the adjacent floodplain or oceanic waters.

Starship/Super Heavy is constructed primarily of stainless steel, which is non-toxic and inert. Other debris includes thermal heat tiles composed of silica that are highly resistant to degradation. The heat tiles are composed primarily of silica, with similar properties to glass, and are therefore inert and resistant to chemical or biodegradation. Heat tiles are expected to exhibit similar physical properties to glass, which is known to shatter or break apart into smaller pieces, with the sharp edges becoming rounded and smooth over time. Impacts on air quality or water chemistry are not expected. It Starship/Super Heavy's propellants are liquid oxygen and liquid methane, which are not hazardous. In the event that Super Heavy or Starship residual propellant ends up in the ocean, residual propellant is expected to evaporate or be diluted relatively quickly due to surface currents and ocean mixing. It is unlikely that residual propellant from either vehicle measurably contributes to the overall pollutant levels in the action area given the limited number of times either stage will be expended (and residual propellant would reach the ocean), and the large action area. The effects of residual propellant in the ocean on ESA-listed species is immeasurable and, thus, insignificant.

The 2025 Conference and Biological Opinion issued by NMFS is in Appendix A. Accordingly, consistent with the data and analyses contained in the 2022 PEA, the Proposed Action would not result in significant water resource impacts.

3.2.7.1. Mitigation and Compliance Commitment Monitoring

The environmental effects of the Preferred Alternative are not expected to result in significant impacts under NEPA if SpaceX conducts its activities in accordance with applicable requirements, permits, standards, and best management practices. Section 3.2.7 describes the relevant regulatory requirements under the Clean Water Act and the steps SpaceX has taken to comply with applicable environmental requirements associated with operation of the deluge system and liquid oxygen tanks.

The FAA is ultimately accountable for oversight of the licensed activities and verifying that these activities are implemented in accordance with applicable requirements. The FAA will receive from SpaceX, or its designees, periodic reports on compliance and may request additional reports as necessary and reasonable to ensure that the mitigation and compliance commitments set forth in its license application, environmental documents, or the license are fully implemented. The FAA will rely on data provided by SpaceX, its designees, regulatory agencies, consultants, and others to document compliance with the commitments relied on by the FAA to reach its determinations regarding the level of anticipated environmental impact and approval of licenses. This includes the following:

- SpaceX must conduct its licensed activities in accordance with the representations made in its license application and must comply with all applicable Federal, Tribal, State, and local environmental laws, regulations, and standards in carrying out its license activities. SpaceX has a

continuing duty to obtain and maintain current all applicable environmental permits, licenses, authorizations, and approvals for activities under this license.

- SpaceX must continue to comply with or carry out, as appropriate, the conditions, limitations, mitigation measures, and monitoring plans set forth in any and all documents prepared by the FAA pursuant to the National Environmental Policy Act, appended to this license, and relied upon to reach a determination that the proposed licensed activities are consistent with applicable environmental requirements and will not significantly affect the quality of the human environment.
- SpaceX is required to send the FAA copies of all monitoring data within 45 days of sampling the use of its deluge system.
- SpaceX will provide the FAA a copy of Final CAFO for Docket No. CWA-06-2024-1768 when it is signed by EPA.
- SpaceX must notify the FAA Operational Safety Directorate, Commercial Space Transportation, Safety Assurance Division (ASA-300), within 15 calendar days of any changes to the representations in its license application or any document prepared or submitted by SpaceX, or its designee, on which the FAA relied to issue the vehicle operator license for Starship/Super Heavy operations at Boca Chica, TX; to support the FAA's compliance with the National Environmental Policy Act, 42 U.S.C. §§ 4321-4336, As Amended Through P.L. 118–5 (June 3, 2023)and FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*; and to reach determinations that the proposed SpaceX licensed activities are consistent with applicable environmental requirements and will not significantly affect the quality of the human environment.
- **Notice required**. If a Federal, State, or local environmental regulator alleges in an investigative report, administrative order, or notice of violation (notices) that SpaceX has violated an environmental requirement, standard, permit, or other authorization at the facilities or operations subject to an FAA-issued vehicle operator license for Starship/Super Heavy operations at Boca Chica, TX, SpaceX must provide the FAA with copies of any such notices within (i) the same time period that SpaceX is given to respond to such allegations by the relevant authority, or (ii) 15 calendar days, whichever is shorter. SpaceX must notify the FAA in writing immediately of actual or alleged violations of applicable Federal, State, or local environmental laws, regulations, permits or other authorizations relating to the license if a launch from Boca Chica, TX is scheduled within 15 days from the date on which SpaceX receives the notice.

  Contents of required notice. SpaceX must transmit the notice(s) to FAA and provide the following information in the required notice:

  1. Nature of alleged or actual violation;
  2. The date on which SpaceX became aware of the alleged or actual violation;
  3. A summary of the actions SpaceX has taken or proposes to take to address or mitigate the violation; and
  4. Contact information for any agency involved in the investigation or enforcement action.

  The FAA will not withhold, delay, or adversely consider license or license modification applications by SpaceX or otherwise take adverse action against SpaceX based on any notice SpaceX provides to the FAA hereunder prior to the final disposition of the underlying violation(s) of Federal State, or local environmental laws, regulations, permits, or other authorizations without first providing

SpaceX with: 1) notice of the proposed adverse action; and 2) a reasonable opportunity to respond in writing.

Annual Certification. SpaceX must submit an annual certification, under penalty of perjury, signed by a responsible official, attesting to SpaceX's compliance with all applicable environmental laws, regulations, permits, or other authorizations related to FAA-licensed activities at Boca Chica, Texas.

Additionally, SpaceX will continue to implement the mitigation measures described in the 2022 PEA and FONSI/ROD. SpaceX would continue to implement its Spill Prevention, Control, and Countermeasures Plan, implement appropriate sampling protocols and water quality in coordination with the TCEQ in accordance with Texas Surface Water Quality. Retention ponds would continue to be impermeable to prevent percolation into groundwater. SpaceX would continue to manage deluge water according to state and local water quality requirements, including NPDES permits. SpaceX would continue to test for changes in water with the 0.6 mile water impact area, in accordance with its Contaminant Monitoring Plan. SpaceX would truck in potable water or it would test any generated water to assure it is comparable to potable water prior to use in the deluge system. Due to the continued implementation of these measures, no significant impacts to water resources are anticipated due to the proposed increased operational cadence.

3.2.8. Biological Resources

Biological impacts, taking into account the new information related to the Proposed Action, would be comparable to those discussed in the 2022 PEA. The 2022 PEA defined the action area for biological resources by the 1 psf contour for Super Heavy landing sonic booms, which extended 13 miles from the VLA. The action area in this tiered EA has been expanded based on updated noise modeling for the proposed vehicle modifications based on the 1 psf Super Heavy sonic boom. The 1 psf contour extends approximately 20 to 27 miles from the VLA over land, and approximately 33 miles over water. Accordingly, an updated official species list, updated environmental baseline descriptions, and updated cumulative activities are provided in the documentation being consulted with USFWS, and are summarized below.

3.2.8.1. Terrestrial Habitat and Wildlife

The 2022 PEA noted that operational activities have potential to impact terrestrial habitats and wildlife due to the presence of structures, lighting, vehicle traffic and presence of humans, launch related noise and vibration impacts, exhaust/heat plumes, and anomalies.

The Proposed Action would increase vehicle traffic and human presence from an estimated 6,040 total trucks per year in the 2022 PEA to 23,771 trucks under the Proposed Action to haul commodities and water to the site. However, SpaceX would continue to implement mitigation measures identified in the PEA, such as operating an employee shuttle to reduce the number of project-related vehicles, to minimize traffic impacts to wildlife, and limiting water truck deliveries to daytime hours to the extent practicable.

Maximum noise levels generated from launches would extend roughly 1 mile further (from 7 miles to 8 miles) from the launch site than anticipated in the 2022 PEA due to the proposed Super Heavy thrust increase (Appendix B). Additionally, the frequency of the noise events would increase from up to five suborbital launches and five orbital launches annually to as many as 25 launches annually. Noise from launches last approximately 3 minutes per launch and would occur approximately 25 times per year. Engine noise from landings, up to 44 per year at the VLA and 6 offshore, would be substantially less noticeable and would last approximately one minute. The 90 dB L_{Amax} contour extends about 6 miles from

the VLA. The 115 dB L_{Amax} contour, which is used as a conservative limit for hearing conservation, is located approximately 1 mile from the landing pad (Appendix B). During launch activities, noise would cause wildlife to be temporarily displaced or disturbed. However, due to the temporary and intermittent nature of these noise sources, wildlife would be expected to resume normal behavior shortly after a launch operation is complete. Sonic booms caused by the landing of Starship and Super Heavy vehicles would occur up to 25 times each per year (50 total, 44 of which may occur at the VLA). As described in Section 3.2.3.5, Starship sonic booms are predicted to reach up to 4 psf, with the 1 psf contour extending approximately 24 miles. Super Heavy sonic booms are predicted to reach up to 21 psf, with the 1 psf contour extending approximately 20 to 33 miles over land or water. Significant impacts to wildlife due to sonic booms are not anticipated. NASA (2003) reported that sonic boom overpressure events generating between 20 and 144 psf have been experienced by humans without injury. A 1991 study funded by the U.S. Air Force found that chicken eggs, when exposed to sonic booms of 17 to 19 psf for a duration of 9 days, did not develop cracks or deviations (Bowles et al. 1991). Numerous other studies also cite sonic booms of varying intensity as having no detrimental effect on wildlife (Maglieri et al. 2014). The increased frequency of sonic booms is not expected to cause a notable difference from the impacts described in the 2022 PEA, including a startle response, species specific defensive behaviors, and orienting responses. Therefore, direct physical injury or death of wildlife from sonic booms are not anticipated. SpaceX would continue to conduct biological monitoring pre- and post-launch to evaluate avian species and vegetation changes due to SpaceX activities.

Under the Proposed Action, heat plume temperatures within the immediate VLA and 0.6-mile radius could injure or cause mortality to individual animals or lead to vegetation changes, including loss of plant community structure, reduction in total cover, and replacement of same native species with weed species. These temperatures would be short-lived (heat plume would dissipate within minutes) and would not be expected to permanently damage the vegetation. Infrequent launches and quick dissipation of heat is not anticipated to affect species at the population level. Following the April 20, 2023 test flight, vegetation monitoring conducted of the 0.6-mile area surrounding the launchpad in accordance with the May 2022 Biological Conference Opinion and the SpaceX Biological Monitoring Plan found minimal damage to vegetation, primarily consisting of sand and debris (Raba Kistner 2023a). A small fire burned approximately 3.5 acres of upland vegetation south of the launchpad (Hicks and Contreras 2023). Based on the vegetation recovery from past fires in the area documented to date, habitat function and ecosystem services should return to pre-burn levels within one to two growing seasons (Hicks and Contreras 2023). Following the launchpad improvements detailed in the November 2023 WR, similar damage to the launchpad is not expected and has not been observed in the two launches since, which will prevent dispersal of sand and debris during launch activities. The second flight in November 2023 resulted in minimal amounts of sand deposited immediately east of the VLA (Raba Kistner 2023b), no signs of damage from heat, and no fires. No dead or injured animals were detected by monitoring following either launch (Raba Kistner 2023c, Raba Kistner 2023d). The third flight in March 2024 resulted in two small brush fires, and a small amount of debris was deposited north of the VLA. An area approximately 0.1 acres was burned in a dry grassy area approximately 0.4 miles northwest of the launch mount. A second fire approximately 0.25 acres in area occurred in a dry grassy region approximately 0.15 miles south of the launch mount. No dead or injured ESA-listed species were observed. Post-fire assessments have been conducted after each fire by experts at the University of Texas Rio Grande Valley, and the assessments have concluded that impacts to wildlife are similar to those which would occur from a prescribed burn in comparable habitat (Hicks and Contreras 2019, 2022, 2023, 2024). Further, the experts concluded that mortality of wildlife due to rapid temperature increases at burned sites during the onset of launch also seems unlikely (Hicks and Contreras 2024). Because of this, although fires have occurred following the orbital test flights, these fires would not be anticipated to cause significant impacts to biological resources

at the proposed increased cadence. Additionally, as the area is regularly subject to high winds, it is not anticipated that sand deposits from engine ignition events will cause significant impacts to the area from the proposed increased cadence. Additionally, the use of the deluge system will continue to minimize these impacts by suppressing dust and potential brush fires. The analysis in the 2022 PEA used a conservative assumption for potential impacts to biological resources from the heat of the plume. Based on the data from the first three test flights, it is expected that the impacts from each launch event would be substantially less than those analyzed in 2022 (SpaceX 2024a, 2024b).

Following the fourth test flight on June 6, 2024, the Coastal Bend Bays & Estuaries Program documented a "thick cloud of dust and small debris" pushed out from the engine thrust during Test Launch #4 and a pea-sized piece of concrete debris damaged a camera lens (LeClaire and Newstead 2024). This report suggests that a "gravel plume" that moves up to pea-sized particles of mud, sand, gravel, and similar materials with enough force to damage shorebird eggs extends at least 0.3 miles from the VLA. A gravel plume was not previously analyzed in the 2022 PEA but is considered in detail in the Biological Assessment. Incidentally, the game camera footage also documented adult nesting shorebirds moving away from nesting areas near the VLA in response to the noise, activity, and heat/vapor/gravel plumes generated by launch activity and returned to areas exposed to these plumes following a launch. However, ongoing monitoring conducted since 2015 has found no significant evidence of trends, either increasing or decreasing, in any of the monitored avian species (SWCA 2024).

In order to minimize impacts to nests near the VLA, SpaceX would implement the following Minimization and Mitigation Measures:

- SpaceX will work with USFWS to develop field experiments to determine the extent of the gravel plume impact area due to Starship/Super Heavy launches. This will help inform the mitigation strategies. The goal of the experiments would be to determine the distance of the gravel plume and methods for protecting artificial nests during launch events. Methods would be agreed upon by USFWS.
- SpaceX will monitor for impacts to nesting MBTA species through use of infrared drone surveillance. SpaceX commits to working with USFWS to develop a protocol to conduct pre-launch drone surveys in order to detect avian nests in open wind/tidal flat habitat south of the VLA, within the identified impact area. SpaceX would also perform a post-launch survey to evaluate identified nests in coordination with USFWS, TPWD, and/or a USFWS-approved biologist. SpaceX, or their contractor, would obtain necessary permits[15] as applicable. SpaceX would provide pre- and post-launch nesting bird reports to the FAA and USFWS within two weeks of each launch event taking place during the avian breeding season (February 15 through August 31).
- SpaceX will work with USFWS to investigate field techniques to protect identified nests during launch events. Methods may include but are not limited to installation of temporary/removable sheltering objects around active nests to shield from the direct movement of gravel. If methods are deemed acceptable by USFWS, SpaceX would install protection measures at active nests prior to launches conducted during avian nesting season.
- SpaceX will make an annual contribution of $5,000 to the Animal Health Department at the Gladys Porter Zoo. The donation will be made within three months of the issuance of the October 2024 Written Re-Evaluation of the 2022 Final Programmatic Environmental Assessment for the SpaceX

[15] Permits to be obtained from USFWS and/or TPWD.

Starship/Super Heavy Launch Vehicle Program at the Boca Chica Launch Site in Cameron County, Texas, and by March 1 of each year thereafter, for the duration of the BO.

Although gravel impacts due to launch or landing plumes was not evaluated in the 2022 PEA, by implementing the above minimization and Mitigation Measures, the proposed project updates would not result in significant biological resources impacts.

As part of consultation related to the October 2024 Written Re-Evaluation noted above, the FAA requested concurrence with USFWS on September 12, 2024 that the updated sonic boom estimates are consistent with prior analyses and determinations supporting the program, and USFWS provided concurrence on October 11, 2024 that expansion of the action area in the September 12, 2024 letter may affect, but is not likely to adversely affect ESA-listed species and designated habitat beyond those effects already evaluated in the 2022 Biological and Conference Opinion (BCO) and Incidental Take Statement (ITS) and 2023 BCO Addendum (Consultation Number 02ETCC00-2012-F-0186-R001). The concurrence includes the following conservation measures:

1. SpaceX will conduct a review of the existing literature on impulsive noise effects of other non-domesticated shorebird species for purposes of comparison. SpaceX will deliver this review to the Service (USFWS) prior to the conclusion of consultation on Addendum #2 or as soon as possible.
2. SpaceX will monitor sonic boom levels during Flight 5 mission profile's Super Heavy booster landing. SpaceX will provide the monitoring data to the FAA within 15 days of the launch for review with other post-launch reporting. SpaceX will continue monitoring the Flight 5 mission profile flights if FAA deems necessary. The FAA will notify the Service (USFWS) if the FAA discontinues monitoring.
3. SpaceX will collaborate with the Service and FAA to identify and prioritize a list of research studies that would help address data gaps regarding the effects of SpaceX launch activity on ESA-listed wildlife. SpaceX will also seek input on research priorities from scientists with expertise in avian acoustics and dispersal. SpaceX commits to initiating this measure prior to Flight 6 and delivering a completed research priority list to the Service (USFWS) and FAA by April 1, 2025, or as soon as possible.
4. SpaceX will provide funds for a necropsy by a qualified professional (subject to Service approval) of any piping plover or red knot found dead within the 15 psf sonic boom overpressure contour. The purpose of the necropsy will be to determine if the bird exhibits indicators of hearing damage.

Additionally, SpaceX would continue to conduct the biological monitoring required in the 2022 BCO and 2022 PEA. SpaceX has deployed avian biologists from SWCA Environmental Consultants (SWCA) with experience monitoring for coastal shorebirds to implement monthly surveys (starting in July 2022) as part of the SpaceX Biological Monitoring Plan. Trend analysis of the avian monitoring data collected by University of Texas Rio Grande Valley (UTRGV) from 2015 to 2021 through current data collected through June 2024 found little to no evidence of meaningful trends, either increasing or decreasing, in the number of birds observed through time (SWCA 2024). SWCA's survey data from July 2022 to June 2024 are consistent with the natural, varied cycles of the target species (SWCA 2024). Additional years of data collection will likely allow for a more definitive conclusion regarding whether there are any trends in abundance that are not the result of background variation or sampling issues. Only one aplomado falcon has been observed several miles away from the VLA since surveying began in 2015.

Annual vegetation monitoring in accordance with the 2022 BCO and 2022 PEA has taken place near the VLA, tracking the composition and extent of three different habitat types that are present adjacent to the

VLA: low-lying and unvegetated mudflats, a transition zone of halophytic vegetation, and short "hind dunes" (referred to in the monitoring reports as "Bare", "Transition", and "Dune" communities). The monitoring also tracks encroachment ("creep") of vegetation at the transition between the unvegetated mudflats and halophytic salt flats. The vegetation monitoring report published in 2021 by UTRGV was previously evaluated in the May 2022 BCO and for the 2022 PEA. Since then, results from the 2022 and 2023 vegetation monitoring surveys were completed. The results show that between 2021 and 2022, plant cover within different habitat types was highly variable. There was a 57% decrease in total live plant cover in mudflats (from 1.87% to 0.80%) and a 20% decrease in transition plots (from 17.57% to 13.97%); however, live plant cover changed little in dune plots (from 26.2% to 26.4%), and there was a 20% increase in creep plots (from 15.7% to 18.8%). This was the lowest plant cover observed in mudflat and transition plots since 2018, and, for transition plots, this represents a continuing decrease in plant cover. Creep plots also exhibited a gradual increase in plant cover. UTRGV identified two possible alternative explanations regarding the observed differences between plant communities in the different monitoring zones: It is possible that some of the observed differences could be explained by additional factors that have not been quantified or analyzed, such as proximity to the road or differences in elevation.

The 2023 monitoring conducted by UTRGV determined that total plant cover within different habitat types was highly variable between 2022 and 2023. There was a 29% decrease in total live plant cover in mudflats (from 0.80% to 0.57%), practically no change in transition plots (from 13.97% to 13.96%), a 26% increase in dune plots (from 26.4% to 33.2%), and a 61% decrease in live plant cover within creep plots (from 18.8% to 7.36%). This represents a continuation of the downward trend seen previously in mudflats. Significant differences between monitoring designation zones suggest that proximity to the launch pad site has influenced plant community structure or composition. Differences among years could represent normal interannual variation in plant community composition arising from variation in rainfall or other external weather or environmental factors; or, they could represent changes over time that have occurred due to impacts from the launch pad and its operations; or, it could be both (these explanations are not mutually exclusive) (UTRGV 2024). Changes in vegetation near the launchpad such as these were considered in the 2022 PEA, including potential loss of vegetation. Additionally, as detailed above, the maximum of the operation of the deluge system is expected to be less than significant in comparison to an average summer rainfall event, this amount of water would be unlikely to alter the habitat and cause adverse alterations to water resources. Consistent with the PEA, SpaceX plans to eventually expand the VLA and develop the area south of the existing pad boundary.

The Proposed Action includes 25 annual launches and 25 annual landings with up to three launches and three landings occurring during the night offshore. SpaceX would only conduct static fires during daytime hours. As described in detail in the 2022 PEA, potential impacts from increased lighting include light attraction of birds, light-induced fallout, nest abandonment, and false crawls. Night lighting may attract and disorient birds, causing injury or mortality through exhaustion or confusion. Night lighting may also play a role in false crawls of nesting sea turtles; however studies suggest that the typical ratio of sea turtle false crawls to successful nesting is roughly 1:1 (NPS 2021). Beach light levels have not been found to correlate with the occurrence of sea turtle false crawls (Byrd 2022), suggesting that light is not a primary driver of this behavior. Therefore, anthropogenic nighttime lighting may not contribute to increases in sea turtle false crawls. Light pollution has, however, been found to correlate with fewer sea turtles emerging from the beach and also with hatchlings not reaching the sea (Witherington et al. 2014). While increased nighttime activity may result in more lighting effects, these effects will continue to remain short in duration and continue to be minimized and mitigated through implementation of the SpaceX Lighting Management Plan. SpaceX would continue to monitor lighting at the VLA according to the SpaceX Light Monitoring Plan during sea turtle nesting season.

Increased frequency of monitoring by Sea Turtle, Inc. as part of SpaceX's Biological Monitoring Plan has resulted in increased detections of false crawls by green sea turtles, such that the previously estimated take limit in the May 2022 BCO (which was based on a lower level of monitoring effort) has been met for this metric. While the extent to which SpaceX activities or monitoring effort contributed to the detected false crawl behaviors is unknown, it is clear that the frequency of detections of green sea turtle false crawls warrants an increase in the amount of authorized take using this metric. Therefore, consultation with USFWS has been conducted to increase the estimated number of false crawls by green sea turtles on Boca Chica Beach from five total (estimated as one documented false crawl per year for five years) to a new estimate of 15 total (estimated as three false crawls per year for five years). The increase is based on five documented false crawls over two years of monitoring under the current protocol, for an average of two and a half per year, rounded up to three per year. Monitoring has not indicated that an increase in take authorization is warranted for the other sea turtle species. At the present levels of take contemplated for the project and with implementation of the SpaceX Light Monitoring Plan to reduce lighting impacts, no significant impacts are anticipated due to increased lighting at the VLA.

Accordingly, consistent with the data and analyses contained in the 2022 PEA, the Proposed Action would not result in significant terrestrial habitat and wildlife impacts.

3.2.8.2. Terrestrial ESA-Listed Species and Critical Habitat

Terrestrial ESA-listed species and critical habitat impacts under the Proposed Action would be similar to those impacts described in the 2022 PEA. In accordance with Section 7 of the ESA, the FAA conducted consultation with the USFWS as part of the 2022 PEA. The FAA determined that the Proposed Action in the 2022 PEA may affect and is likely to adversely affect ESA-listed species and critical habitat under USFWS jurisdiction and conducted formal consultation with the USFWS. The USFWS issued a BCO, which concluded the 2022 PEA Proposed Action is not likely to jeopardize the continued existence of any federally listed species or adversely modify designated critical habitat. The BCO contained Reasonable and Prudent Measures and associated Terms and Conditions to avoid, minimize, and mitigate the effects on listed species and critical habitat.

Following issuance of the 2022 BCO, the FAA reinitiated formal consultation with USFWS on September 1, 2023, regarding the effects of operating a deluge and detonation suppression system, an updated environmental baseline within the action area and the April 20, 2023, launch and mishap, a newly listed species, and a newly proposed endangered species. The USFWS issued Reinitiation #1 of Interagency Consultation on November 14, 2023 (BCO Reinitiation #1), which serves as a Final BCO Addendum. The Addendum concluded that the November 2023 WR Proposed Action is not likely to jeopardize the continued existence of any federally listed species or adversely modify designated critical habitat, and that additional incidental take would not be reasonably certain to occur.

The Proposed Action would not introduce any additional construction-related effects at the VLA that are outside the scope of impacts analyzed in the 2022 PEA and the USFWS BCO (FAA 2022) to ESA-listed species. This tiered EA evaluates potential impacts to six species of seabirds that were not evaluated in the 2022 PEA, due to expansion of the action area under the Proposed Action. The black-capped petrel (*Pterodroma hasitata*), Band-rumped storm-petrel (*Oceanodroma castro*), Hawaiian petrel (*Pterodroma sandwichensis*), Newell's shearwater (*Puffinus auricularis newelli)*, Roseate tern (*Sterna dougallii*), and Short-tailed albatross (*Phoebastria albatrus*) are evaluated in Section 3.2.8.2, *Marine Resources*, as these birds spend most of their lives in the marine environment. The Cactus Ferruginous Pygmy-owl (newly listed as threatened) and tricolored bat (proposed endangered listing) have been added to this EA due to change in listing/nomination status. Table 6 provides a summary of operation-related stressors or threats

previously considered under the 2022 PEA and USFWS BCO that would still apply under the Proposed Action.

In accordance with ESA Section 7, the FAA reinitiated consultation with the USFWS on May 6, 2024. The FAA determined the Proposed Action may affect and is likely to adversely affect ESA-listed species and critical habitat under USFWS jurisdiction and conducted formal consultation with the USFWS. The consultation materials are included in Appendix A.

Table 6. Potential Effects to ESA-Listed Species and Critical Habitat Based on Stressors/Threats Associated with the 2022 Proposed Action compared to the Proposed Action

Stressor or Threat	PEA Proposed Action Potential Effect on Species	Proposed Action Potential Effect on Species	Species Potentially Affected
Visual presence and noise from launches (including landings)	Disturbance to species from noise depends on the type of noise generated, the proximity to the noise source, duration of the sound, frequency of events, the species, and the history of exposure to noise events by individuals of a species. For instance, vehicular traffic can mask bird calls (such as alarm calls) and inhibit breeding birds to find mates and to defend territories. Sudden noise events, such as sonic booms, can cause birds to abandon nests or roosts which may increase the potential for predation. Noise events associated with construction and operations (including launches and landings) are generally thought to result in short-term behavioral responses which may be considered harassment, but sustained noise events may render habitat unusable.	The EA Proposed Action involves more frequent launches and landings. This frequency would amount to 25 Starship/Super Heavy launches and 50 landings annually (25 Starship landings and 25 Super Heavy landings). Additionally, the number of noise events generated by launch operations would increase from 10 to 25 and would still last minutes. The number of noise events generated by landing operations would increase and would less than a minute. Based on the still relatively intermittent launch frequency, short duration of launch and landing events, however, the Proposed Action is not expected to significantly affect any listed species due to the little to no evidence of the launch activity impacting trends to the species.	Piping plover (T) Red knot (T) Northern aplomado falcon (E) Eastern black rail (T) Cactus Ferruginous Pygmy-owl (T) Jaguarundi (E) Ocelot (E) Tricolored bat (PE) Green sea turtle (T) Hawksbill sea turtle (E) Kemp's ridley sea turtle (E) Leatherback sea turtle (E) Loggerhead sea turtle (T) Black-capped petrel (E) Band-rumped storm-petrel (E) Hawaiian petrel (E) Newell's shearwater (E) Roseate tern (E) Short-tailed albatross (E)
Rocket heat plume	Due to the infrequency of launches and quick dissipation of heat plumes, the plumes are not anticipated to cause significant effects on ESA-listed species or their habitat.	Ignition of the Starship/Super Heavy rocket engines would have the maximum plume heat of any other ignition events at the VLA. Temperatures at the VLA generated by the heat plume would reach about 300°F. Within an approximate 0.3-mile radius surrounding the VLA, the temperatures would reach about 212°F and within an approximate 0.6-mile radius, the temperatures would reach an ambient temperature of 90°F. Any ESA-listed species located within the 0.6-mile radius of the heat plume may be injured or subject to mortality. However, noise associated with the pre-launch operations and the engines is expected to drive individuals to disperse from the area prior to exposure to the heat plume. Some pre-launch activities, such as the use of drones, or cryogenic venting could trigger the startle response of birds and other animals, allowing	Piping plover (T) Red knot (T) Northern aplomado falcon (E) Eastern black rail (T) Jaguarundi (E) Ocelot (E) Green sea turtle (T) Hawksbill sea turtle (E) Kemp's ridley sea turtle (E) Leatherback sea turtle (E) Loggerhead sea turtle (T) Black-capped petrel (E) Band-rumped storm-petrel (E) Hawaiian petrel (E) Newell's shearwater (E) Roseate tern (E) Short-tailed albatross (E)

Stressor or Threat	PEA Proposed Action Potential Effect on Species	Proposed Action Potential Effect on Species	Species Potentially Affected
		additional dispersal time. The operation of the deluge system also has been shown to reduce these temperatures and produce steam and condensate that would be rapidly cooled as it travels through the air. Therefore, although launch cadence would increase, launches would still occur infrequently and each event would be intermittent and temporary in nature. Proposed Action activities would be consistent with launch, landing, and testing events already occurring at the site. As such, the species that frequent the area have likely experienced this disturbance. Additionally, temperatures recorded during flight 3 indicate that the 2022 PEA analysis conservatively estimated the size of the heat plume, and that temperature was ambient (90°F) at 0.2 miles from the launch mount. It is not anticipated that the increased thrust will cause the heat plume to extend beyond the 0.6-mile radius area assessed. The increased mission cadence will increase the frequency that the open ocean around the landing platform or droneship is exposed to heat and vapor plumes. As a landing is initiated, any birds that are resting on the platform or foraging around the platform could be exposed to the heat and vapor plume created by the landing. However, the birds would be expected to flush in advance of the heat and vapor plume, avoiding physical injury. Piping plovers and red knots regularly or occasionally use habitat within the gravel plume area for foraging and resting. The noise and activity associated with engine ignition likely cause piping plovers or red knots that may be close to the VLA to flush prior to the creation of the gravel plume. This behavioral response would likely prevent physical injury or death from the gravel plume. To date, no piping plovers or red knots have been found dead or injured following testing of the Starship and Super Heavy launch vehicles. Since piping plovers and red knots	

Stressor or Threat	PEA Proposed Action Potential Effect on Species	Proposed Action Potential Effect on Species	Species Potentially Affected
		do not breed in Texas, no immobile eggs or chicks would be present in the vicinity of the VLA, and none would be exposed to the potentially harmful effects of the gravel plume.	
Launch related closures	The 2022 PEA states that SpaceX estimates its operations that require restricting public access to protect public safety would require up to 500 hours annually. An additional 300 hours would be needed for anomaly response closure hours. Launch-related access restrictions during sea turtle nesting season could impact the ability of sea turtle patrol personnel to locate nests and collect eggs for off-site incubation. Launch-related access restrictions could also impact researchers and National Wildlife Refuge staffs' ability to conduct bird and vegetation surveys.	Areas in the vicinity of the Boca Chica Launch Site would require temporary access restrictions due to the Proposed Action. The number of closure hours for licensed activities and anomaly response would be the same as the PEA and are not anticipated to generate new impacts.	Piping plover (T) Red knot (T) Green sea turtle (T) Hawksbill sea turtle (E) Kemp's ridley sea turtle (E) Leatherback sea turtle (E) Loggerhead sea turtle (T)
Night lighting	Lighting on beaches may disrupt hatchling emergence from sea turtle nests. The PEA assumed 20% of annual operations would occur at night.	The Proposed Action would launch primarily during daylight hours (7:00 a.m. and 7:00 p.m.). Up to one launch could occur at night under the Proposed Action. During nighttime launch activity, SpaceX would require bright spotlighting for short durations when illuminating the launch vehicle. Lighting at night can disorient or interrupt the nesting process nocturnally nesting species of sea turtles. All sea turtle nests detected on Texas beaches are collected, and the eggs are incubated in facilities and therefore the likelihood of eggs not collected hatching at the same time a night launch occurs is low. Inappropriate lighting may also result in abandonment of roosting areas by terrestrial birds, however this displacement is temporary. Piping plovers and Red knots do not breed in Boca Chica, TX. Aplomado falcons are not known to nest within the vicinity of the VLA. Therefore, lighting effects would not impact nesting of the ESA species.	Piping plover (T) Red knot (T) Northern aplomado falcon (E) Green sea turtle (T) Hawksbill sea turtle Kemp's ridley sea turtle (E) Leatherback sea turtle (E) Loggerhead sea turtle (T)

Stressor or Threat	PEA Proposed Action Potential Effect on Species	Proposed Action Potential Effect on Species	Species Potentially Affected
Lighting on Landing Platforms and Drone Ships	N/A	Seabirds may be attracted to lights on ships and platforms at sea as they forage at night, and any attraction towards platforms or ships where a rocket is to land could increase the chance of the birds being injured from the heat/vapor plume. However, the number of birds attracted to the light is expected to be low, given the distance that the platform or ship is to be stationed from the Hawaiian Islands. During the day, it is not expected that the lights would have any effect on sea birds.	Black-capped petrel (E) Band-rumped storm-petrel (E) Hawaiian petrel (E) Newell's shearwater (E) Roseate tern (E) Short-tailed albatross (E)
Hazardous materials	During operations, there is the potential for spills of hazardous materials. The likelihood that an ESA-listed species would come into contact of a hazardous material during a spill is low given SpaceX's immediate clean-up response.	Under the Proposed Action, there is potential for spills of hazardous materials. The likelihood that an ESA-listed species would come into contact with a hazardous material during a spill would continue to be low, however, given SpaceX's immediate clean-up response.	Piping plover (T) Red knot (T) Northern aplomado falcon (E) Eastern black rail (T) Jaguarundi (E) Ocelot (E) Green sea turtle (T) Hawksbill sea turtle (E) Kemp's ridley sea turtle (E) Leatherback sea turtle (E) Loggerhead sea turtle (T)
Ground vibrations	There is a potential for ground vibrations that occur during launches and landings to disturb nesting turtles and birds and potentially impact eggs. These vibrations from rocket launches could frighten nesting sea turtles, causing them to abandon their nesting attempt. The likelihood of significant disturbance is low, however, given the short-term, infrequent nature of vibration impacts; vibrations from launch operations would only last a few minutes.	Under the Proposed Action, the likelihood of significant disturbance would still be low given the short-term, infrequent nature of vibration impacts. The Proposed Action increased launch schedule may increase the likelihood of this occurrence; however, the events would still relatively infrequent (about once to twice a month) for only a few minutes. The operation of the deluge system may also mitigate some of the vibration and sound impacts. The current minimization measures taken by SpaceX to reduce impacts are being implemented through coordination with Sea Turtle, Inc. to conduct surveys daily during sea turtle nesting season and immediately prior to a launch. Hatched sea turtles are then brought back to Boca Chica beach and released. These measures would continue to occur under the Proposed Action.	Green sea turtle (T) Hawksbill sea turtle (E) Kemp's ridley sea turtle (E) Leatherback sea turtle (E) Loggerhead sea turtle (T)

Stressor or Threat	PEA Proposed Action Potential Effect on Species	Proposed Action Potential Effect on Species	Species Potentially Affected
Increased traffic and human presence	Vehicle traffic during daily operations from SpaceX operations personnel could potentially increase the likelihood of wildlife being killed by a collision with a vehicle. In addition, traffic and human presence could cause wildlife to avoid the area. The area is already trafficked by humans, and to date, monitoring has not shown any documented "take" of ESA-listed species due to vehicle strikes involving SpaceX.	The Proposed Action would increase the number of truck trips for transport of propellant and water to the Project. Although jaguarundis are known to be diurnal, ocelots are active around sunset and sunrise, with activity continuing during the night. The ongoing increase in traffic and human presence would likely cause wildlife to avoid areas near SH 4. However, the area already experiences frequent human and vehicle activity, and to date, monitoring has not shown any "take" of ESA-listed species due to vehicle strikes involving SpaceX. SpaceX would also continue to implement environmental protection operation measures as discussed in Section 2022 PEA and November 2023 WR. Some of the operational measures include education plans for personnel on the potential for vehicle collision with ocelots and jaguarundis, encouragement for personnel to use employee shuttle, speed limits of 25 miles per hour at the VLA with restrictions to operated vehicles only in existing paved and dirt roads and parking, and water truck delivery limited to daylight hours as practicable.	Piping plover (T) Red knot (T) Northern aplomado falcon (E) Eastern black rail (T) Jaguarundi (E) Ocelot (E)
Habitat loss (including critical habitat)	Direct loss of habitat reduces a species ability to reproduce, find food, find shelter, and survive.	The operation of the deluge system has the potential to change surrounding habitat however, water would be retained to the greatest extent possible.	Piping plover (T) Red knot (T) Northern aplomado falcon (E) Eastern black rail (T) Jaguarundi (E) Ocelot (E) Green sea turtle (T) Hawksbill sea turtle (E) Kemp's ridley sea turtle (E) Leatherback sea turtle (E) Loggerhead sea turtle (T)

Stressor or Threat	PEA Proposed Action Potential Effect on Species	Proposed Action Potential Effect on Species	Species Potentially Affected
Anomaly	An anomaly in which a Starship/Super Heavy test operation, launch, or landing fails could result in impacts including debris and fire, which could injure or cause mortality to wildlife species adjacent to the launch pad or within areas impacted by debris. Fires are unlikely and, consistent with monitoring to date, are not expected to cause a significant impact on any species.	The April 2023 WR included the installation of a fire suppression system to prevent the risk of a fire on the launch pad. This fire suppression system would continue to be operated as part of the Proposed Action. The operation of the deluge system evaluated in the November 2023 WR would reduce the dissemination of debris directly surrounding the launch pad and help with fire suppression. The Proposed Action to increase the frequency of launches at the VLA, is not expected to increase the probability of an anomaly occurring due to the increase in reliability and capability of the vehicle that occurs with each successful launch, proposed measures discussed above would continue in the help mitigate the potential impacts to an unlikely event of an anomaly to ESA-listed species or critical habitat.	Piping plover (T) Red knot (T) Northern aplomado falcon (E) Eastern black rail (T) Jaguarundi (E) Ocelot (E) Green sea turtle (T) Hawksbill sea turtle (E) Kemp's ridley sea turtle (E) Leatherback sea turtle (E) Loggerhead sea turtle (T)
Increased boat traffic	A potential increase in boat traffic during launch days could increase the potential for seagrass beds to be disturbed from rotor wash and therefore result in a decrease in a food source for the manatee. In addition, the risk to manatees from boat strikes would increase.	Boaters are not permitted to be in the Gulf at Boca Chica Beach or near the landing locations in the oceans. The Proposed Action would not alter boating activity in the Project vicinity.	West Indian manatee (T)

Notes: (T) = Endangered species action status of threatened

(E) = Endangered species action status of endangered

(PE) = Proposed Endangered

In accordance with the FONSI/ROD, SpaceX would continue to coordinate with Sea Turtle, Inc. prior to the launch-related access restrictions of State Highway 4 and Boca Chica Beach to ensure any discovered eggs could be accessed by Sea Turtle, Inc. and removed from the beach prior to launch. For the first three launches of Starship/Super Heavy, no sea turtle eggs were discovered during Sea Turtle Inc.'s surveys on April 19, 2023 (during sea turtle nesting season) or on November 18, 2023 (outside of sea turtle nesting season), or March 14, 2024 (before sea turtle nesting season).

SpaceX is in ongoing compliance with all mitigation measures in the PEA and prior ESA consultations. For example, SpaceX maintains compliance with its Biological Monitoring Plan, Lighting Management Plan, Stormwater Pollution Prevention Plan, and Anomaly Response Plan, among other required plans. SpaceX implements best management practices for construction activities that occur during the avian breeding season and incorporates raptor protection measures into construction. SpaceX performs quarterly cleanups of Boca Chica Beach and State Highway 4 and contributes to wildlife conservation programs including the Friends of Laguna Atascosa NWR Adopt-an-Ocelot Program, Peregrine Fund, and Sea Turtle Inc. SpaceX operates an employee shuttle to reduce vehicle traffic and risk to wildlife. Additionally, SpaceX has funded the installation of vehicle barriers along State Highway 4 to prevent vehicles from entering refuge land and is working with Texas Department of Transportation regarding the construction of wildlife crossings on State Highway 4. SpaceX's ongoing compliance with these and other mitigation measures identified in the 2022 PEA and during prior ESA consultations will continue to mitigate impacts on wildlife and no significant effects are expected.

The 2022 USFWS Biological Conference Opinion (BCO), 2023 Addendum to the BCO, and the 2025 Addendum to the BCO (included in Appendix A), concluded the Proposed Action is not likely to jeopardize the continued existence of any federally listed species or adversely modify designated critical habitat. The 2022 BCO and Addendums contain Reasonable and Prudent Measures and associated Terms and Conditions to avoid, minimize, and mitigate the effects on listed species and critical habitat.

Accordingly, it is anticipated that the Proposed Action would not result in significant impacts to terrestrial ESA-listed species and critical habitat.

3.2.8.3. Marine Resources

Federally Listed Species and Critical Habitat

Marine ESA-listed species and critical habitat impacts, taking into account the new information related to the Proposed Action, would be comparable to those discussed in the 2022 PEA.

As described in the 2022 PEA, the FAA completed a programmatic ESA consultation with the NMFS for launch and reentry operations in the marine environment (NMFS 2022) and included analysis of launches at Boca Chica TX and landing of the Starship at the VLA, downrange in the Gulf of America or in the Pacific Ocean. Super Heavy could land at the VLA or downrange in the Gulf of America. NMFS concurred with the FAA's determination that the activities presented in the programmatic consultation would not adversely affect ESA-listed marine species or designated critical habitat. A programmatic letter of concurrence (LOC) was issued (2022 LOC; NMFS 2022).

Following the issuance of the 2022 NMFS LOC, the FAA initiated formal consultation with NMFS to evaluate additional information provided by SpaceX regarding Starship and Super Heavy planned descents during the first launch. Specifically, the consultation evaluated Starship's planned landing and Super Heavy's planned soft water landing, more clearly defined the existing launch profile for Starship and Super

Heavy ocean landings, and evaluated the expansion of the potential area for Starship's ocean landing location. On April 14, 2023, NMFS provided a letter of concurrence for the FAA's determination of may affect, but is not likely to adversely affect ESA-listed species and designated habitat when considering this additional information (2023 LOC; NMFS 2023).

In February of 2024, the FAA requested informal consultation with NMFS for Starship reentry operations in the Indian Ocean. The consultation evaluated the potential for up to a total of ten nominal operations, including up to a maximum of five overpressure events from Starship intact impact and up to a total of five reentry debris or soft water landings in the Indian Ocean, until March 2025. On March 7, 2024, NMFS provided a letter of concurrence for the FAA's determination of may affect, but is not likely to adversely affect ESA-listed species and designated habitat when considering this additional information (NMFS 2025).

The NMFS LOCs identified potential stressors to ESA-listed species due to 2022 PEA activities. These potential stressors, which would still apply under the Proposed Action, include the following:

- impact by fallen objects: spacecraft, rocket parts, radiosonde;
- exposure to hazardous materials;
- exposure to sonic booms (overpressure) and impulse noise generated during spacecraft reentry or stage landings in the ocean;
- ship strike; and
- harassment by aircraft overflight.

Impacts by fallen objects and hazardous materials under the Proposed Action would remain highly unlikely to occur and thus discountable, as the amount of material or debris would not increase per landing, but only the frequency at which the landings occur. There may be residual propellent on board during splashdown, however a spacecraft's propellant storage is designed to retain residual propellant, so any propellant remaining in the spacecraft is not expected to be released into the ocean. In an unlikely event the propellant tank ruptures on impact, the propellant would evaporate or be quickly diluted and buffered by seawater. As stated in the LOC, the chance for ESA-listed marine species to be exposed to the residual propellants from a splashdown or launch failure is extremely low and therefore discountable. Under previous consultations, NMFS concluded that hazardous material exposure to ESA-listed marine mammals, sea turtles, and fish in the action area may affect, but are not likely to adversely affect these animals. SpaceX would still implement the avoidance and minimization measures presented in the 2022 LOC and the 2022 PEA to minimize encounters with ESA-listed species.

As presented in the 2022 and 2023 LOC, studies use an impulsive noise threshold value of 12 pounds per square inch (psi) for a harassment risk to marine mammals and sea turtles. To produce the 12 psi in the water, there needs to be nearly 900 psf at the water surface, assuming excellent coupling conditions. NMFS also noted that it is very difficult to create sonic booms that even approach 50 psf. Furthermore, the 2022 LOC states that ESA-listed marine mammals and sea turtles could be exposed to the overpressures from sonic booms in the air when they are surfacing for air; however, the chances of both events happening at same time (i.e., species surfacing and a sonic boom occurring) is extremely unlikely, especially considering the length of a sonic boom is less than one second. The previous consultation and letter of concurrence references a maximum overpressure of 2.2 psf would be generated, therefore, the 2022 LOC determination that exposure to sonic booms and impulse noise would not affect marine species

due to little energy transferring into water as a result of sonic booms (FAA 2017) and the highly unlikeliness of impacts to surfacing species is likely still valid, even with the increase in launch cadence.

For the seabirds, foraging individuals could be exposed and subsequently startled by engine noise and/or sonic booms associated with ascent and landing, or by noise associated with downrange booster and fairing recovery. The black-capped petrel is the only species out of these six seabirds that ranges close enough to the VLA to be exposed to launch activities. However, this species has not been recorded during monitoring efforts and does not typically come inland, so launch activities are not expected to have an adverse effect. Species that are drawn in by light may have a higher risk of injury depending on lighting of landing platforms and droneships. Petrels, storm-petrels, and shearwaters, including Newell's shearwater and band-rumped storm-petrel, have been shown to be attracted to lights on ships and platforms at sea as they forage at night (Troy et. al 2013), and any attraction towards platforms or ships where a rocket is to land could increase the chance of the birds being injured from the heat/vapor plume. However, the number of birds attracted to the light is expected to be low, given the distance that the platform or ship is to be stationed from the Hawaiian Islands and the fact that most observed fallout from light occurs on land, near populated areas (Troy et al. 2013). The increased mission cadence will increase the frequency that the open ocean around the landing platform or droneship is exposed to heat and vapor plumes. As a landing is initiated, any birds that are resting on the platform or foraging around the platform could be exposed to the heat and vapor plume created by the landing. However, the birds would be expected to flush in advance of the heat and vapor plume, avoiding physical injury. As a species that spends most of its life at sea, the potential exists, although unlikely, for overpressure events associated with the Proposed Action to impact individual black-capped petrels. However, foraging flocks of black-capped petrels are generally no larger than 65 birds (USFWS 2023), making the likelihood of an overpressure event directly impacting a black-capped petrel in the large landing areas exceedingly unlikely and discountable.

The 2023 LOC evaluated the potential effects of an explosive event near the ocean's surface for Starship's landing in the Pacific Ocean. NMFS evaluated the potentially affected area within which ESA-listed marine species could be harassed. Data on the abundance and distribution of the species in the potentially affected area was evaluated to quantitatively analyze potential impacts. The number of ESA-listed marine species was expected to be less than one, and NMFS concurred with the FAA's findings that the Proposed Action may affect, but was not likely to adversely affect ESA-listed species or critical habitats.

The March 2024 LOC evaluated the potential effects of Starship/Super Heavy operations in the Indian Ocean. Using a similar evaluation, it was determined that the number of ESA-listed marine species was expected to be less than one, and NMFS concurred with the FAA's finding that the Proposed Action may affect, but was not likely to adversely affect ESA-listed species or critical habitats.

The FAA consulted with NMFS in 2024 and 2025 regarding the Proposed Action increases in overpressure events due to the overall increase in frequency of landings and the jettison of the heat shield. The FAA determined the Proposed Action, specifically explosive events, may affect, and is likely to adversely affect two of the 24 ESA-listed species (Kemp's Ridley Turtle and Loggerhead Turtle – Northwest Atlantic Ocean DPS) and critical habitat under NMFS jurisdiction. For the other 22 ESA-listed species within the Project Area, the FAA determined that the Proposed Action may affect but not likely to adversely affect. NMFS issued a Conference and Biological Opinion (NMFS 2025), which is in Appendix A. SpaceX will implement the Reasonable and Prudent Measures, and Terms and Conditions as noted in the Conference and Biological Opinion.

MMPA impacts are determined through the Incidental Harassment Authorization (IHA) process with NMFS. NMFS reviewed SpaceX's IHA application concerning Starship/Super Heavy Launch Vehicle and

Reentry Operations submitted May 16, 2024, and determined that the Proposed Action is not likely to result in the incidental take of marine mammals under NMFS's jurisdiction, and thus did not require an IHA (Laws. B, MMPA Incidental Harassment Authorization NMFS Response to SpaceX, 12/17/2024). As discussed in the application submitted by SpaceX, the only potential for take incidental to the planned program of launch and reentry activities would be through harassment. NMFS determined the Proposed Action is not likely to result in take in the form of harassment because it is not likely to present either the potential to injure or the potential to disturb marine mammals by causing disruption of behavioral patterns.

Accordingly, consistent with the data and analyses contained in the 2022 PEA, and the new LOC and IHA, it is anticipated that the Proposed Action would not result in significant impacts to ESA-listed marine species and critical habitat.

Essential Fish Habitat

EFH impacts, taking into account the new information related to the Proposed Action, would be comparable to those discussed in the 2022 PEA.

As described in the 2022 PEA, in the event of a failure, there could be potential impact on marine species and EFH if launch vehicle debris falls into the ocean. The Starship/Super Heavy launch vehicle would sink but would not result in permanent changes to physical parameters (temperature, salinity, oxygen concentration, etc.) of the water column. The 2022 PEA also determined that amount of propellant, metals, and other substances that could leach or dissolve into the water column or substrate after the launch vehicle sinks to the ocean floor, would be minimal, as the spacecraft's propellant storage is designed to retain residual propellant, so any propellant remaining in the spacecraft is not expected to be released into the ocean. In an unlikely event the propellant tank ruptures on impact, the propellant would evaporate or be quickly diluted and buffered by seawater. As part of NMFS consultation during the 2022 PEA, NMFS provided the two following Conservation Recommendations pursuant to 50 CFR §600.920, which SpaceX and the FAA agreed to implement:

- Conservation Recommendation 1: Prior to any in-water work (i.e., debris recovery or sinking), SpaceX would ensure all ballast and vessel hulls do not pose a risk of introducing new invasive species and that project implementation would not increase abundance of invasive species present at the project site. SpaceX would sanitize any equipment that has been previously used in an area known to contain invasive species prior to its use for project activities.
- Conservation Recommendation 2: The FAA would coordinate with NMFS in the case of a launch failure and any vessel grounding to determine if consultation re-initiation is appropriate.

The new Proposed Action would increase the number of Starship/Super Heavy vehicle launches, but as the number of launches increases, the reliability of the vehicle would increase and the risk of an anomaly would remain the same as described in the 2022 PEA. The probability of an expended vehicle impacting EFH would remain negligible. SpaceX expects fuel onboard the launch vehicle to be consumed during vehicle breakup, as well as all residual propellant, which would combust. Any remaining structural debris would be made of inert materials and are not anticipated to affect water quality and EFH. SpaceX would also continue to either sink or recover any large floating debris, as necessary, and implement previous NMFS Conservation Recommendations.

As discussed under marine ESA-listed species, single event impulse noise levels and sonic booms would not affect marine species or EFH, as little energy is transferred into the water column as a result of these

events (FAA 2017). As the likelihood of creating a sonic boom in excess of 50 psf remains highly unlikely, the increase in launch cadence would not alter noise impacts to species with designated EFH.

The FAA has revised the Proposed Action to remove the Pacific Ocean action area from the EEZ and establish a buffer zone around the Papahānaumokuākea Marine National Monument. These changes respond to public concerns and ensure that potential environmental impacts will not be significant by:

- Avoiding Sensitive Ecosystems: The removal of the Pacific Ocean action area from the Hawaiian EEZ ensures that operations avoid areas of the Pacific Ocean with unique biodiversity, thereby minimizing risks to marine life and ecosystems.
- Avoiding Overlap with Protected Areas: The establishment of a buffer zone around the monument ensures that activities remain at a safe distance from the boundary, reducing the likelihood of any adverse impacts on the marine environment.
- Mitigating Potential Cross-Boundary Impacts: By revising the action area, the likelihood of debris dispersion affecting the Hawaiian Islands and surrounding waters is significantly decreased and expected to be negligible.

Based on the above findings, consistent with the data and analyses that were discussed in the 2022 PEA, the Proposed Action would not result in significant impacts to EFH.

3.2.9. Land Use

Land use impacts, taking into account the new information related to the Proposed Action, would be comparable to those discussed in the 2022 PEA. The PEA determined that impacts to land use from launch related operations were not anticipated because the Proposed Action would not violate any local land use plans or zoning ordinances. Additionally, the planned uses under the PEA were deemed consistent with current land uses.

Proposed Actions considered in this EA would occur within SpaceX's property boundary and therefore would not change compatibility with zoning ordinances or land use plans. Beach and beach access point restrictions would still be subject to an existing Memorandum of Agreement between Cameron County and TGLO, which delineates the circumstances under which the County is authorized to conduct access restrictions to protect public health and safety during spaceflight activities. SpaceX's Roadway Closure Traffic Control Plan and access restriction text message service would also continue to be utilized to ensure safety and security during launch operations. Licensed access restrictions would not change under the Proposed Action and would continue to be limited to 500 hours per year for operations plus 300 hours per year to address anomalies.

Transport of Starship/Super Heavy, cargo, and payloads to the VLA would continue to occur on SH4, which is the only road leading to the VLA. If either stage of the launch vehicle were recovered downrange, SpaceX would deliver it by barge to the Port of Brownsville and transport it the remaining distance to the VLA over roadways. Although the Proposed Action could increase the frequency of transport due to an increase in launches and landings, transport of rocket components and payloads over this stretch of SH 4 is currently a common occurrence. Additionally, the increase in landing-related transports would be negligible compared to annual average daily traffic counts on SH 4 closest to the site, which were 2,473 in 2022 (TXDOT 2023). The additional transports could cause some road delays on SH 4 and may slow visitor's access to Boca Chica Beach and other resources in the area. SpaceX will continue to notify the public of planned delays on SH 4 through updates to the Cameron County website's "Temporary and

Intermittent State Highway 4 Road Delay" updates (Cameron County 2024) and through variable message signs posted along SH 4.

Impacts to state owned submerged lands and offshore oil and gas leases would not change; SpaceX would continue to notify and coordinate with leaseholders and oil and gas operators prior to launches and landings. Risks associated with debris and hazardous materials are addressed below, in the Hazardous Materials, Solid Waste, and Pollution Prevention section.

Accordingly, consistent with the data and analyses contained in the 2022 PEA, the Proposed Action would not result in significant land use impacts.

3.2.10. Hazardous Materials, Solid Waste, and Pollution Prevention

Hazardous materials, solid waste, and pollution prevention impacts, taking into account the new information related to the Proposed Action, would be comparable to those discussed in the 2022 PEA. The 2022 PEA found that no substantial volumes of hazardous materials would require disposal and the potential for impacts would be limited through the implementation of appropriate handling and management procedures for hazardous materials.

Under the Proposed Action, hazardous materials transportation, storage, and disposal would continue to occur in a manner consistent with applicable federal, state, and local environmental, public, and occupational health and safety regulations.

Transportation of commodities containing hazardous materials (LOX, methane, liquid nitrogen) would increase under the Proposed Action (from 3,850 to 18,421 trucks per year). The transport of hazardous materials would have the potential to result in accidental spills that could adversely impact soil, surface water, and groundwater adjacent to transportation routes. However, SpaceX has appropriate plans in place to address accidental spills or releases of hazardous materials (e.g., Spill Prevention, Control, and Countermeasures Plan). In the case of a reportable spill or the discovery of previously unknown contaminants that exceed a reportable threshold, SpaceX would stop work and contact the National Response Center. If the reportable spill occurs within tidal waters, SpaceX would also notify the TGLO. SpaceX would treat or remove soils adversely affected by spills in accordance with applicable federal and state regulations.

Propellent (LOX and methane) quantities used for launch vehicles would also increase from 1,500 MT to a total of 2,650 MT for Starship and from 3,700 MT to 4,100 MT for the Super Heavy vehicle. However, most of the hazardous materials would be consumed prior to landing. Although the Proposed Action would increase the number of launches and landings that occur at the site, the probability of a launch anomaly that releases debris and hazardous materials would decrease. Any launch anomalies would be subject to the guidance, policies, and protocols regarding hazardous material incidents and associated emergency response described in SpaceX's Anomaly Response Plan. SpaceX would respond to any accidental releases of polluting substances quickly and implement appropriate clean-up measures in accordance with applicable laws to minimize impacts to the environment, per PEA mitigation measures.

During engine ignition the surface of the pad flame deflector could experience a small amount of ablation. Ablation is the mechanical erosion of steel from the surface of the metal as result of exposure to heat and force and is considered a common consequence of activities on metal launch infrastructure. The ablated steel would be minimal and would quickly recondense near the launch mount when exposed to the deluge water. The increased mission profile would increase the cumulative amount of metal that may be ablated

and subsequently deposited outside the VLA. SpaceX would continue to conduct contaminant sampling in accordance with the November 2023 WR and BCO Reinitiation #1. Sampling conducted from the second and third flights of Starship/Super Heavy showed negligible changes from baseline contaminant levels. All of the soil sample results registered below the Texas-specific soil background concentrations[16] for pre- and post-launch sampling events. There were no evident trends between the pre- and post-launch. Water samples collected following the second and third flights showed results for all tested analytes that remain well below the Standard for Industrial Multi-Sector General Permit Numeric Effluent Limits (TCEQ 2016). Additionally, hexavalent chromium was non-detectable before and after the launch. SpaceX will continue to conduct contaminant monitoring and provide the results to the FAA and USFWS. Baseline data will be compared to future monitoring data to confirm that no deposition and or/accumulation or potential contaminants is occurring, and no significant changes from baseline levels are expected (SpaceX 2024c, 2024d). As required in the BCO Reinitiation #1, sampling will occur after every launch beginning in 2023, twice a year after a launch in 2024, and potentially quarterly the following 3 years depending on the findings of the monitoring.

SpaceX would continue to salvage or recycle solid waste to the maximum extent practicable and dispose of the remaining solid waste in appropriately permitted landfills. In 2022, the nearby Seabreeze landfill had approximately 28,826,044 remaining tons of capacity and had an estimated 22 remaining years of operational capacity (TCEQ 2023).

A launch anomaly could result in debris and hazardous materials being distributed in the immediate area of the landing site. If any anomalies occurred during the landing event SpaceX would respond to all accidental releases of polluting substances quickly and implement appropriate cleanup measures in accordance with applicable laws to minimize impacts to the environment. Starship would have approximately 34 gallons of hydraulic fluid. In the event of an anomaly, hydraulic fluid may remain contained in the vehicle, ignite, or be released. Remaining hazardous materials such as propellant, ordnance, or chemicals would be transported back to SpaceX in accordance with DOT regulations for transport of hazardous substances.

Accordingly, consistent with the data and analyses contained in the 2022 PEA, the Proposed Action would not result in significant hazardous materials, solid waste, and pollution prevention impacts.

3.2.11. Natural Resources and Energy Supply

Natural resources and energy supply impacts, taking into account the new information related to the Proposed Action, would be comparable to those discussed in the 2022 PEA.

3.2.11.1. Natural Resources

The primary natural resource of concern for the Proposed Action is water. The 2022 PEA evaluated potential impacts to groundwater quality, municipal water supply, and aquifer draw down. The PEA concluded the Proposed Action would have minimal impact to the groundwater quality, the demand placed on municipal water supplies would not be significant, and aquifer drawdown could range up to 0.6 feet after 20 years.

The Proposed Action would not alter the potential for impacts to groundwater quality and should not alter rates of potential 20-year aquifer drawdown. It would, however, increase the water required for Super

[16] 30 TAC §350.51(m)

Heavy static fires and launches by approximately 10,270,000 gallons annually. As reported in the 2022 PEA, actual municipal water use for the city of Brownsville was 20.8 million gallons per day (MGD) in 2018 and is projected by the Texas Water Development Board to be 36.8 MGD in 2030, with total municipal capacity from the Rio Grande at 47.5 MGD. Thus, even if the demand for municipal water increased 10,270,000 gallons per year, or 0.03 MGD, the increase would be approximately 0.1% of the City's 2018 usage and well within the current and projected capacity for the City of Brownsville.

SpaceX purchases potable water from Brownsville Public Utility Board (BPUB) which is a municipally owned utility providing electrical, water, and wastewater services to the Brownsville, Texas area, serving approximately 54,000 customers with water and wastewater services (BPUB 2023). BPUB's water supply includes raw water from the Rio Grande, with reservoirs holding 185.6 million gallons and additional storage in clear wells and elevated tanks. BPUB operates three water treatment plants, with capacities detailed in Table 7 below.

Table 7. BPUB Water Treatment Plants and Delivery Capacities

Treatment Plant	Ownership	Type	Capacity MGD)
WTP 1	100%	Traditional	20
WTP 2	100%	Traditional	20
SRWA	92.91%	Reverse osmosis	10

This table, sourced from BPUB's 2022-2023 corporate report, indicates a total daily capacity of 50 million gallons per day (MGD). The annual water capacity is calculated by multiplying the daily capacity by 365 days, assuming full operation throughout the year. Thus:

- Daily capacity: 50 MGD = 50,000,000 gallons/day
- Annual capacity: 50,000,000 × 365 = 18,250,000,000 gallons/year, or 18.25 billion gallons per year.

This calculation is standard for utility reporting, focusing on maximum potential supply rather than actual production, which may vary due to demand, maintenance, or drought conditions. Based on BPUB's official documentation, the annual water capacity is approximately 18.25 billion gallons, derived from a daily capacity of 50 MGD across three treatment plants. This analysis provides a robust foundation for understanding BPUB's water capacity, acknowledging both current operations and future expansion plans.

At the heart of BPUB's drought response initiatives is BPUB's majority stake in the Southmost Regional Water Authority (SRWA) water treatment plant. The SRWA plant operates 20-deep well taps into the Rio Grande Alluvium within the Gulf Coast Aquifer that treats brackish groundwater using reverse osmosis, serving Brownsville and surrounding communities, including the Brownsville Navigation District and City of Los Fresnos. The SRWA plant's current capacity is 10 MGD, however BPUB is exploring expansion, and aiming for up to 22.5 MGD by 2030.

While the source of the water used in the deluge system is potable water trucked to Starbase from the BPUB, SpaceX's increased water usage accounts for 0.05% of BPUB's annual water delivery capacity. The FAA concludes that the deluge system will not have significant effects on the area's water supply.

3.2.11.2. Energy Supply

The 2022 PEA evaluated impacts associated with 1) demand for electricity, 2) demand for diesel and gasoline to fuel ground equipment, and 3) demand for the various propellant fuels and commodities required for launches and static fire tests. The PEA determined:

- The use of power from the existing on-site solar energy farm, along with the proposed expansion of the solar farm and additional battery system would minimize impacts to the electric power supply.
- The PEA determined that demand for diesel and gasoline would not adversely impact the balance of diesel and gasoline supply and demand in the highly industrialized Rio Grande Basin.

The Proposed Action would not change these conclusions. Since the publication of the 2022 PEA, the Magic Valley Electric Coop installed a line that extends from Brownsville east to Boca Chica Beach. This power line provides additional power to users east of Brownsville, including test and launch operations at the VLA.

With respect to demand for various propellant fuels, the Starship has a propellant capacity of 2,650 MT and the Super Heavy has a propellant capacity of 4,100 MT. The estimated demand for propellant for launches estimated in the PEA amounted to approximately 33,500 MT. The increased launch events and propellant capacity would increase the total propellant to 168,750 MT, which would be an increase of 135,250 MT annually[17]. Regional and national supplies of propellants and commodities are not expected to be impacted by this increase. Annual production of oxygen in the U.S. was approximately 10,993 million kg, or 11.0 million MT, in 2019 (EPA 2023c), so the increase would represent 1.1% of domestic production. LCH_4 is a more purified form of LNG that is in large supply in the U.S., which exported 6,903 billion cubic feet of LNG, or 141.7 million MT, in 2022 (U.S. Energy Information Administration 2023). The increased demand for LCH_4 would be less than 0.01% of the amount of LNG produced for export per year in the U.S. There are large markets in the U.S. for LOX and LCH_4 and therefore the relatively minor increased demand would not likely adversely affect prices or supplies at the regional or national level.

Accordingly, consistent with the data and analyses contained in the 2022 PEA, the Proposed Action would not result in significant energy supply impacts.

3.2.12. Socioeconomics and Children's Environmental Health and Safety Risks

3.2.12.1. Socioeconomics

The 2022 PEA determined that Project activities would not adversely affect existing economic activity, income, employment, population, housing, sustenance, public services, and/or social conditions. Specific PEA findings included the following:

- Launch operations may result in economic benefits to the local area, including increased labor demand, higher revenues for local businesses, and an overall increased per capita income.
- While the population living under the poverty threshold may not benefit through direct employment, individuals may indirectly benefit as regional economic activity is stimulated by the increase in space exploration-related employment and purchases.

[17] With the Raptor engine's 3.6:1 mixture ratio by weight of LOX to LCH_4 the total increased demand for LOX and LCH_4 would be roughly 37,200 MT and 10,300 MT respectively.

- Impacts on property values and quality of life would be difficult to assess due to the large number of variables that can influence these topics. Negative impacts on home values or quality of life associated with noise, traffic, and lighting conditions near the launch facilities could potentially be offset by increased demand in the area created by employment opportunities at the site.
- Airspace closures would not result in the closure of any public airport or severely restrict the use of the surrounding airspace so as to prevent access to an airport for an extended period of time.

The Proposed Action would not materially change the expected number of operational personnel, expenditures, or taxes and so would not change expected impacts to economic activity, income, employment, population, sustenance, public services, and/or social conditions.

Although the increased launch cadence would incrementally increase noise and traffic in the Project area, a review of estimated home values using the Zillow Home Value Index (Zillow 2023), in the ten years from 2014 to 2023 showed that the change in estimated home prices in the Boca Chica zip code (78521) were similar to the change for Cameron County, with increases in home values estimated at 73.6% and 67.4% respectively. No obvious trend has emerged to indicate either an increase in home values associated with the higher demand from employment and development in the area or a decrease in home values associated with proximity to the launch area. While it is important to note that average estimated home values in the zip code do not capture potential impacts to specific properties, these data do suggest that facility operation has not resulted in systematic property value reductions.

In response to concerns regarding recreational area access restrictions during launch activities, SpaceX is working with Cameron County to enhance natural and recreational resources through projects that provide the public with improved access to public beaches, greater community recreational and educational opportunities, and improved parks and park amenities. SpaceX is contributing $15,000,000 to Cameron County towards these efforts which include:

- Andy Bowie Park and Pavilions and Parking Lot Improvements
- Isla Blanca/Amphitheater Road Improvements
- Beach Access #3 Improvements
- Laguna Madre Estuary
- Adolph Thomae Boat Ramp Dock Renovations
- Pedro “Peter” Benavides Park Mountain Bike Trail Improvement
- Santa Maria Park Improvements/Community Center
- Jaime Zapata Boat Ramp Improvements
- Isla Blanka Park Entrance Improvements
- Boat Ramp/SPI Convention Center

Accordingly, consistent with the data and analyses contained in the 2022 PEA, the Proposed Action would not result in significant socioeconomic impacts.

3.2.12.2. Children's Environmental Health and Safety Risks

The 2022 PEA determined that risks to children's environmental health and safety would be limited since the Project is located in a sparsely populated area with no children living in the only nearby residential area. The nearest public school is 6 miles outside of the Project Area.

The 2020 U.S. Decennial Census (U.S. Census Bureau 2020) shows less than five children living in the census blocks immediately adjacent to the launch site, which includes a radius of over 2 miles. The Ad Astra School, a private school started by SpaceX, is the nearest school and is located approximately 6 miles from the launch site. Since publication of the 2022 PEA, more SpaceX employees have moved into area with their children. Children would not be near the VLA during launch or landing operations. The school is located within the 60 dB CDNL contour, however, the school is closed during launch/landing activities.

Noting that the 2022 PEA already contemplated the risks posed by orbital launches (i.e., Starship with the Super Heavy rocket attached) the only new consideration relates to the unexpected creation of a dust plume that affected communities when SpaceX conducted its first launch of Starship with the Super Heavy rocket attached on April 20, 2023, the effect of increased traffic, and the effect of increased noise.

- As noted in Section 3.2.1, *Air Quality*, corrective actions and launch pad modifications made by SpaceX are expected to prevent similar dust impacts in the future.
- As noted in Section 3.2.9, *Land Use*, an additional 65 truck trips per day along SH 4 would not represent a material change in the previously contemplated traffic volume.
- As noted in Section 3.2.3, *Noise and Noise-Compatible Land Use*, the 2022 PEA already contemplated the noise associated with Starship/Super Heavy orbital launches and landings. An increase in these noise events would not fundamentally change children's environmental health concerns or safety risks.

Thus, risks to children's environmental health and safety would be comparable to those discussed in the 2022 PEA. Accordingly, consistent with the data and analyses contained in the 2022 PEA, the Proposed Action would not result in significant risk to children.

3.2.13. Coastal Resources

The Proposed Action is subject to the regulations set forth by the Coastal Zone Management Act (16 U.S.C. §§ 1451-1466). The State of Texas, through the TGLO, exercises its authority to implement the Texas Coastal Management Plan under the Coastal Zone Management Act through 31 Texas Administrative Code §501.3. The Texas General Land Office (TGLO) determined it does not require a consistency review under the Texas Coastal Management Plan since it is not a listed activity. As the activity type has not changed, no additional consistency review is needed.

To mitigate potential effects on marine ecosystems and cultural resources, the FAA has revised the EA to remove the US EEZ from the Pacific Ocean action area. This change ensures that operations avoid areas of unique biodiversity and cultural significance, such as World Heritage Sites, thereby minimizing risks to marine life and ecosystems associated with the monument. By shifting the action area, the likelihood of debris dispersion affecting the Hawaiian Islands and surrounding waters is significantly decreased and expected to be negligible.

The 2022 PEA concluded that no significant impacts to coastal resources would occur, as no coastal construction or seafloor disturbing activities would take place, and any downrange landings would occur no closer than 19 miles offshore. The Proposed Action includes downrange landings no closer than 1 nautical mile offshore and the jettison of the heat shield no closer than 1 nm offshore. SpaceX is proposing to expand the boundary of the Gulf portion of the landing zone action area to within 1 nautical mile of the coast for a distance of 100 miles north and south of the VLA. SpaceX may land the Starship vehicle anywhere within the revised boundary (Figure 2). Landing and recovery operations, including the jettisoned heat shield would not take place in intertidal areas, salt marshes, estuaries, or coral reefs. As an applicant of the FAA-license, SpaceX is responsible for coordinating with the TGLO to ensure its activities are consistent with the TCMP. However, the proposed activity is not included on the states "Listed Activities Subject to CZMA Review" and does not require further coordination with TGLO. No further analysis in this EA is warranted.

3.3. Reasonably Foreseeable Effects in Context of Past, Present, and Future Actions[18]

Reasonably foreseeable effects may include those that interact with baseline conditions caused by other past and present activity as well as reasonably foreseeable environmental trends and planned activity in the affected environment. Some of these past, present, and future activities include the Starfactory construction at SpaceX's production and manufacturing area, housing developments in Boca Chica Village and at Rio East and West (located near State Highway 4 and Richardson Avenue), vehicle engineering testing at SpaceX's property known as Massey's, and construction of a water and other utility lines from Brownsville to the Boca Chica along State Highway 4. The expenditure of Starship and Super Heavy vehicles into the ocean are also detailed in the water resources section below.

3.3.1.1. Air Quality

Effects on air quality from past, present, and future actions near the VLA would be less than significant. The VLA is located in Cameron County which is in an attainment area for all pollutants (EPA 2023). The operational emissions for the Proposed Action represent an extremely small percentage of the Cameron County regional emissions and would not cause an exceedance of any NAAQS. The Proposed Action would result in temporary air emissions during a launch operation. It should be noted that each launch, landing, or static test fire operation would occur separately, avoiding simultaneously combining impacts associated with exhaust plumes from more than one operation at a time. Air emissions from other projects would be localized and short-term in nature.

Air emissions from the Proposed Action when combined with other past, present, or reasonably foreseeable future actions would not result in an exceedance of any NAAQS and therefore would not result in significant air quality impacts.

[18] Section 3.3 of the FAA's Draft Revised Tiered EA (Draft) refers to the impacts discussed in this section as "Cumulative Impacts." This term is used in CEQ's NEPA-implementing regulations. 40 CFR § 1508(i)(3) (2024). Since the publication of the Draft, however, CEQ issued an interim final rule to remove these regulations in accordance with E.O. 14154, *Unleashing American Energy*. See n. 1. As explained by CEQ in its February 19, 2025 memorandum, *Implementation of the National Environmental Policy Act*, NEPA, as amended, does not employ the term "cumulative effects" or "cumulative impacts." CEQ instead directs agencies to consider "'reasonably foreseeable' effects, regardless of whether or not those effects might be characterized as 'cumulative,'" consistent with NEPA. 42 U.S.C. § 4332(2)(C)(i). In accordance with this direction, the FAA has removed the term "cumulative effects" and "cumulative impacts" wherever previously used, but retains with edits the underlying analysis in Section 3.3 of the Draft Tiered EA.

3.3.1.2. Climate

Effects to climate from past, present, and future actions near the VLA would be less than significant. GHG emissions that would result from the Proposed Action would be comparable to those discussed in the 2022 PEA and minute compared to current emissions in the United States and the State of Texas. In combination with the ongoing and reasonably foreseeable actions by SpaceX and others in the Project area, the GHG contributions of these projects would be insignificant and is not expected to result in any changes in climate impacts.

3.3.1.3. Noise and Noise-Compatible Land Use

Effects associated with noise may result from past, present, or reasonably foreseeable projects within the vicinity of the VLA. Construction noise from developments in the area may result in incremental noise impacts, depending on the timing of construction activities in conjunction with the other potential future projects. Construction noise would be temporary, and in comparison to the current land use of the site, distance to sensitive noise receptors, and distance to other proposed future projects, construction noise is not expected to result in any long-term adverse cumulative noise impacts. Operational noise from vehicle testing at Massey's site would be temporary and intermittent, and similar to the testing noise impacts described in the 2022 PEA. Additionally, prior to SpaceX converting the area to a testing facility, the Massey's site operated as a publicly accessible gun range, which exposed the surrounding area to operational noise. For comparison, according to the American Speech-Language-Hearing Association, the average gunshot is approximately 140 decibels (2023). Although there may be short-term and incremental noise increases in the area, noise would return to baseline conditions at the completion of the operational activity.

As a result, any noise impacts from nearby activity would be short-term and temporary, and, combined with the Proposed Action, would not be expected to result in sustained, long-term impacts.

3.3.1.4. Visual Resources

Effects to visual resources may result from past, present, or reasonably foreseeable projects within the vicinity of the VLA. The SpaceX housing developments known as Rio East and Rio West are located at the eastern edge of the Palmito Ranch Battlefield National Historic Landmark. Although the additional houses will introduce new visual elements to the area, they are located near existing houses in the vicinity of Tarpon Bend and will result in similar visual impacts as the existing homes.

Construction of Starfactory at Boca Chica launch site would also result in changes to the viewshed in the area. However, the baseline condition of the area is already an industrial setting, and changes to the infrastructure from multiple smaller structures to one large structure would not change the existing industrial setting.

Vehicle testing at SpaceX's Massey's site may introduce new visual impacts to the Palmito Ranch Battlefield National Historic Landmark. However, these impacts would be temporary, and only occur when a vehicle was present at the testing site. Activities would include testing (*e.g.* tank tests and static fires), which were evaluated in the 2022 PEA. Unlicensed testing activities are not part of the federal action under FAA's jurisdiction; however, this testing is expected to be within the ranges analyzed in the 2022 PEA. Activities at Massey's may require nighttime lighting. Lighting impacts would be minimized by facility best management practices, such as angling lighting downwards, shielding of lighting, and turning off lights when not in use. Visual impacts would be similar to those evaluated in the 2022 PEA and would not

significantly degrade the existing viewshed. The infrastructure at the VLA is not visible from the visitor site at the NHL.

Therefore, implementation of the Proposed Action in conjunction with other past, present, or reasonably foreseeable projects would not result in significant impacts to visual resources.

3.3.1.5. Cultural Resources

Effects to cultural resources may result from past, present, or reasonably foreseeable projects within the vicinity of the VLA. Ongoing economic development and commercial activity could have an impact on cultural resources in the area. For example, the SpaceX housing developments known as Rio East and Rio West are located at the eastern edge of the Palmito Ranch Battlefield National Historic Landmark. Although the additional houses will introduce new visual elements to the area, they are located near existing houses in the vicinity of Tarpon Bend and will result in similar visual impacts as the existing homes. The same may be said for other present or reasonably foreseeable future infrastructure or economic development projects, depending on the scope and vicinity of the projects to nearby cultural resources. Within the 10-mile APE for architectural resources, visual and temporary noise intrusions would result in a cumulative effect on historic properties. The extent of the impacts may vary depending on factors such as visibility of the infrastructure from the historic resource itself, and distance from the noise source. SpaceX will continue to implement the mitigation measures identified in the Section 106 Programmatic Agreement to offset impacts to cultural resources protected under Section 106 of the National Historic Preservation Act.

Therefore, implementation of the Proposed Action in conjunction with other past, present, or reasonably foreseeable projects would not result in significant impacts to cultural resources.

3.3.1.6. Department of Transportation Act Section 4(f)

Effects to Section 4(f) properties may result from past, present, or reasonably foreseeable projects within the vicinity of the VLA. Ongoing development in the vicinity of the Boca Chica launch site and continued activity, both commercial and recreational could have an impact on identified Section 4(f) properties.

The SpaceX housing developments known as Rio East and Rio West would be located at the eastern edge of the Palmito Ranch Battlefield National Historic Landmark. Although the additional houses will introduce new visual elements to the area, they are located near existing houses in the vicinity of Tarpon Bend and will result in similar visual impacts as the existing homes.

Construction associated with the developments in the area would result in short-term increases in sound levels from the use of heavy equipment. However, this noise would be temporary and would not rise to the level of significant impacts to the quiet settings of the 4(f) resources. Unlicensed vehicle testing at the VLA and at SpaceX Massey's site would also result in temporary noise impacts and may temporarily disturb wildlife in the area. However, these would be short duration and infrequent, and would not rise to the level of significant impacts to the quiet settings of the 4(f) resources.

3.3.1.7. Water Resources

Effects to water resources may result from past, present, or reasonably foreseeable projects within the vicinity of the VLA. Ongoing development in the vicinity of Boca Chica and continued commercial activity could have an impact on water resources.

As discussed in Section 3.2.7, although the deluge water discharged under the Texas Multi-Sector General Permit (MSGP) and July 11, 2022 LOX release were found to be un-permitted discharges, the discharges complied with all effluent limits under the Texas MSGP and were consistent with the FAA's findings in the 2022 PEA and November 2023 WR. These activities did not significantly impact water quality and therefore did not contribute to significant impacts to water resources.

There are currently no water lines in the Boca Chica area. Water has historically been brought into the Boca Chica and surrounding areas by truck, resulting in large truck traffic on State Highway 4. The water that would be sourced via the waterline would no longer need to be trucked in and would not result in changes to water needs in the area. Additionally, the build out of the Starfactory would require water resources during the construction phase, however the factory would subsume existing structures at SpaceX's production and manufacturing areas, and the existing, baseline activities would continue to operate. Additional water tanks support unlicensed static fires for manufacturing at the VLA. It is not expected that the modification and operation of the Starfactory would significantly alter water usage of SpaceX's production and manufacturing activities.

The primary impacts on water resources from past, present, or reasonably foreseeable future actions would likely be due to housing developments in the area. The additional housing developments would require additional water for household use. As noted in the 2022 PEA, the nearest municipal water supply is the BPUB located in the City of Brownsville. Based on the Texas Water Development Board projected municipal water use in Brownsville from 2020 through 2070, the projected municipal water usage in 2020 was 31.7 million gallons per day, and projected municipal water use in 2030 is 36.8 million gallons per day (Texas Water Development Board 2021). The additional water required for household use would not significantly impact water usage in Brownsville. Impacts on water resources from past, present, and future actions near the VLA would be less than significant because of Best Management Practices to control stormwater runoff, erosion, and sedimentation would be used throughout all phases of construction for each project. All development activities would require permitting for both wetland and soil disturbance; the permitting process would ensure impacts to water resources are avoided, minimized, and mitigated to the extent practicable.

Potential impacts to the ocean action areas related to the expenditure of Starship and Super Heavy vehicles and components in the proposed ocean landing areas were also analyzed. Both Starship and Super Heavy are proposed to be reused, although either stage could be expended depending on mission requirements and state of development of the program. Vehicle reliability is expected to increase over time as the program matures.

Starship/Super Heavy is constructed primarily of stainless steel, which is non-toxic and inert. Other debris includes thermal heat tiles composed of silica that is highly resistant to degradation. The heat tiles are considered inert and resistant to chemical or biodegradation. Impacts on air quality or water chemistry are not expected. The heat tiles are composed primarily of silica, with similar properties to glass, and are therefore inert. Glass is known to shatter or break apart into smaller pieces, with the sharp edges becoming rounded and smooth over time. It is likely that the heat tiles would similarly change if the same environmental conditions were present. Starship/Super Heavy's propellants are liquid oxygen and liquid methane which are non-hazardous rather than highly toxic hypergolic fuels. Potential impacts from residual propellant of the expended vehicles entering the ocean were also analyzed by NMFS in their Biological Opinion (NMFS 2025). NMFS determined that in the event that Super Heavy or Starship residual propellant ends up in the ocean, the residual propellant is anticipated to evaporate or be diluted quickly due to surface currents and ocean mixing. NMFS also assessed that it is unlikely that residual propellant

from either vehicle measurably contributes to the overall pollutant levels in the action area given the limited number of times either stage will be expended in the action area. The Conference and Biological Opinion issued by NMFS is in Appendix A. SpaceX would expend Starship or Super Heavy a limited number of times in the beginning phase of the program. A key component of SpaceX's Starship program is full reusability, which is designed to significantly reduce rocket debris in the oceans. Based on the broad ocean areas being proposed, the limited number of times this type of event is expected to occur, the cumulative effects of these materials alongside other reasonably foreseeable commercial activities is expected to be negligible.

3.3.1.8. Biological Resources

As discussed above in Section 3.2.8, there would be some adverse effects to biological resources from the Proposed Action in a manner that is comparable to the 2022 PEA. The construction of water lines from Brownsville to Boca Chica would, however, have a beneficial impact on biological resources, as less trucks would be needed for launch activity, testing, production and manufacturing. Additionally, the water lines would serve the housing developments, which would further remove water trucks from State Highway 4, reducing the likelihood of vehicle collisions with wildlife.

The development of new houses would remove potential wildlife habitat in the area. Additionally, the increased presence of people in the development areas would affect wildlife by disturbing animals. Construction of the Starfactory would be unlikely to affect biological resources, as it is an industrial area currently used for production and manufacturing, which does not contain wildlife habitat. For these reasons, there would be impacts from these other activities on biological resources by additional development, human activity, and noise.

The mitigation measures identified in the 2022 PEA would help to decrease the impacts but would not eliminate the impacts to biological resources. However, given the context and intensity of the impacts in the context of past, present, and future actions, significant impacts to biological resources are not expected.

3.3.1.9. Land Use

The Massey's site has been used as a commercial site, and conversion to a SpaceX testing facility would not result in a significant change of land use at this site. Additionally, the Starfactory development is located in an industrial area, and would not result in a change of land use. The housing developments would convert presently undeveloped land, however this land was platted for residential development, so the conversion would be in conformance with development planning for the area.

As illustrated above in *Noise and Noise Compatible Land Use*, operational noise from vehicle testing at Masseys would be temporary and intermittent, and similar to the testing noise impacts described in the 2022 PEA. Additionally, prior to SpaceX converting the area to a testing facility, the Massey's site operated as a publicly accessibly gun range, which exposed the surrounding area to operational noise on a daily basis.

The changes in land use associate with Proposed Action and other past and reasonably foreseeable actions are in conformance with current land use and planned land use, and noise impacts would be minor and would not result in adverse noise impacts to land use in the area.

3.3.1.10. Hazardous Materials

Construction associated with the developments in the area could have a potential for impacts to hazardous materials, pollution prevention, and solid waste in the vicinity of the VLA. However, management of hazardous materials and hazardous waste would continue to be conducted under all federal, state, and local laws and regulations for all projects. Best management practices would continue to be implemented to reduce the potential for impacts due to an inadvertent release of hazardous materials.

When past, present, and reasonably foreseeable projects are analyzed in conjunction with the Proposed Action, significant impacts from these projects would not be expected.

3.3.1.11. Natural Resources and Energy Supply

Effects to natural resources and energy supplies could occur due to projects near the Boca Chica project area consuming energy and natural resources (including water resources, covered separately above). There are other ongoing and future construction projects, both private and public, near the Boca Chica area that will result in cumulative consumption of resources. However, the Proposed Action is not expected to contribute in any substantive manner to adverse impacts to supplies of natural resources or energy use. As noted in section 3.2.11., the Proposed Action's potable water usage accounts for 0.06% of BPUB's current annual water delivery capacity (BPUB 2023) and does not account for future improvements proposed to SRWR's water treatment system. There are resource providers located throughout the State of Texas and beyond to provide resources and supplies to projects in the area. Under the Proposed Action, there would be increases in the consumption of fuel, oil, propellants, electricity, aggregate water, and groundwater. Recent studies indicate that local, regional, and nationwide suppliers would be able to accommodate the increases in consumption of these resources, resulting in no significant impacts. For example, production of liquified natural gas is projected to increase in the area with the construction of liquified natural gas terminals at the Port of Brownsville (FERC 2019a, FERC 2019b). Additionally, the municipal supply would also be able to accommodate the increased consumption with no significant impacts. While the source of the water used in the deluge system is potable water trucked to Starbase from BPUB, the annual water usage accounts for 0.1% of BPUB's water capacity and FAA concludes that the deluge system will not have significant effects.

When past, present, and reasonably foreseeable projects are analyzed in conjunction with the Proposed Action, there would be an increase in the demand on natural resources and energy supply within the surrounding communities. However, the impacts are not anticipated to be significant.

3.3.1.12. Socioeconomics, and Children's Environmental Health and Safety Risks

Impacts to socioeconomics, and children's environmental health and safety risks may result from past, present, or reasonably foreseeable projects within the vicinity of the VLA. The development of additional homes would add to the available number of housing units, although this housing would likely only be occupied by SpaceX employees and may not be available to the public. The additional housing may draw some SpaceX employees from Brownsville, Port Isabel, and South Padre Island, which may have some effect on the local housing market. However, due to the small percentage of SpaceX employees compared to the population of Cameron County, it is not anticipated that the housing market will be significantly impacted by the housing developments.

Therefore, no significant impacts to socioeconomics, and children's environmental health and safety risks are anticipated.

4. CONCLUSION

The 2022 PEA examined the potential for significant environmental impacts from Starship/Super Heavy launch operations at the Boca Chica Launch Site and defined the regulatory setting for impacts associated with Starship/Super Heavy. The areas evaluated for environmental impacts in this EA included air quality; climate; noise and noise-compatible land use; visual resources; cultural resources; Department of Transportation Section 4(f); water resources; biological resources (terrestrial and marine wildlife); land use; hazardous materials; natural resources and energy supply; and socioeconomics, and children's health. In each of these areas, this EA concludes that no significant impacts would occur as a result of SpaceX's proposed action.

5. LIST OF PREPARERS, INDEPENDENT EVALUATORS, AND AGENCIES AND PERSONS CONSULTED

5.1. List of Preparers

Name (Role)	Title	Area of Contribution
SpaceX (Permit Applicant)		
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Katy Groom, P.E. B.S. Environmental Engineering Years of Experience: 12	Director, Environmental Regulatory Affairs	Quality Control
Kelsey Condell, M.S. M.S. Biology B.S. Wildlife and Fisheries Conservation Biology Years of Experience: 12	Environmental Engineer	NEPA Document Preparation
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SWCA Environmental Consultants (SpaceX Contractor)		
Amanda Glen M.S. Biology Years of Experience: 26	Senior Natural Resources Technical Director	Preparation of Preliminary Written Re-evaluation*
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Name (Role)	**Title**	**Area of Contribution**
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Selina Detzel B.S. Marine Biology Years of Experience: 1	Assistant Staff Biologist	Preparation of Preliminary Written Re-evaluation*
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Cara Emery B.S. Wildlife Ecology and Conservation Years of Experience: 5	Assistant Project Biologist	Draft EA Comment Coding
Kari Chalker M.A. Liberal Education Years of Experience: 20	Lead Environmental Planner	Final EA Revisions**
Charlotte Garris M.S. City and Metropolitan Planning Years of Experience: 4	Assistant Staff Environmental Planner	Final EA Revisions**
Emily Waters M.S. Environmental, Natural Resources, and Energy Law Years of Experience: 9	Lead Project Manager	Draft EA Comment Coding; Final EA Revisions**
Rachel Carlson M.E.N.V, Environmental and Natural Resources Policy Years of Experience: 5	Associate Project Environmental Planner	Final EA Revisions**
Julia Aaronson M.S. Ecology Years of Experience: 9	Associate Project Environmental Planner	Final EA Revisions**
Caitlyn Reilley M.S. Sustainable Forest Management Years of Experience: 6	Associate Project Environmental Planner	Draft EA Comment Coding; Final EA Revisions**
Kelcie Witzens B.A. Creative Writing Years of Experience: 4	Associate Project Formatter	Section 508 Compliance
Victor Hernandez	Founder/owner, OnPoint Language Solutions, LLC	Spanish Translation

* Written Re-evaluation was subsequently revised into the Draft EA by SpaceX/FAA.

** Revisions to Final EA were based on FAA response to public comments.

5.2. List of Independent Evaluators

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5.3. List of Agencies and Persons Consulted

Federal Agencies

- National Aeronautics and Space Administration
- National Park Service
- U.S. Army Corps of Engineers
- U.S. Coast Guard
- U.S. Fish and Wildlife Service

State Agencies

- Texas Parks and Wildlife Department
- Texas Historical Commission
- Texas Government Land Office

6. LITERATURE CITED

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