

S.1 Introduction

The Federal Aviation Administration (FAA) is evaluating Space Exploration Technologies Corporation’s (SpaceX) proposal to operate its Starship/Super Heavy launch vehicle at its existing Boca Chica Launch Site in Cameron County, Texas (Figure S-1). SpaceX’s proposed operations include launches originating from this site, as well as landings at this site, in the Gulf of Mexico, or in the Pacific Ocean off the coast of Kauai, Hawaii. SpaceX must obtain an experimental permit and/or a vehicle operator license from the FAA for Starship/Super Heavy launch operations. Issuing an experimental permit or a vehicle operator license is considered a major federal action under the National Environmental Policy Act (NEPA) of 1969, as amended (42 United States Code [U.S.C.] 4321, et seq.), and the Council on Environmental Quality (CEQ) NEPA-implementing regulations (40 Code of Federal Regulations [CFR] Parts 1500–1508 [2020]¹) and requires an environmental review. The FAA is the lead federal agency for this environmental review.

SpaceX has applied to the FAA for a license for the Starship/Super Heavy launch vehicle. SpaceX may require a number of new or modified experimental permits or vehicle operator licenses from the FAA in order to execute its Starship/Super Heavy program over time. Thus, SpaceX has prepared a Programmatic Environmental Assessment (PEA) under the supervision of the FAA, which evaluates the potential environmental impacts of the activities associated with SpaceX’s Starship/Super Heavy program. A programmatic document is a type of general, broad NEPA review from which subsequent NEPA documents can be tiered, focusing on the issues specific to the subsequent actions. The use of a programmatic NEPA document, and subsequent preparation of a project specific NEPA document, is referred to as “tiering” the environmental review. The FAA has recognized that a programmatic review and tiering may be appropriate “to sequence environmental documents from the early stage of a proposed action to a subsequent stage to help focus on issues that are ripe for decision and exclude from consideration issues not yet ripe or already decided.” The FAA may tier subsequent documents from this PEA to focus on environmental impacts specific to the Starship/Super Heavy program under a new or different license application.

The applicant has provided the FAA with a mission profile of proposed launch operations that is analyzed in this PEA. The FAA’s Federal Action is to issue experimental permit(s) and/or a vehicle operator license to SpaceX for this mission profile. If SpaceX modifies or adds operations as part of its Starship/Super Heavy program in the future, the FAA would analyze the environmental impacts of those activities in a tiered environmental document, which would summarize the issues discussed in the PEA that remain applicable (e.g., the environment around the Boca Chica launch site) and concentrate on the issues specific to the subsequent action (e.g., a mission profile involving a new landing site).

The completion of the environmental review process does not guarantee that the FAA will issue an experimental permit or vehicle operator license to SpaceX for Starship/Super Heavy launches at the

¹ CEQ published a final rule in the Federal Register on April 20, 2022, to amend certain provisions of its regulations for implementing NEPA. However, this final PEA began in 2021 and thus prepared in accordance with the 2020 CEQ NEPA-implementing regulations.

launch site. SpaceX's license application must also meet FAA safety, risk, and financial responsibility requirements per 14 CFR Chapter III.

The FAA published a draft PEA on September 17, 2021, for public review and comment, the scope of which addressed the potential environmental impacts associated with SpaceX's proposed operations as well as the construction of additional support infrastructure. Since the conclusion of the draft PEA public comment period, SpaceX made the following changes to its proposal:

- Removed construction and operation of the desalination plant, natural gas pretreatment system, liquefier, and power plant. SpaceX removed this infrastructure from its proposal in response to public and agency comments and other developments.
 - The desalination plant was included in the draft PEA because it would have been used to facilitate deluge for the launch pad. SpaceX is still considering whether to use deluge water for the launch pad, but, in the event it will, it has decided that it will use truck water, rather than a desalination plant. A desalination plant is not in the reasonably foreseeable future.
 - The natural gas pretreatment system and liquefier are no longer needed due to advances in the design and capabilities of SpaceX's Raptor engines. Previously, additional refinement of methane to purer levels than commercially available was anticipated to be needed. However, as a result of engine advances, SpaceX can rely on commercially available methane without refinement. Accordingly, SpaceX is no longer proposing a natural gas pretreatment system and liquefier.
 - Because SpaceX is no longer proposing a desalination plant, natural gas pretreatment system, and liquefier, SpaceX does not require a power plant.
- Removed the "Program Development" phase in response to public and agency comments and other developments, including the advancement of Starship through testing under SpaceX's existing license². Under the Proposed Action, SpaceX may continue to conduct some prototype testing and suborbital launches. However, SpaceX plans to shift focus to orbital launches and conduct fewer suborbital launch operations.
- Modified the Raptor engine and engine configuration. SpaceX increased the thrust of the Raptor engine; therefore, SpaceX has reduced the total number of engines. This change would not constitute any discernable changes in environmental impacts. An increase from 61.7 meganewtons (MN) to 74 MN would result in a less than 1 decibel change and would constitute a negligible change to the noise contours. The maximum thrust for Super Heavy would not exceed 74 MN. Additionally, modeled emissions of the modified Raptor engine were analyzed. Section 3.3.4.2 of the PEA and Appendix G were updated to reflect these changes. These changes would not constitute any discernable changes in environmental impacts.

² SpaceX is currently authorized under FAA license LRLO 20-119 to conduct flights using the Starship prototype vehicle from SpaceX's Boca Chica Launch Site. See: https://www.faa.gov/about/office_org/headquarters_offices/ast/licenses_permits/media/License%20and%20Orders%20SpaceX%20LRLO%2020-119%20Starship%20Prototype%202022-05-27.pdf.

Provisions contained in CEQ's NEPA-implementing regulations and in FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*, require the preparation of a supplemental EA if the applicant makes substantial modifications in the proposed action that are relevant to environmental concerns or there are significant new circumstances or information relevant to environmental concerns or bearing on the proposed action or its impacts (see, e.g., FAA Order 1050.1F, Paragraph 9-3). After independently reviewing SpaceX's project modifications noted above, the FAA does not consider these modifications to be "substantial" in the context of presenting new or additional potential impacts beyond the scope already addressed in the draft PEA. Further, the removal of the proposed infrastructure reduces the Proposed Action's anticipated environmental consequences.

Figure S-1. Launch Site Location



S.2 Purpose and Need

The FAA's authority with respect to SpaceX's license application is stated in PEA Section 1.2. The purpose of SpaceX's proposal is to provide greater mission capability to the National Aeronautics and Space Administration (NASA), Department of Defense, and commercial customers. SpaceX's activities would continue to fulfill U.S. expectation that space transportation costs are reduced to make continued exploration, development, and use of space 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 fundamental to achieving National Space Policy goals.”

SpaceX’s proposal is needed to increase operational capabilities and cost effectiveness of space flight programs. Satisfaction of these needs benefits government and public interests and reduce operation costs. Demand for launch services has continued to increase over the past 20 years and the space industry growth projections indicate this will continue into the foreseeable future. The proposed Starship/Super Heavy launch capability and pad expansion would provide necessary redundancy (launch capability from one pad in case there the other is disabled by an anomaly) and allow SpaceX to prove the capability and reliability of Starship in support of commercial, NASA, and national security missions with minimal disruption to critical Falcon 9, Falcon Heavy, and Dragon missions that must continue from other launch sites.

SpaceX is now developing a multi-mission, fully reusable, super heavy-lift launch vehicle (Starship/Super Heavy). Starship/Super Heavy would reduce the cost of access to space, exceeding the capabilities of the Falcon 9 and Falcon Heavy launch vehicles, enabling cost-effective delivery of cargo and people to the Moon and Mars. SpaceX’s proposal 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.

S.3 Public Involvement

The FAA used multiple methods of stakeholder engagement and public outreach to solicit comments and feedback regarding the proposal. The FAA conducted a public scoping process and published the draft PEA for public review and comment. Public comments received during the comment period for the draft PEA can be accessed at: <https://www.faa.gov/spacexstarship/starshipsuperheavy/comments-draft-programmatic-environmental-assessment-pea-spacex>.

S.3.1 Scoping

Scoping provides an opportunity for the general public, government agencies, and interested parties to learn about a proposed project and provide input. The FAA sent an email on November 23, 2020, to interested parties³ notifying them that the FAA was in the beginning stages of conducting an environmental review for SpaceX’s Starship/Super Heavy proposal. The FAA also sent an email on December 22, 2020, stating that the agency was holding a public scoping period to determine the scope of issues for analysis in the draft PEA. The email provided an overview of the proposed project and the indication that the FAA would be considering the preparation of a programmatic EA as well as an overview of the FAA’s overall environmental review process. The scoping comment period was open through January 22, 2021.

³ The FAA has and will continue to update its list of interested individuals and entities throughout the PEA process. Members of the public may join the list at https://www.faa.gov/space/stakeholder_engagement/spacex_starship/.

A total of 321 comments were received between December 22, 2020, and January 26, 2021. Concerns raised by commenters about the project included the following:

- Potential impacts on protected species and habitat
- Potential cumulative effects of the proposed project and other development projects in the Rio Grande Valley
- Restrictions on access to public areas such as local roads and Boca Chica Beach
- Level of environmental review (i.e., the appropriateness of an EA versus an Environmental Impact Statement [EIS])
- Potential impacts on airspace
- Potential impacts on minority and low-income residents
- Potential impacts on land of cultural importance
- Safety of launch operations given the proximity to nearby liquified natural gas facilities
- Degradation of the environment due to test and launch operations

Positive impacts raised by commenters included the following:

- Economic benefits to the regional economy
- Continued innovation and progress in commercial space transportation
- Benefits of reusable launch vehicles
- Job creation
- Ideal southerly location

All comments received during the scoping period were given equal consideration in the preparation of the draft PEA.

S.3.2 Public Review of the Draft PEA

In accordance with CEQ's NEPA-implementing regulations and FAA Order 1050.1F, the FAA released the draft PEA for a 30-day public review on September 17, 2021. The FAA sent an email announcing the availability of the draft PEA on the FAA's project website,⁴ notice of a 30-day public comment period and request for comments, and notice of two virtual public hearings. After receiving requests for an extension, the FAA extended the public review period to 45 days. The 45-day public comment period ended on November 1, 2021. The FAA received approximately 17,000 public comment submissions.

In addition to posting the draft PEA, the FAA posted a summary of the draft PEA in both Spanish and English on the FAA's project website. The draft PEA and summary were also available in three public

⁴ See: https://www.faa.gov/space/stakeholder_engagement/spacex_starship/.

buildings in Brownsville, Texas, which were chosen after the FAA consulted with Cameron County, Texas officials:

- Brownsville Public Library, Main Branch located at 2600 Central Blvd, Brownsville, TX 78520
- Brownsville Public Library, Southmost Branch located at 4320 Southmost Road, Brownsville, TX 78521
- The Dancy Building County Judge Office located at 1100 E Monroe St Suite 218, Brownsville, TX 78520

The FAA also held two virtual public hearings on October 18, 2021, and October 20, 2021. Notice of all of this information appeared on FAA's website and FAA social media pages.

In response to public comments, SpaceX revised the draft PEA, as appropriate, and prepared this final PEA, under the supervision of the FAA. The final PEA reflects the FAA's consideration of comments, and the FAA has provided responses to comments in Appendix I.

S.4 Other Licenses, Permits, and Approvals

To proceed with all of its proposed Starship/Super Heavy operations and associated construction, SpaceX would require several environmental and regulatory permits and approvals in addition to the FAA's license or permit. The FAA has identified the following additional environmental permits and approvals for SpaceX's proposal, but others may be required.

- **Air emissions** from applicable operations would be permitted by the Texas Commission on Environmental Quality (TCEQ). Typical ground-processing operations of the size proposed at the Vertical Launch Area (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 Title 30 Chapter 116.
- **Endangered Species Act.** In accordance with Section 7 of the Endangered Species Act (ESA), the FAA conducted consultation with the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). NMFS concurred with the FAA's determination that the Proposed Action *may affect, but is not likely to adversely affect*, ESA-listed species and critical habitat under NMFS jurisdiction. 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 USFWS issued a Biological Opinion (BO), which concluded the Proposed Action is not likely to jeopardize the continued existence of any federally listed species or adversely modify designated critical habitat. The BO contains Reasonable and Prudent Measures and associated Terms and Conditions to avoid, minimize, and mitigate the effects on listed species and critical habitat. SpaceX must implement the Terms and Conditions. Refer to PEA Appendix D for a copy of the BO.
- **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 and release of hazardous material (e.g., liquid propellant).

The FAA consulted NMFS regarding potential adverse effects to EFH, and NMFS provided two Conservation Recommendations pursuant to 50 CFR §600.920, which SpaceX and the FAA have agreed to implement. Refer to PEA Section 3.10.

- **Coastal Zone Management Act.** The Coastal Zone Management Act places obligations on both the FAA and SpaceX to ensure actions proposed within or affecting the coastal zone are consistent with the enforceable policies of the state's approved coastal zone management program. For FAA permitting or licensing approvals, if the proposed action is specifically listed within an existing coastal zone management program, the FAA must ensure that the requirements of 15 CFR, Subpart D, *Consistency for Activities Requiring a Federal License or Permit*, are satisfied. For unlisted activities, like the Proposed Action, compliance with this subpart is also required where the responsible state agency specifically indicates to the FAA that approval for a proposed project would affect coastal zone resources and that it intends to review the approval.

On December 20, 2021, the Texas General Land Office (TGLO) emailed SpaceX and stated TGLO will not be conducting a consistency review because the Proposed Action is not a listed activity and is not subject to review under the Texas Coastal Management Program (TCMP). However, TGLO stated that TCEQ would conduct a federal consistency review for the U.S. Army Corps of Engineer's modification of SpaceX's Clean Water Act (CWA) Section 404 permit (see PEA Appendix J). SpaceX is responsible for ensuring its activities within the coastal zone comply with the policies of the TCMP (i.e., state laws) and will be conducted in a manner consistent with the TCMP.

- **National Historic Preservation Act.** As part of National Historic Preservation Act Section 106 consultation, the FAA determined the Proposed Action would create an adverse effect on historic properties. The FAA, Texas State Historic Preservation Officer, National Park Service, Advisory Council on Historic Preservation, Texas Parks and Wildlife Department, USFWS, and SpaceX executed a Section 106 Programmatic Agreement (PA) to resolve the adverse effects. Refer to PEA Appendix C for a copy of the PA.
- **Clean Water Act.** SpaceX's proposal includes filling wetlands, which requires a CWA Section 404 permit. Also, a Texas Pollutant Discharge Elimination System (TPDES) permit, equivalent to a National Pollutant Discharge Elimination System (NPDES) permit, is required for point source discharges from SpaceX facilities during construction or operations. TCEQ administers the NPDES program in Texas. SpaceX would update its facility Construction and Industrial Stormwater Pollution Prevention Plans prior to conducting FAA-permitted or -licensed operations to maintain compliance with the TPDES permit.
- **National Wildlife Refuge System Administration Act.** In the event of an anomaly that creates debris on Refuge fee-owned or managed lands, SpaceX would be required to obtain a Special Use Permit on an emergency basis from the USFWS, as applicable, for clean-up activities.

S.5 Proposed Action and Alternatives

The final PEA for the Starship/Super Heavy Program was prepared by SpaceX under the supervision of the FAA. The FAA has an obligation, consistent with 40 CFR 1506.5(a) and 14 CFR 450.47, to independently evaluate and to take responsibility for the contents of the PEA. Subsequent to that independent evaluation, the PEA becomes a Federal document supporting the Federal actions described in the analyses. While the FAA's authority under the Commercial Space Launch Act only extends to launch activities, the PEA provides a broader analysis of all reasonably foreseeable activities and effects expected to be caused by the proposed permitting or licensing action, such as the building of infrastructure to support the launch activities.

The final PEA evaluates two alternatives in detail: the Proposed Action and the No Action Alternative. Refer to PEA Section 2.3 for additional action alternatives considered but eliminated from further consideration.

S.5.1 Proposed Action (Preferred Alternative)

SpaceX's Proposed Action, which is its preferred alternative, is for the FAA to take a Federal action to issue one or more experimental permits and/or a vehicle operator license to SpaceX that would allow SpaceX to operate its Starship/Super Heavy launch vehicle at its existing Boca Chica Launch Site in Cameron County, Texas. The Federal Action also includes the FAA's issuance of temporary airspace closures. SpaceX's proposed operations include launches originating from this site, as well as landings at this site, in the Gulf of Mexico, or in the Pacific Ocean off the coast of Kauai, Hawaii. SpaceX's goal is to use Starship/Super Heavy for low Earth orbit, sun-synchronous orbit, geostationary transfer orbit, and interplanetary missions for cargo and humans.

SpaceX's proposed annual launch operations include suborbital launches and orbital launches. SpaceX's proposal also includes tank tests, static fire engine tests, expansion of the VLA and solar farm, and construction of additional launch-related infrastructure. All elements of the Proposed Action and SpaceX's proposal are identified in Table S-1.

The analysis in this PEA reflects the environmental impacts that may result from the Proposed Action. If SpaceX proposes modifications to the activities discussed below, and they fall outside the footprint of the proposed project or the scope of this environmental review, the FAA will conduct additional environmental analysis.

Table S-1. Elements of the Proposed Action

FAA Action	Elements of SpaceX's Proposal	Brief Description
Issuance of an Experimental Permit or Vehicle Operator License	Test and Launch Operations	<ul style="list-style-type: none"> • Starship static fire engine tests • Super Heavy static fire engine tests • Starship suborbital launch • Super Heavy launch • Starship landing at the VLA, on a floating platform in the Gulf of Mexico or the Pacific Ocean, or expended in the Gulf of Mexico or Pacific Ocean • Super Heavy landing at the VLA, on a floating platform in the Gulf of Mexico, or expended in the Gulf of Mexico
	Tank Tests	<ul style="list-style-type: none"> • Test the structural capability of the launch vehicle stages
	Nominal Operational Access Restrictions	<ul style="list-style-type: none"> • SpaceX anticipates the proposed operations would require 500 hours of annual access restriction
	Anomaly Response Access Restrictions	<ul style="list-style-type: none"> • If an anomaly occurred, SpaceX anticipates debris clean-up would require up to 300 hours of annual access restriction
	Related Infrastructure Construction	<ul style="list-style-type: none"> • Redundant launch pad (Launch Pad B) and commodities (approximately 15 vertical tanks) • Redundant landing pad • Integration towers • Tank structural test stands • Support buildings and parking lots • Trenching • Payload Processing Facility • Expanded solar farm • State Highway 4 pull-offs

Launch Vehicle

The fully integrated launch vehicle is comprised of two stages: Super Heavy is the first stage (or booster), and Starship is the second stage. The fully integrated Starship/Super Heavy launch vehicle is expected to be approximately 400 feet tall and 30 feet in diameter. As designed, both stages are reusable, with any potential refurbishment actions taking place at SpaceX facilities, including the VLA, SpaceX production and manufacturing locations in Boca Chica Village, Hawthorne, CA, or McGregor, TX. Both stages are expected to have minimal post-flight refurbishment requirements; however, they might require periodic

maintenance and upgrades. Unlike the SpaceX Falcon launch vehicle, Starship/Super Heavy would not have separable fairings or parachutes.

Super Heavy is expected to be equipped with up to 37 Raptor engines, and Starship will employ up to six Raptor engines. The Raptor engine is powered by liquid oxygen (LOX) and liquid methane (LCH₄) in a 3.6:1 mass ratio, respectively. Super Heavy is expected to hold up to 3,700 metric tons (MT) of propellant and Starship will hold up to 1,500 MT of propellant. Super Heavy, with all 37 engines, will have a maximum lift-off thrust of 74 MN, allowing for a maximum lift-off mass of approximately 5,000 MT. Starship, with six engines, will have a maximum lift-off thrust of 12 MN, allowing for a maximum lift-off mass of approximately 1,000 MT. Launch propellant and commodities are currently stored at the VLA in aboveground tanks. Commodities include liquid nitrogen (LN₂), water, gaseous oxygen, gaseous methane, gaseous nitrogen, helium, hydraulic fluid, LOX, and LCH₄.

Operations

The Starship/Super Heavy program includes tank tests, pre-flight operations, suborbital launches, and orbital launches. SpaceX is still in the testing stages of the launch vehicle, including ongoing Starship prototype tests that have been approved under a separate license. SpaceX also will need to conduct similar tests of Super Heavy prototypes, which has not yet been approved under a separate license. SpaceX would still conduct tests (tank tests, static fire engine tests, and some suborbital launches). As shown in Table S-2, SpaceX plans to shift to orbital launches.

Table S-2. Proposed Annual Operations

Operation	Time	Operational Limit
Starship Static Fire Engine Test ^a	Day	150 seconds
Super Heavy Static Fire Engine Test ^a	Day	135 seconds
Starship Suborbital Launch	Day or Night	5
Super Heavy Launch ^b	Day or Night	5
Starship Land Landing ^c	Day or Night	10
Super Heavy Land Landing ^d	Day or Night	5

Notes:

^a A static fire engine test is defined by the FAA as a launch licensed event beginning at functional Autonomous Flight Termination System installation and integration of the Starship and Super Heavy at the pad.

^b A Super Heavy launch could be orbital or suborbital and could occur by itself or with Starship attached as the second stage of the launch vehicle.

^c A Starship landing could occur at the VLA, on a floating platform in the Gulf of Mexico, or on a floating platform in the Pacific Ocean. Alternatively, SpaceX could expend Starship in the Gulf of Mexico or Pacific Ocean. Further environmental review of landing at sites not described in this document would be necessary if proposed in the future.

^d A Super Heavy landing is part of a launch, as it would occur shortly after takeoff. Super Heavy could land at the VLA or on a floating platform in the Gulf of Mexico. Alternatively, SpaceX could expend Super Heavy in the Gulf of Mexico. Further environmental review of landing at sites not described in this document would be necessary if proposed in the future.

Tank Tests

Prior to conducting a static fire engine test or launch of a Super Heavy or Starship prototype, SpaceX must conduct tank tests to ensure the tank’s reliability. This involves performing proof pressure tests to confirm the structural integrity of the launch vehicle. Proof pressure tests are broken into two main categories: pneumatic and cryogenic. Pneumatic proof pressure testing consists of pressurizing the launch vehicle’s tank with gaseous media (either helium, nitrogen, oxygen, or methane) and holding pressure for an extended duration. Cryogenic proof pressure tests consist of loading the tank with a single propellant

(typically LN₂, LOX, or LCH₄). The tanks are then pressurized past their rated limit to confirm their structural capability with appropriate factors of safety. These proof pressure tests are designed to not release any propellant to the environment. All propellant is recycled back into the ground system tanks after the test is completed.

In addition to the proof pressure tests, SpaceX may perform development tests on test tank articles to validate design improvements or characterize vehicle behavior. These development tests include hydrostatic and cryogenic break tests, in which the tanks are filled with water, LN₂, or LOX, and pressurized to a specific limit or to deliberate failure in order to characterize the structural capability of the production vehicles. Break testing includes the deliberate release of the test media (water, LN₂, or LOX) to the environment upon failure of welds on the primary structure.

Pre-flight Operations

Pre-flight operations include mission rehearsals and static fire engine tests. The goal of mission rehearsals is to verify that all vehicle and ground systems are functioning properly, as well as to verify that all procedures are properly written. After final systems checkout, SpaceX would conduct a mission rehearsal without propellants on the launch vehicle (referred to as a *dry dress rehearsal*), followed by a mission rehearsal with propellants on the launch vehicle (referred to as a *wet dress rehearsal*) to verify full launch readiness.

After completing rehearsals, SpaceX would conduct static fire engine tests. The goal of a static fire engine test is to verify engine control and performance. A static fire engine test is identical to a wet dress rehearsal, except engine ignition occurs. During a static fire engine test, the launch vehicle engines are ignited for approximately 5-15 seconds and then shut down.

Suborbital Launches

SpaceX is proposing to conduct up to five Starship suborbital launches per year. Each launch would include a landing (Table S-2). During a suborbital launch, Starship would launch from the VLA and ascend to high altitudes and then throttle down or shut off engines to descend, landing back at the VLA or at least 19 miles offshore and downrange either directly in the Gulf of Mexico or on a floating platform in the Gulf of Mexico.

Orbital Launches

SpaceX is proposing to conduct up to five Starship/Super Heavy orbital launches annually. Each launch may include a landing of Starship and/or Super Heavy. Starship/Super Heavy missions would include human and cargo missions to the Moon, satellite payload missions, and future human flight to Mars. From the Boca Chica Launch Site, orbital launches would primarily be to low inclinations with flight trajectories north or south of Cuba that minimize land overflight. Future launches from the site may be to higher, 70-degree inclination with limited overflight of remotely populated portions of Mexico.

Each Starship/Super Heavy orbital launch would include an immediate boost-back and landing of Super Heavy. Landing could occur at the VLA or downrange in the Gulf of Mexico (either on a floating platform or expended in the Gulf of Mexico), no closer than approximately 19 miles off the coast. During flight, Super Heavy's engines would cut off at an altitude of approximately 40 miles and the booster would separate from Starship. Shortly thereafter, Starship's engines would start and burn to the desired orbit

location. After separation, Super Heavy would rotate and ignite to conduct the retrograde burn, which would place it in the correct angle to land. Super Heavy would then perform a controlled descent using atmospheric resistance to slow it down and guide it to the landing location (like current Falcon 9 booster landings at Cape Canaveral Space Force Station).

For Super Heavy landings at the VLA or downrange on a floating platform in the Gulf of Mexico, once near the landing location, Super Heavy would ignite its engines and conduct a controlled landing. Super Heavy would land vertically and go into an automated safing sequence (i.e., put the vehicle in a safe state).

Similarly, each Starship/Super Heavy orbital mission would include a Starship landing after Starship completes its orbital mission. Starship landing could occur at the VLA or downrange in the Gulf of Mexico (on a floating platform or expended in the Gulf of Mexico), or Pacific Ocean (on a floating platform or expended in the Pacific Ocean). Starship would land vertically at the VLA or on a floating platform in the Gulf of Mexico or the Pacific Ocean and go into an automated safing sequence.

During early unmanned orbital launches, SpaceX may require expending Super Heavy or Starship downrange in the Pacific Ocean or Gulf of Mexico, or for Starship only, in the Pacific Ocean, no closer than 19 miles offshore. If this occurs, SpaceX would not recover Super Heavy or Starship. SpaceX expects each stage would break up upon impact with the water's surface. SpaceX expects most of the launch vehicle would sink because it is made of steel. Lighter items may float but are expected to eventually become waterlogged and sink. If there are reports of large debris, SpaceX would coordinate with a party specialized in marine debris to survey the situation and sink or recover as necessary any large floating debris. SpaceX would coordinate with all land and water regulatory authorities, as required, prior to taking action to recover debris.

As part of SpaceX's first orbital launch, SpaceX intends to expend (i.e., not recover) Starship off the coast of Hawaii. The PEA evaluates this activity. The location of the expendable landing is approximately 62 nautical miles north of Kauai, Hawaiian Islands near the Pacific Missile Range Facility. While SpaceX does not anticipate that debris from expending Starship in the water would remain afloat, personnel would follow routine notification processes and procedures to manage floating debris. As SpaceX develops its landing capabilities downrange, SpaceX may plan to land the Starship on islands in the Pacific Ocean. Proposed landing activities on islands would be analyzed in a separate NEPA document, which may tier off this PEA, if plans develop.

Operational Access Restrictions

For purposes of the PEA, the FAA is defining an operational access restriction as follows:

An access restriction begins when local law enforcement, under the direction of an order from the Cameron County Commissioners Court, shuts down State Highway 4 (SH 4) and Boca Chica Beach to support the FAA-permitted or FAA-licensed activity, which may include a tank test, wet dress rehearsal, static fire engine test, or launch. An access restriction ends when the operation is completed and local law enforcement opens SH 4 and Boca Chica Beach.

Tanks tests, wet dress rehearsals, static fire engine tests, and launches (suborbital and orbital) would require restricting public access to various degrees in the vicinity of the VLA and securing land and water areas as part of public safety requirements. SpaceX refers to the areas on land that would be closed to

public access as the *access restriction area* (Figure S-2). The access restriction area includes an area of Boca Chica Beach, ranging from the Brownsville Shipping Channel south to the U.S./Mexico border. The Brownsville Shipping Channel would be temporarily restricted during orbital launches and some suborbital launches, but not restricted during tank tests, wet dress rehearsals, or static fire engine tests.

SpaceX would perform the following notifications prior to a planned access restriction and in accordance with SpaceX's Access Restriction Notification Plan:

- Provide a forecast of planned access restrictions one to two weeks in advance of the access restriction on the County's website and/or send via email to the agency distribution list. Information about the proposed access restriction would be available on Cameron County's website.⁵ The Cameron County judge issues a public notice of a Cameron County order to temporarily close Boca Chica Beach and SH 4 anywhere from a few hours to a few days after receiving SpaceX's request to close.
- Send access restriction notifications to the regulatory and public land-managing agencies as plans finalize (typically 48 hours prior to the access restriction). The agencies would continue to receive updates immediately when the access restrictions go into place and when the access restrictions end, as well as cancellations of requested access restrictions. SpaceX personnel at the launch and landing control center (LLCC) would send these notifications to ensure the most up-to-date information is distributed.
- Send real time status and updates on access restrictions through a text message alert service. Subscribers can text "BEACH" to 1-866-513-3475 to receive updates.

Airspace Closures

All launch and reentry operations would comply with the necessary notification requirements, including issuance of Notices to Air Missions (NOTAMs), as defined in agreements required for a launch license issued by the FAA. A NOTAM provides notice of unanticipated or temporary closures to components of, or hazards in, the National Airspace System (FAA Order 7930.2S, *Notices to Air Missions [NOTAM]*). The FAA issues a NOTAM at least 72 hours prior to a launch or reentry activity in the airspace to notify pilots and other interested parties of temporary conditions. Advance notice via NOTAMs and the identification of Aircraft Hazard Areas (AHAs) would assist pilots in scheduling around any temporary disruption of flight activities in the area of operation. Launches and reentries would be infrequent, of short duration, and scheduled in advance to minimize interruption to air traffic.

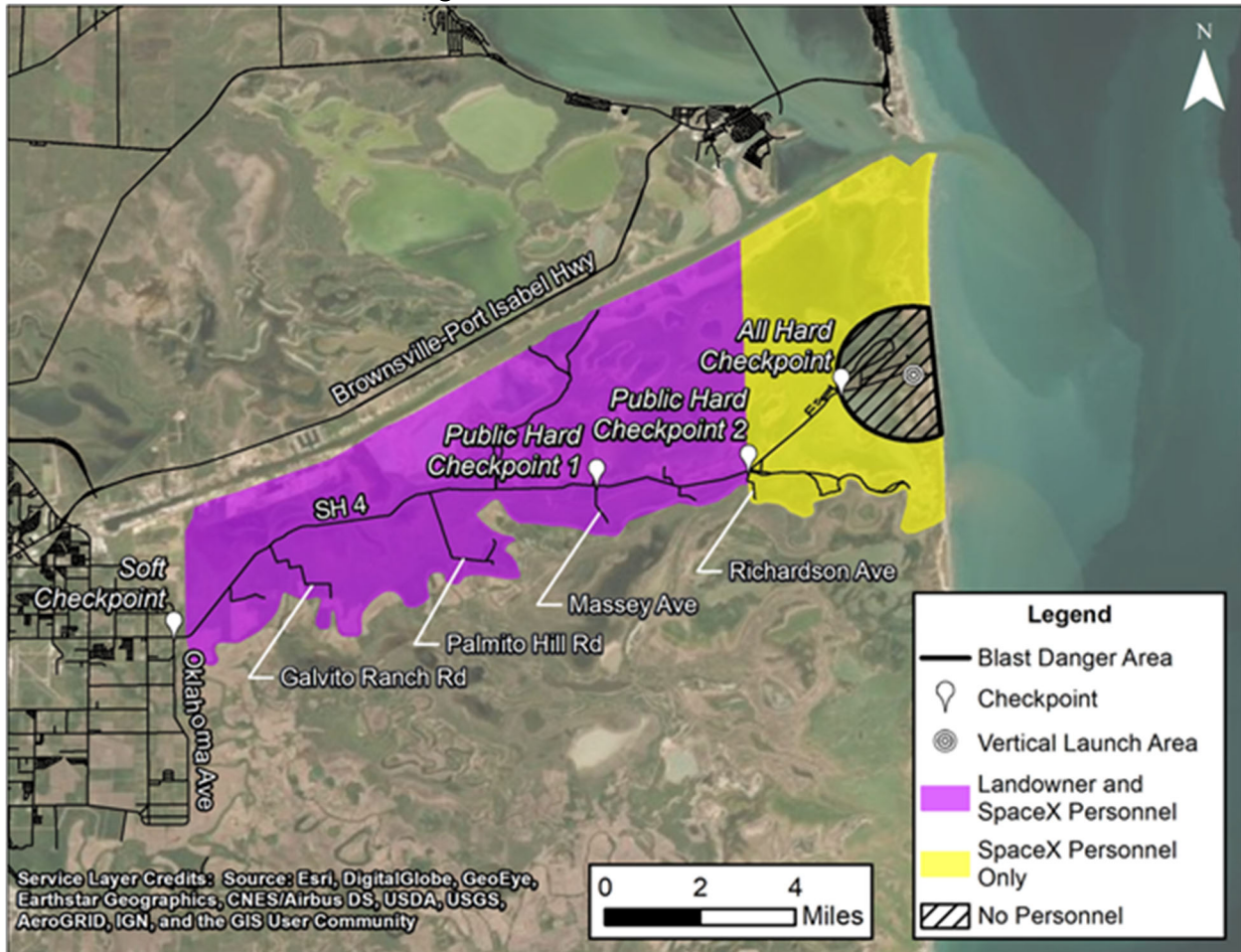
Airspace closures are immediately released once the mission has successfully cleared the area and no longer imposes a risk to the public. The actual duration of airspace closure is normally much less than the original planned closure, especially if the launch or reentry window is relatively long and the launch or reentry occurs at the beginning of the window. The FAA typically begins to clear airspace and reroute aircraft in advance of a launch or reentry and directs aircraft back into the released airspace after the mission to recover to normal flow and volume.

The location and size of airspace closures for commercial space operations also vary with each mission type and are influenced by multiple factors, including vehicle hardware reliability. The size of airspace

⁵ See: <https://www.cameroncounty.us/space-x/>.

closures shrink as reliability is established with results and analysis from each launch. For the initial launch of a new launch vehicle (e.g., Starship/Super Heavy), the hazard areas and associated airspace closures are bigger to account for the increased risk of a vehicle failure, relative to a mature rocket. Subsequent launches of that launch vehicle will include smaller hazard areas compared to the initial launch. The airspace closures for SpaceX’s pre-launch testing (tank tests, wet dress rehearsals, and static fire engine tests) would be localized to an area near the pad and may extend up to approximately 13,000 feet in altitude. The size of airspace closures for Starship suborbital flights are expected to be smaller than an orbital launch.

Figure S-2. Access Restriction Area



Construction

SpaceX is proposing additional launch-related construction, including expanding the solar farm near the LLCC, adding infrastructure and facilities at the VLA, parking lots, a payload processing facility, and trenching and pull-offs along SH 4. At the VLA, SpaceX is proposing to construct a redundant launch pad and commodities, a redundant landing pad, two integration towers, tank structural test stands, additional support buildings, and parking lots. The new infrastructure and facilities would result in expansion of the VLA footprint to SpaceX’s property boundary, excluding the dune buffer zone, which is 1,000 feet from the mean high tide line. The VLA would be expanded from approximately 17 acres to a total of approximately 40 acres.

S.5.2 No Action Alternative

Under the No Action Alternative, the FAA would not issue new experimental permits or licenses to SpaceX for any test or launch operations at the Boca Chica Launch Site. In this situation, SpaceX’s production and manufacturing that do not require a license from the FAA or approval by any other federal agencies would continue at its existing facilities and production and manufacturing infrastructure would expand. Testing operations, including tank tests and static fire engine tests, that do not require approval by the FAA or other federal agencies would also continue at the VLA. In addition, SpaceX could conduct missions of the Starship prototype launch vehicle as authorized by the current license (LRLO 20-119).⁶ The license expires on May 27, 2023. This alternative provides the basis for comparing the environmental consequences of the Proposed Action.

S.5 Summary of Environmental Consequences

The following environmental impact categories were considered to provide context for understanding and assessing the potential environmental effects of the Proposed Action: air quality; climate; noise and noise-compatible land use; visual effects; cultural resources; Department of Transportation Act Section 4(f); water resources; biological resources; coastal resources; land use; hazardous materials, solid waste, and pollution prevention; natural resources and energy supply; and socioeconomics, environmental justice, and children’s environmental health and safety risks. Table S-3 provides a summary of potential environmental impacts from the Proposed Action. Table S-4 provides the mitigation measures that the FAA would ensure SpaceX implements to minimize environmental consequences.

Under the No Action Alternative, impacts to the human environment from Starship prototype suborbital launches would be similar to the types of launch-related impacts discussed in the FAA’s 2014 EIS for Falcon launch vehicle operations at the Boca Chica Launch Site, as well as similar airspace closures associated with the launches. However, in general, the intensity of the impacts would be less than the impacts discussed in the 2014 EIS because the Starship prototype is a smaller launch vehicle and uses fewer engines (and therefore has less thrust) than the Falcon Heavy. Also, the Starship prototype uses methane for fuel compared to Falcon Heavy’s use of kerosene. SpaceX would continue its existing production and testing infrastructure and operations, which are not subject to FAA licensing.

Table S-3. Summary of the Proposed Action’s Environmental Consequences

Environmental Impact Category	Environmental Consequences
Air Quality	Air emissions would result from the proposed construction activities, pre-launch and launch operations, and operation of employee and contractor vehicles. None of the emissions are expected to result in an exceedance of the National Ambient Air Quality Standards, as established by the U.S. Environmental Protection Agency under the Clean Air Act. Therefore, the Proposed Action is not expected to result in significant air quality impacts.
Climate	Proposed construction and operations would involve mobile source fuel combustion that would generate greenhouse gas (GHG) emissions from associated launch, landing, and test operations. Launch-related operations are estimated to emit 43,892 metric tons of

⁶ See: https://www.faa.gov/data_research/commercial_space_data/licenses/.

	<p>carbon dioxide equivalent per year. This estimation is substantially less than the total GHG emissions generated by the United States in 2018. The Proposed Action is not expected to result in significant climate-related impacts.</p>
<p>Noise and Noise-Compatible Land Use</p>	<p>The Proposed Action would result in short-term increases in sound levels from the use of heavy equipment during construction and modification of the launch site. Starship/Super Heavy launch operations would temporarily increase sound levels during static fire engine tests and launches, including landings. Static fire tests and launches, including landings, are limited in number and duration, as described in Table S-2. Starship/Super Heavy orbital launch (takeoff) events would be the loudest single events of all the proposed launch operations, which are limited to five per year. Sound levels during landing would be less than sound levels during takeoff due to lower total engine thrust used for landing operations.</p> <p>Noise from individual launch (including landing) and static fire engine test events is expected to be heard by people in the surrounding communities, including Brownsville, Laguna Vista, Port Isabel, and South Padre Island. On behalf of SpaceX, KBR modeled estimated cumulative sound levels (day-night average sound levels [DNL]) for projected launch (including landing) and static fire engine test operations. Cumulative noise in the surrounding communities, whether from multiple events of a single operation type or from all the individual events combined, is estimated to be below levels associated with adverse noise exposure. The Proposed Action is not expected to increase noise by DNL 1.5 decibels (dB) or more for a noise sensitive area that is exposed to noise at or above the DNL 65 dB noise exposure level, or that will be exposed at or above the DNL 65 dB level due to a DNL 1.5 dB or greater increase, when compared to the no action alternative for the same timeframe. Therefore, the Proposed Action is not expected to result in significant noise impacts.</p> <p>SpaceX modeled single-event sonic boom levels during Starship and Super Heavy descent. Predicted overpressure levels for a Starship landing at the Vertical Launch Area (VLA) range from 1.2 to 2.2 pounds per square foot (psf). The 2.2 psf contour is estimated to be offshore and not impact land. Overpressures between 2 and 1 psf are predicted to impact the southern part of South Padre Island during landings at the VLA. Port Isabel, Brownsville, and Mexico are not predicted to be impacted by Starship sonic booms.</p> <p>Predicted overpressure levels for a Super Heavy landing range from 2.5 to 15 psf. A very small area of Boca Chica State Park to the south of the VLA is predicted to experience up to 15 psf during landings at the VLA. A small portion of Brazos Island State Park and portions of Boca Chica State Park are predicted to experience levels of 11–15 psf during landings at the VLA. Public access to Boca Chica State Park, portions of the Lower Rio Grande National Wildlife Refuge (NWR), and Brazos Island State Park would be restricted during launch and landing operations. Boca Chica Village is predicted to experience 9 psf during landings at the VLA. The southern portion of South Padre Island is predicted to experience 6 psf and Port Isabel and Laguna Heights are expected to experience 4–6 psf during landings at the VLA. The remainder of South Padre Island is expected to experience between 2–4 psf, and Laguna Vista and Tamaulipas, Mexico is expected to experience 2 psf during landings at the VLA. No land locations are expected to be impacted from Starship or Super Heavy water landings in the Gulf of Mexico or the Pacific Ocean.</p>

	<p>Cumulative sonic boom levels were converted to a C-weighted DNL (CDNL) to allow for comparison to FAA’s significance threshold in DNL.⁷ Populated areas on a portion of South Padre Island would not be exposed to overpressures above 2.5 psf during Starship landings at the VLA or up to 6 psf during Super Heavy landings at the VLA. The cumulative 2.5 psf and 6 psf contour for sonic booms is approximately equivalent to CDNL 54, which is less than FAA’s significance threshold for noise. SpaceX would provide public notice of upcoming Starship and Super Heavy landings to educate the public about the expected sonic boom, which would help reduce startle reactions to these noise events. Sonic booms generated during downrange landings in the Gulf of Mexico would not impact land.</p> <p>Therefore, the Proposed Action is not expected to result in significant noise impacts. Any structural damage from a sonic boom would be minor, compensated by SpaceX in the event it did occur, and would not present a risk to human safety.</p>
<p>Visual Effects</p>	<p>Potential visual impacts to the landscape in the study area include glare from the proposed infrastructure and Starship/Super Heavy launch vehicles at the Boca Chica Launch Site and light emissions during nighttime launch and testing operations. All of SpaceX’s lighting at the VLA would comply with SpaceX’s Lighting Management Plan, which includes measures that are intended to minimize nighttime lighting impacts to the surrounding areas and mitigate sky glow.</p> <p>Two permanent integration towers, each 480 feet tall, and a 450-foot-tall crane would be present at the VLA; the crane would remain at that height at most times. When on the launch pad, the integrated Starship/Super Heavy would be approximately 450 feet above ground level. Given the location of the Boca Chica Launch Site adjacent to the NWR and state parks, the launch vehicle, towers, and crane would be visible to visitors in parts of the state parks, NWR, Palmito Ranch Battlefield National Historic Landmark (NHL) and South Padre Island (a major beach destination). Visual impacts would vary depending on distance and vantage. SpaceX has developed an area near Boca Chica Village for its production and manufacturing activities, including the addition of numerous tall structures and facility lighting. The proposed infrastructure analyzed in this PEA would look similar to the existing infrastructure from a distance (e.g., high rises on South Padre Island, SpaceX’s production and manufacturing facilities), to the extent that such existing infrastructure was in the viewshed, and would not contrast with the existing visual character of the study area. The Proposed Action is not expected to result in significant visual effects so long as the mitigation measures identified in Table S-4 are implemented.</p>
<p>Cultural Resources</p>	<p>The Proposed Action has the potential to affect a total of 17 historic properties. Potential effects could result from visual, auditory, or vibration effects. Other potential effects could result from increased visitation and use of the area due to SpaceX’s presence, and, for two properties, potential effects from debris associated with an anomaly. The FAA made a <i>finding of adverse effect</i> for 17 historic properties, because the effects could diminish the integrity of the properties, which is one of the criteria for listing on the National Register of Historic Places.</p> <p>The FAA conducted National Historic Preservation Act Section 106 consultation with the State Historic Preservation Officer (SHPO) and other consulting parties. The FAA received concurrence from the SHPO on April 25, 2022, regarding the <i>finding of adverse effect</i>, and the findings are available in Appendix C. The FAA, SHPO, National Park Service, Advisory Council on Historic Preservation, Texas Parks and Wildlife Department (TPWD), USFWS, and SpaceX executed a Section 106 Programmatic Agreement to resolve the</p>

⁷ C-weighting is preferred over A-weighting for impulsive noise sources with large low-frequency content such as sonic booms.

	<p>adverse effects. With the resolution of adverse effects on historic properties, the Proposed Action would not result in significant impacts on historical, architectural, archeological, or cultural resources.</p>
<p>Department of Transportation Act, Section 4(f)</p>	<p><u>Construction</u></p> <p>Construction of the proposed infrastructure would not result in a permanent incorporation of any Section 4(f) property. Construction includes trenching to install underground utilities within the SH 4 right-of-way (ROW) between the Launch and Landing Control Center (LLCC) and the VLA. USFWS claims ownership of SH 4, but the State of Texas disputes USFWS claim of ownership to SH 4. The FAA has determined that if the USFWS owns SH 4 in this area, then SpaceX’s installation of utilities along the SH 4 ROW would involve a <i>temporary occupancy</i> of the NWR and impacts would be <i>de minimis</i> because the FAA would ensure that SpaceX restores the ROW to pre-disturbance conditions after installation. The USFWS concurred with this determination.</p> <p>The FAA considered the potential for the construction of Starship/Super Heavy infrastructure to result in adverse effects on each of the historic properties from visual effects. Visual effects from project infrastructure would result in no adverse effects for four of the resources, and as such, the FAA has determined there is no <i>constructive use</i> of these four properties from visual effects under Section 4(f). For the 13 historic properties for which visual effects from project infrastructure would result in adverse effects, the FAA has determined that the visual effects on historic resources eligible for Section 4(f) are expected to be minimal due to the distance between the resource and the infrastructure, other industrial infrastructure in the area, and SpaceX mitigating and resolving any adverse visual effects through the Section 106 PA.</p> <p>The FAA considered the potential for the construction of Starship/Super Heavy infrastructure to result in a <i>constructive use</i> of Boca Chica State Park, Brazos Island State Park, the NWR, South Bay Coastal Preserve (Preserve), Isla Blanca Park, Laguna Atascosa NWR, Trail Park, and Laguna Madre Nature Trail. The FAA has determined that visual effects of the Proposed Action would not substantially impair the protected activities, features, or attributes of these properties; and therefore, there is no <i>constructive use</i> of these properties under Section 4(f) from visual effects.</p> <p><u>Access Restrictions</u></p> <p>The proposed launch activities would have temporary, intermittent impacts on public access to Boca Chica State Park, Brazos Island State Park, the Preserve, and portions of the NWR, NHL, and the Palmetto and Cypress Bridge Pilings and Palmetto Pilings Historic Marker. In addition, the Palmetto and Cypress Bridge Pilings and Palmetto Pilings Historic Marker, Brazos Island State Park, the Preserve, and Boca Chica State Park would be subject to temporary access restrictions for anomalies, if they occurred. The NHL and all of the NWR except Boca Chica State Park, which is currently leased to the USFWS and managed as part of the NWR, would only be subject to access restrictions for launch operations, not anomalies. Access restrictions would be for safety and security reasons and to alleviate concerns raised by state and federal agencies regarding the potential impacts to public lands from the viewing public (e.g., increased traffic/visitors during launch operations). Access restrictions would be intermittent, temporary, short, subject to advance-notice requirements, planned to avoid times of high visitation, and conducted to minimize disruption for agencies that own or manage the property. Temporary access restrictions for anomalies would be even rarer than those for launch operations. Based on the temporary and short duration of the access restrictions, the notification and planning with the applicable land-management agencies, and the avoidance of days of higher public use, the FAA determined that the access restrictions associated with launch operations and anomalies would not substantially impair the activities, features, or attributes that qualify Boca Chica State Park, Brazos Island State</p>

	<p>Park, the Preserve, NWR, NHL, Palmetto and Cypress Bridge Pilings, and Palmetto Pilings Historic Marker for protection under Section 4(f). SpaceX will collaborate with TPWD and USFWS to meet fishing, wildlife observation, interpretation, photography, and environmental education objectives for the area and to meet NHL priorities. The FAA has determined that no <i>constructive use</i> under Section 4(f) would result from temporary access restrictions from launch operations or anomalies.</p> <p><u>Launch Noise/Sonic Booms</u></p> <p>The FAA evaluated noise from launch operations to determine whether noise increases would result in the substantial impairment of significant activities, features, or attributes that qualify the Preserve, NWR, Trail Park, Laguna Atascosa NWR, and Laguna Madre Nature Trail properties as a Section 4(f) resource, thus constituting a <i>constructive use</i>. The assessment used the 90 dB L_{Amax} (maximum A-weighted instantaneous sound level) noise contour for launch operations. The noise modeling demonstrates that all of Boca Chica State Park and Brazos Island State Park, the Preserve, NWR, Isla Blanca Park, Trail Park, and Laguna Madre Nature Trail would be within the 90 dB L_{Amax} noise contour for the launch event scenarios. However, due to temporary access restrictions, no people would be present in Boca Chica State Park, NWR, Brazos Island State Park, or the Preserve during launches, and as such, the public's experience of the properties' setting will not be substantially impaired by noise impacts. For Isla Blanca Park, Trail Park, and Laguna Madre Nature trail, launch noise will be intermittent and of short duration. At all other times, the quiet setting of the Section 4(f) properties would persist. Because of the short-term and intermittent nature of the impacts from noise during operational activities, the FAA has determined that noise from operations would not substantially diminish the activities, features, and attributes of the NWR, Isla Blanca Park, Laguna Atascosa NWR, Trail Park, and Laguna Madre Nature Trail. Therefore, the FAA has determined that noise from launch operational activities would not constitute a <i>constructive use</i> of these Section 4(f) properties.</p> <p>The FAA considered the potential for noise from launch operations to result in adverse effects on historic properties. The FAA determined there was no adverse effect to the NHL, Palmetto and Cypress Bridge Pilings, Palmetto Pilings Historic Marker, and the causeway bridges. Because there is no adverse effect, the FAA has determined there is no <i>constructive use</i>. For all other historic properties, because of the short-term and intermittent nature of the impacts from noise during operational activities, the FAA has determined that noise from operations would not substantially diminish the activities, features, and attributes of these properties. Therefore, the FAA has determined there is no <i>constructive use</i> of the properties resulting from launch operation noise.</p> <p>The FAA considered the potential for Starship/Super Heavy launch operations to result in adverse effects on historic properties from launch vibrations and sonic booms. Vibrations and sonic booms would result in no adverse effects for the NHL, and as such, the FAA has determined there is no <i>constructive use</i> of this historic resource from vibrations or sonic booms under Section 4(f). For all other historic resources, the FAA determined that vibrations and sonic booms would result in adverse effects. Regarding the Palmetto and Cypress Bridge Pilings, and Palmetto Pilings Historic Marker, launch noise and sonic booms could cause physical damage to the structural features of these objects, such as displacement or breakage of the structural features of the pilings, cracking of the marker's foundation, or the marker toppling over. SpaceX would hire a qualified professional to make recommendations for the stabilization and protection of the resource. If permanent stabilization is necessary, it would be done following the Secretary of the Interior's Standards for the Treatment of Historic Properties and SpaceX would pay for the stabilization and protection. Given these conditions imposed in accordance with 36 CFR § 800.5(b), there would be no adverse effects. SpaceX would</p>
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	<p>conduct a pre-launch condition assessment and monitoring for the first five orbital launches, and if damage is likely to occur or occurs, stabilize the resources. All other historic resources would experience noise levels between 111–130 dB during orbital launches; no potential structural damage is expected to these other historic resources. SpaceX is undertaking several mitigation measures to monitor potential damage and repair of any actual damage resulting from vibrations or sonic booms. Accordingly, the FAA determined that vibrations and sonic booms from launch operations would not constitute a <i>constructive use</i> of historic properties.</p> <p>The FAA considered the potential for structural damage from vibration and sonic booms from Starship/Super Heavy launch operations to substantially impair the features of the state parks, NWR, Preserve, Laguna Atascosa NWR, Trail Park, and Laguna Madre Nature Trail. Other than the Palmetto and Cypress Bridge Pilings and Palmetto Pilings Historic Marker, Boca Chica State Park, Brazos Island State Park, the Preserve, and NWR have no structures in the noise and sonic boom contours. Damage to structures in Laguna Atascosa NWR and Laguna Madre Nature Trail is extremely unlikely and expected to be rare in Isla Blanca Park. For these reasons, the FAA has determined that structural damage from vibration and sonic booms would not result in a <i>constructive use</i> of the Isla Blanca Park, Laguna Atascosa NWR, or Laguna Madre Nature Trail.</p> <p>Noise and vibrational impacts from launch operations and sonic booms are not expected to substantially impair wildlife values on the NWR or other properties. Even if wildlife were to avoid nesting and other use of the area immediately surrounding the VLA due to vibrations, noise, and/or other effects, other parts of the Boca Chica State Park and the NWR will continue to serve as valuable habitat for birds and other wildlife, and no population-level effects are expected.</p> <p>Anomalies</p> <p>Anomalies would not result in a permanent incorporation of Section 4(f) properties. The FAA considered whether the potential for debris and debris-response activities could result in a <i>temporary occupancy</i> of Section 4(f) properties. Anomalies would not result in a permanent incorporation of Section 4(f) properties. The FAA has not historically analyzed potential impacts from debris and debris-response activities arising from commercial space launch activity to public parks, recreation areas, or wildlife and waterfowl refuges under Section 4(f). The FAA nonetheless opted to consider the possibility of a <i>temporary occupancy</i> resulting from debris and debris-response activities in order to more broadly inform review of the potential effects. A Starship/Super Heavy anomaly could result in an explosion on the launch pad, which would spread debris. Debris is expected to be contained within the debris study area, which is a 700-acre area within the “all hard checkpoint” area. SpaceX’s SN11 anomaly created the largest debris field of all launch anomalies to-date and although debris spread outside the launch pad, it was contained to the debris study area. The debris study area includes the following 4(f) resources: Boca Chica State Park, Brazos Island State Park, Palmetto and Cypress Bridge Pilings, and Palmetto Pilings Historic Marker. SpaceX has entered into a memorandum of agreement (MOA) with TPWD to mitigate and restore any impacts from anomalies at Boca Chica State Park, Brazos Island State Park, and other TPWD land. The MOA provides a protocol for responding to events, recovering debris, and implementing, monitoring, and adapting restoration efforts to restore impacts. By implementing, monitoring, and adapting restoration efforts, it is expected that any affected land can be restored and long-term impacts to the natural, cultural, and recreational values of TPWD lands and habitat would be avoided. Additionally, SpaceX must obtain a Special Use Permit on an emergency basis from USFWS as applicable, for clean-up activities for any anomaly debris on Refuge fee-owned or managed lands. The FAA has determined that the <i>temporary occupancy</i> of Boca Chica State Park and Brazos Island State Park resulting</p>
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	<p>from anomalies constitutes a <i>use</i> under Section 4(f). However, the FAA has determined that, through the implementation of the terms of the MOA, the debris and debris-response activities would not adversely affect the activities, features, or attributes that make Boca Chica State Park and Brazos Island State Park eligible for Section 4(f) protection and any such impacts are expected to be <i>de minimis</i>, because debris and debris-response activities would be temporary and there would be no permanent effects to the property. TPWD and USFWS concurred with this determination.</p> <p>Anomalies at the launch pad could generate debris that may impact the Palmetto and Cypress Bridge Pilings Site and Palmetto Pilings Historic Marker. In the event of an anomaly impacting the resource, SpaceX would hire a qualified professional to make recommendations for restoration of the historic resource to pre-disturbance conditions given any damage and pay for the restoration. All work would be done following the Secretary of the Interior’s Standards for the Treatment of Historic Properties. Given these conditions imposed in accordance with 36 CFR § 800.5(b), and the monitoring and mitigation to ensure protection of the Palmetto and Cypress Bridge Pilings and Palmetto Pilings Historic Marker, there would be no adverse effects to the pilings and historic marker. As part of Section 106 consultation with the SHPO, the FAA made a finding of no adverse effect for the Palmetto and Cypress Bridge Pilings Site and the Palmetto Pilings Historic Marker. The FAA has determined that an anomaly could result in a <i>temporary occupancy</i> of the Palmetto and Cypress Bridge Pilings and the Palmetto Pilings Historic Marker as a result of debris and debris-response activities. However, following the Section 106 finding of no adverse effect, the FAA has determined that any potential <i>temporary occupancy</i> of the historic properties would be <i>de minimis</i>. The SHPO concurred with this determination.</p> <p><u>Daily Operations</u></p> <p>Small and temporary increases in noise levels from delivery trucks and personnel vehicles would be expected along SH 4, which is adjacent to the NWR, NHL, and Boca Chica State Park, including during construction. Increased noise levels would be greatest during commuting hours, although these periods would be of relatively short duration. The FAA has determined that noise from daily operations traffic would not substantially diminish the quiet setting of the NWR, NHL, and Boca Chica State Park. Therefore, the FAA has determined the noise generated by daily operations would not constitute a <i>constructive use</i> of these Section 4(f) properties. No increase in noise from daily operations is expected at Brazos Island State Park, the Preserve, Isla Blanca Park, Laguna Atascosa NWR, Trail Park, and Laguna Madre Nature Trail.</p> <p>The FAA considered the potential for daily operational noise, including construction, to result in adverse effects on historic properties other than the NHL. The FAA determined there would be no adverse effect to any historic properties from daily operational noise. Because there is no adverse effect, the FAA has determined there is no <i>constructive use</i> of historic properties resulting from daily operational noise.</p> <p>The Proposed Action is expected to increase the number of visitors to the NWR, Boca Chica State Park, and Brazos Island State Park, particularly during launch, landing, and testing operations. However, any impacts from noise and other effects from increased visitation and associated traffic are expected to be minimal. To help reduce potential effects from public off-road vehicle use to the properties and habitat, however, SpaceX will coordinate with USFWS NWR staff to identify options that would assist in protecting refuge lands and species habitats from impacts that may result from public vehicle intrusions. The FAA has determined that any increased visitation and associated traffic effects of the Proposed Action would not substantially impair the protected activities, features, or attributes of these properties. No other public parks or wildlife or waterfowl</p>
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	<p>refuges are expected to experience increased visitation or traffic resulting from the Proposed Action.</p> <p>The FAA considered the potential for increased traffic and visitors to result in adverse effects on historic properties. The presence of increased numbers of people would bring greater attention to historic sites including the NHL, and possibly Palmetto and Cypress Bridge Pilings Site, and the Palmetto Pilings Historical Marker. To mitigate, SpaceX would undertake mitigation measures including maintaining checkpoints, and developing interpretive signage in English and Spanish that will educate visitors on the importance of cultural areas and the need to stay within defined access areas and the legal implications of vandalism and artifact collecting. Given this monitoring and mitigation to ensure protection of the historic resources, the FAA has determined there is no substantial impairment to the NHL, Palmetto and Cypress Bridge Pilings Site, and the Palmetto Pilings Historical Marker. Therefore, the FAA has determined that daily operations would not result in a <i>constructive use</i> of these Section 4(f) properties. No other historic resources are expected to experience an increase in the number of visitors or traffic.</p> <p>In summary, the FAA has determined the Proposed Action would not result in more than a minimal (i.e., <i>de minimis</i>) physical use of a Section 4(f) resource and would not constitute a <i>constructive use</i>. The FAA has consulted with the officials having jurisdiction over the 4(f) properties in the study area and has considered their comments and those of the public in making the final 4(f) determinations identified in the PEA.</p>
<p>Water Resources</p>	<p>Construction activities could affect surface waters through ground disturbance activities and use of construction equipment. Potential impacts to groundwater quality during construction include contamination from spills or leaks from construction vehicles and machinery. Surface water discharges from runoff during construction and operations would be managed according to requirements of the Texas Pollutant Discharge Elimination System. The Proposed Action would have minimal impact to groundwater quality with stormwater treatment and industrial wastewater systems that are properly designed and operated in accordance with permit conditions. Construction is anticipated to permanently fill 17.16 acres of wetlands. Wetland impacts would be mitigated through the Clean Water Act (CWA) Section 404 permitting process. The U.S. Army Corps of Engineers (USACE) will evaluate an application from SpaceX under Section 404 of the CWA which requires review of various issues including alternatives and appropriate mitigation for wetland impacts. USACE will issue a separate decision on SpaceX's permit application after completion of its review.</p> <p>Fill material would be required to elevate areas of proposed expansion out of the floodplain. The proposed expansions would result in the filling of 25.8 acres of floodplain. Filling this relatively small area (less than 1 percent of the contiguous area) would not result in new areas being subject to 100-year floods, nor would it result in existing areas subject to 100-year floods becoming more prone to floods. Accordingly, the Proposed Action is not expected to result in significant impacts on water resources.</p>
<p>Biological Resources</p>	<p>Construction activities would impact terrestrial habitats and wildlife through habitat loss or degradation, use of construction equipment/human activity, hazardous materials, lighting, and invasive species. Permanent construction impacts (i.e., habitat removal) would be localized and small (approximately 25 total acres) compared to the overall available habitat within the Lower Rio Grande Valley, and the effects of the use of construction equipment, hazardous materials, and lighting would be primarily short-term and reduced through mitigation and monitoring measures. Potential introduction and spread of invasive plants would be avoided or minimized through mitigation measures.</p>

	<p>Therefore, the Proposed Action is not expected to result in significant impacts on terrestrial habitats or wildlife populations.</p> <p>Operational activities have the potential to impact terrestrial habitats and wildlife through the presence of new structures, increased vehicle traffic and presence of humans, launch-related noise and vibration impacts, exhaust/heat plumes, lighting, and anomalies. The FAA anticipates the expansion of existing infrastructure and facilities would have a negligible impact on species, particularly given the mitigation and monitoring.</p> <p>The presence of newly constructed structures, including the integration towers and expanded solar farm could pose a potential collision impact to birds, due to height and glare. However, these structures do not include glass windows and would be comprised of opaque surfaces, which are of less risk regarding bird collisions. Further, SpaceX would implement USFWS measures to reduce the risk of bird collisions.</p> <p>An increase in vehicle traffic during daily operations from construction and SpaceX operations could increase the likelihood of wildlife being killed by a collision with a vehicle. However, SpaceX would coordinate with USFWS NWR staff to identify options that would assist in protecting refuge lands and species habitats from impacts that may result from public vehicle intrusions. To help reduce potential effects from increased visitation and associated traffic, SpaceX will coordinate with Texas Department of Transportation regarding funding the installation of up to five additional wildlife crossing signs along SH 4 for a total of ten signs (five in each direction). Five wildlife crossing signs have already been installed along SH 4.</p> <p>Noise from general operations, launches, landings, and static fire tests could also affect wildlife. Vibration and sonic booms have the potential to temporarily disturb wildlife. However, noise from the Proposed Action would not be expected to cause a significant impact because the noise events are infrequent and short-term.</p> <p>The heat plume generated from launches, which would travel away from the launch pad (reaching ambient temperatures approximately 0.6 mile from the launch pad), may cause some alterations to the plant community, and could lead to vegetation changes, including loss of plant community structure, reduction in total cover, and replacement of some native species with weed species. However, the heat plume is not expected to permanently damage vegetation as these temperatures would be short-lived (heat plume would dissipate within minutes). Changes to terrestrial habitat structure might occur from fire in small areas adjacent to the launch mount and landing pad. Vegetative land cover in these areas is classified as barren or grasslands, both of which would recover quickly post-fire. Increased noise from pre-launch activities and the Raptor engines would cause a startle response of animals and would effectively direct them away from the area and reduce the risk of being affected by the heat of the plume. While unlikely, individual animals caught in the heat plume could be injured or killed, but the infrequent launches and quick dissipation of heat is not anticipated to affect species at the population level. And, as discussed above, noise-induced startle responses from operations-related noise and vibration impacts are not expected to have a significant impact on wildlife.</p> <p>Nighttime operations at the VLA would increase light emissions in the vicinity of the VLA; however, impacts would be minimized with adherence to the Lighting Management Plan.</p> <p>Debris impacts and fire from anomalies also have the potential to impact terrestrial habitats and wildlife. However, debris response activities would be temporary, and the impacted land would be restored by SpaceX in consultation with the landowner. By</p>
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	<p>implementing, monitoring, and adapting restoration efforts, it is expected that any affected land can be restored and long-term impacts to wildlife habitat would not be expected. While debris from anomalies could impact habitat in the vicinity of the VLA, a direct wildlife strike would be very unlikely.</p> <p>Potential activities that may affect marine habitats and wildlife include downrange platform landings, expendable ocean landings, and vessel traffic to and from downrange platform landing locations. Given the low frequency of the Starship/Super Heavy ocean reentry operations, and the fact that marine wildlife, marine mammals, and special status species spend the majority of their time submerged as opposed to on the surface, it is extremely unlikely they would be impacted (e.g., struck) by a Starship/Super Heavy ocean landing on the platform or from an anomaly (e.g., vehicle misses the platform). Direct strikes by falling debris and the ocean landing of the spacecraft are extremely unlikely for all species of concern, fish, sea turtles, and marine mammals.</p> <p>Sonic booms created by landings intercept the ocean surface. They are expected to intercept the ocean surface no closer than 19 miles of the reentry location. Due to the low magnitude of the boom during reentry, and the substantial attenuation of a sonic boom at the air/water interface, coupled with exponential attenuation with water depth, the sonic boom would not result in impacts to marine species beneath the surface.</p> <p>There is no essential fish habitat (EFH) in the construction area, and no in-water construction activities are proposed to occur. Therefore, impacts to substrate or marine sediments from construction are not anticipated. Downrange platform landings would not be anticipated to impact EFH, as all elements of the operation would occur at the ocean surface. Downrange expendable ocean landings may have the potential to impact EFH. Offshore EFH in the areas that could be affected by downrange expendable ocean landings consists of the water column and unconsolidated sand substrate. Expendable landings would not result in permanent changes to physical parameters (temperature, salinity, oxygen concentration, etc.) of the water column. The amount of propellant, metals, or other substances that could leach or dissolve into the water column or substrate after the Starship or Super Heavy sinks to the ocean floor would be minimal and would not result in detectable changes to water or sediment quality. Additionally, the probability an expended Starship or Super Heavy impacting EFH would be considered negligible given the small number of number (up to five) of landings per year in the study area. There may be temporary adverse effects to EFH, particularly in the event of launch failure involving the spread of debris and release of hazardous material (e.g., liquid propellant). The FAA consulted the National Marine Fisheries Service (NMFS) regarding this EFH adverse effect determination. NMFS provided two Conservation Recommendations pursuant to 50 CFR §600.920, which SpaceX and the FAA have agreed to implement:</p> <ul style="list-style-type: none"> • Conservation Recommendation 1: Prior to any in-water work (i.e., debris recovery or sinking), SpaceX will ensure all ballast and vessel hulls do not pose a risk of introducing new invasive species and that project implementation will not increase abundance of invasive species present at the project site. SpaceX will 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 will coordinate with NMFS in the case of a launch failure and any vessel grounding to determine if consultation re-initiation is appropriate. <p>The FAA has determined the Proposed Action would adversely affect species listed under and critical habitat designated under the federal Endangered Species Act (ESA). The FAA submitted a Biological Assessment to the USFWS and requested to initiate formal</p>
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	<p>consultation per ESA Section 7. ESA Section 7 consultation with the USFWS was completed when USFWS issued a Biological Opinion (BO). The BO concurred with FAA’s findings for the West Indian manatee and eastern black rail and concluded the Proposed Action is not likely to jeopardize the continued existence of listed species or adversely modify designated critical habitat. The BO includes non-discretionary Reasonable and Prudent Measures and associated Terms and Conditions to avoid, minimize, and mitigate the impacts to listed species (i.e., amount or extent of incidental take) and critical habitat. SpaceX must implement the Terms and Conditions outlined in the BO.</p> <p>The FAA consulted NMFS regarding potential effects of the Proposed Action on ESA-listed species in the marine environment, including potential ship strikes on sea turtles and marine mammals. The ESA consultation concluded with NMFS concurring that the Proposed Action is not likely to adversely affect ESA-listed species or critical habitat under NMFS jurisdiction. The consultation includes measures that SpaceX must implement to avoid or minimize effects to listed species and habitat.</p>
<p>Coastal Resources</p>	<p>The Proposed Action would take place in the coastal zone. Landing and recovery operations would not take place in intertidal areas, salt marshes, estuaries, or coral reefs. The Proposed Action does not include any coastal construction or seafloor-disturbing activities and would be consistent with commonly occurring Gulf of Mexico maritime operations. The Proposed Action is not prohibited for development within the Coastal Barrier Resource System Unit, as the project is not federally funded. SpaceX is responsible for coordinating with the Texas General Land Office (TGLO) to ensure its activities are consistent with the Texas Coastal Management Program (TCMP). TGLO did not conduct a federal consistency review because the Proposed Action (i.e., issuance of a commercial space experimental permit or license) is not a listed activity and is not subject to review under the TCMP. However, TGLO stated that the Texas Commission on Environmental Quality would conduct a federal consistency review for the USACE’s modification of SpaceX’s CWA Section 404 permit. Therefore, the Proposed Action is not expected to result in significant impacts to coastal resources.</p>
<p>Land Use</p>	<p>The Proposed Action is consistent with existing land uses at the Boca Chica Launch Site, and would not violate any local land use ordinances, plans, or zoning ordinances. Additionally, the planned uses under the Proposed Action are consistent with the current land uses. Access restriction areas would be established prior to launch-related operations and publicized by Cameron County. Access restrictions would be limited to up to 500 hours per year for nominal operations and up to an additional 300 hours per year to address anomalies, which may not occur. SpaceX has established a hotline for real time status and updates on access restrictions through a text message alert service. Subscribers can text “BEACH” to 1-866-513-3475 to receive updates and public notices will also be available on the Cameron County webpage.</p>
<p>Hazardous Materials, Solid Waste, and Pollution Prevention</p>	<p>SpaceX would comply with all applicable federal, state, and local rules and regulations pertaining to the proper storage, handling, and use of hazardous materials. SpaceX has appropriate plans in place to address accidental spills or releases of hazardous materials. Therefore, the Proposed Action is not expected to result in significant impacts related to hazardous materials.</p> <p>SpaceX would place solid wastes in covered receptacles until disposal to avoid or minimize accidental entry into coastal waters or contact with stormwater and to prevent offsite deposition from wind. SpaceX would salvage or recycle solid wastes to the maximum extent practicable and dispose of the remaining solid waste in appropriately permitted landfills. The Proposed Action would not generate solid waste that exceeds the capacity of the Seabreeze Landfill currently used by SpaceX. Therefore, the Proposed Action is not expected to result in significant impacts related to solid waste.</p>

	<p>SpaceX would prevent pollution via source reduction whenever feasible. SpaceX would recycle and/or treat polluting substances whose use cannot be avoided in accordance with applicable laws. SpaceX’s disposal of all polluting substances would be employed only as a last resort and would be conducted in accordance with applicable laws. Therefore, the Proposed Action is not expected to result in significant impacts related to pollution prevention.</p>
<p>Natural Resources and Energy Supply</p>	<p>Under the Proposed Action, SpaceX would power daily operations at the VLA primarily via solar power from the solar panels near the LLCC. The solar energy farm currently supplies approximately 1 megawatt (MW) of power. The proposed expansion of the solar farm would add an additional 750 kilowatts of power, for a total of 1.6 MWs of energy. SpaceX would install an additional battery system at the solar farm, with up to 8 MW-hours of storage.</p> <p>SpaceX would use various propellant fuels and commodities for launches and static fire engine tests, as well as diesel and gasoline to fuel ground equipment. Propellants would be generated through the air separation unit or provided by regional or national suppliers and brought to the site by truck. Use of these propellants in support of the Proposed Action would not adversely impact local supply, as the ability for SpaceX to supply their own propellants would reduce the demand on the local supply. Similarly, SpaceX does not anticipate that the gasoline and diesel fuels required for operations would adversely impact local supply, as the Boca Chica Launch Site is located in the highly industrialized Rio Grande Basin.</p> <p>SpaceX uses groundwater for various operations and for personnel use at the facilities. Potable water would either be delivered by truck or pumped from an existing on-site well at the VLA. Water required to support the VLA would be primarily generated from the existing well and generated from Cameron County. Groundwater in the study area is within the Gulf of Mexico aquifers designated as underground sources of drinking water. The amount of groundwater required for the Proposed Action would create a negligible impact on groundwater supply in Cameron County.</p> <p>As such, the Proposed Action would not have the potential to cause demand to exceed available or future supplies of applicable resources. Impacts on natural resources and energy supply are not anticipated to be significant.</p>
<p>Socioeconomics, Environmental Justice, and Children’s Environmental Health and Safety Risks</p>	<p>The Proposed Action does not involve activities anticipated to adversely affect existing economic activity, income, employment, population, housing, sustenance, public services, and social conditions. Launch operations may result in moderate economic benefits, including increased demand in the workforce, higher revenues, and increased per capita income in the local area. While the population under the poverty threshold may not directly benefit through employment and income, it may indirectly benefit as regional economic health is improved through the proposed increase in employment for commercial space exploration activity. Therefore, the Proposed Action would not result in significant socioeconomic impacts.</p> <p>The counties within the study area, and the Census Block Group where the Boca Chica Launch Site is located, have substantially higher proportions of minority and low-income populations than Texas as a whole. The Proposed Action would have some unavoidable impacts from increased noise, traffic, lighting during nighttime operations, and intermittent and temporary access restrictions to Boca Chica Beach. These impacts would be minimized by following all appropriate FAA, Occupational Health and Safety Administration, Department of Transportation, and state requirements and guidelines, as well as the mitigation measures identified in the PEA. Further, FAA will continue providing Spanish translations of vital project-related documents and information, and oral interpretation services for public meetings, or by request, in the future.</p>

	<p>Access to Boca Chica Beach would be temporarily restricted for Starship/Super Heavy operations and would occur on an intermittent basis, up to 500 hours per year for nominal operations, and would be temporary. Boca Chica Beach is within the unincorporated area of Cameron County and requires no fee for parking or access. As the access restrictions to Boca Chica Beach would be temporary and intermittent, and there are other cost-free public beach access locations within the vicinity of local communities, the Proposed Action would not result in disproportionate high and adverse impacts to minority and low-income populations. Therefore, the Proposed Action would not result in significant impacts on environmental justice populations.</p> <p>The Proposed Action is located in a sparsely populated area approximately 6 miles from the nearest public school. Boca Chica Village is the only residential area near the Proposed Action and has no children under the age of 18. The Proposed Action would not increase risks to children’s environmental health or safety.</p> <p>Public safety risks are also closely evaluated by the FAA in reviewing SpaceX’s proposed operations for compliance with the Commercial Space Launch Act’s strict public risk requirements.</p> <p>Accordingly, impacts on socioeconomics, environmental justice, and children’s environmental health and safety risks are not anticipated to be significant.</p>
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Table S-4. Mitigation Measures

Environmental Impact Category	Mitigation Measure
Air Quality	<p>The FAA would ensure that SpaceX implements the following measures to minimize impacts on air quality:</p> <ol style="list-style-type: none"> 1. Periodic water spraying to control particulates and fugitive dust. 2. Best Management Practices (BMPs) such as minimal idling of engines, watering of soils to be disturbed, and use of low volatility coatings. 3. Compliance with Texas Commission on Environmental Quality’s (TCEQ) authorization under the Oil and Gas Standard Permit, including adherence to any permit conditions.
Climate	None.
Noise and Noise-Compatible Land Use	<p>The FAA would ensure that SpaceX uses its notification plan to educate the public and announce when a launch or landing event would occur. Announcements of upcoming Starship/Super Heavy launches and landings would serve to warn people about these noise events and would likely help reduce human adverse reactions to 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. This approach is consistent with the public notification efforts conducted by SpaceX at Cape Canaveral Space Force Station and Vandenberg Space Force Base. While the overall impact of sonic booms would not be significant, SpaceX’s advance public notice would help reduce human adverse reactions. SpaceX would be responsible for resolving any structural damage caused by a sonic boom.</p> <p>Per FAA regulations and the Commercial Space Launch Act, SpaceX is required to carry insurance to cover claims by third parties that result from licensed activities, including any structural damage. The FAA requires that SpaceX carry insurance in the amount of the “Maximum Probable Loss,” which is determined on a launch-by-launch basis by the FAA and is up to \$500,000,000 per launch. In the event that structural damage results from noise-induced vibrations or sonic booms, any such claims of damage would be</p>

	<p>subject to the insurance policy terms and process specified by the Commercial Space Launch Act and FAA regulations.</p>
<p>Visual Effects</p>	<p>The FAA would ensure that SpaceX implements the following measures to minimize visual effects:</p> <ol style="list-style-type: none"> 1. Management of Launch Site Lighting <ol style="list-style-type: none"> a. Exterior lights used expressly for safety or security purposes are limited to the minimum number and configuration required to achieve their functional roles. b. Minimization measures include directing, shielding, or positioning lighting to avoid visibility from the beach, minimize lateral light spread, and decrease uplighting; turning off lights when not needed; using low-pressure sodium to the extent practicable; installing lighting with multiple levels of control (i.e., some, all, or none of the lights can be turned on); and installing lighting timers where appropriate. c. SpaceX will issue annual notices to all complex personnel prior to sea turtle nesting season reminding personnel of light use requirements and responsibilities. 2. Monitoring Launch Site Lighting <ol style="list-style-type: none"> a. To minimize lighting impacts to sea turtles, SpaceX will monitor its lighting. This monitoring will be conducted to verify SpaceX's compliance with the SpaceX Boca Chica Launch Site Lighting Management Plan. b. A qualified biologist will conduct lighting inspections to eliminate unnecessary lighting before nesting season and weekly during the nesting-hatching season (March 15th to October 1st) and send the results of the inspections to the FAA. c. SpaceX will conduct evening inspections between 9:00 p.m. and 5:00 a.m. monthly during sea turtle nesting season. d. Data from monitoring and unannounced inspections, as well as any compliance issues and remedies, will be summarized in SpaceX's annual monitoring report, per the requirements of the U.S. Fish and Wildlife Service's (USFWS) Biological Opinion (BO).
<p>Cultural Resources</p>	<p>The FAA would ensure that SpaceX implements the measures identified in the Section 106 Programmatic Agreement (PA). The PA contains the following measures to avoid, minimize, or mitigate adverse effects:</p> <ol style="list-style-type: none"> 1. Installing all utility lines between the Launch and Landing Control Center (LLCC) and Vertical Launch Area (VLA) underground to avoid visual effects to the Palmito Ranch Battlefield National Historic Landmark (NHL). 2. Preparing a historical context report (i.e., historical narrative) of the historic events and activities of the Mexican War (1846-1848) and the Civil War (1861-1865) that took place in the geographic area associated with and including the Area of Potential Effects (APE). 3. Funding the development and production of five interpretive signs (in English and Spanish) that describe the history and significance of the historic properties in the APE. 4. Funding educational outreach (i.e., webpage content for agency websites, informative videos) to the public about the region's cultural heritage. 5. Documenting the landscape of the Palmito Ranch Battlefield following the Level I Historic American Landscapes Survey standards and guidelines for nationally significant properties. 6. Implementing measures to reduce noise levels generated by construction equipment. 7. Implementing measures to minimize noise from truck (construction, tanker, concrete, water, delivery) traffic.

	<ol style="list-style-type: none"> 8. 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. 9. Replicating and installing the missing stars and wreaths on the Palmetto Pilings Historical Marker. 10. Maintaining access restriction to the area west of the existing U.S. Customs and Border Protection checkpoint at a location east of where State Highway (SH) 1419 crosses SH 4 and west of where an unnamed north-south canal crosses SH 4, as generally depicted in PEA Appendix C, to include the entire extent of the Palmito Ranch Battlefield NHL. 11. Placing temporary construction barriers around the Palmetto Pilings Historical Marker during construction. 12. If an anomaly affects a historic property, SpaceX will hire a qualified professional to make recommendations for restoration of the historic property. All work will be done following the Secretary of the Interior's Standards for the Treatment of Historic Properties. The proposed restoration will be subject to the review process described in PA Stipulation V. Upon review and approval, SpaceX will hire a qualified professional to restore the historic property. 13. In addition, an Unanticipated Discoveries Plan will be prepared to outline the processes to be followed when previously unknown cultural resources or human remains are discovered during construction or operation of the Proposed Action.
<p>Department of Transportation Act, Section 4(f)</p>	<p>The FAA would ensure that SpaceX implements the following measures to avoid, minimize, or mitigate impacts on Section 4(f) resources:</p> <ol style="list-style-type: none"> 1. SpaceX would restore the SH 4 ROW to pre-disturbance conditions after installation of utilities. 2. In the event of an anomaly, SpaceX would notify Texas Parks and Wildlife Department (TPWD), Texas General Land Office (TGLO), and/or USFWS, as applicable, per the procedure outlined in SpaceX's Anomaly Response Plan. 3. Following an anomaly, SpaceX would release the access restriction area west of the "All Hard Checkpoint" to allow visitors to continue to access the NHL and Lower Rio Grande Valley National Wildlife Refuge (NWR) while anomaly-response actions are taken. SpaceX would keep the "All Hard Checkpoint" in place to protect public safety and implement the measures outlined in its Anomaly Response Plan. 4. SpaceX or a qualified contractor would conduct debris removal in accordance with a method as determined by TPWD and agreed to by SpaceX. 5. Restoration measures regarding any adverse impacts to landforms include monitoring disturbed areas for spread of non-native vegetation and removal upon discovery, spreading seeds found locally from preferred grass species, and regrading disturbed land to its pre-existing condition. Alternative restoration approaches may be considered as determined by TPWD and agreed to by SpaceX. 6. Restoration actions with respect to algal flats include grooming of tracks with the use of hand tools and ambient soils to prevent further impacts, removing fill, establishing the proper slope within the tidal range, and inoculating the soils with a mixture of the dominant algal species, or any other approach as determined by TPWD and agreed to by SpaceX. 7. SpaceX would implement the additional measures outlined in TPWD's Section 4(f) concurrence letter, dated May 11, 2022, which include the following: <ol style="list-style-type: none"> a. Strict compliance with all terms and conditions of the Memorandum of Agreement (MOA) executed September 2, 2021, between TPWD and SpaceX.

	<ul style="list-style-type: none"> b. Completion and maintenance of bollard-and-cable traffic control fencing along SH 4 demarcating the boundaries of TPWD lands. SpaceX at its sole cost will survey the SH 4 boundary and will leave two or three gaps in the western portion of the fence only as necessary to provide reasonable access to privately owned inholdings at access points recorded in the real property records of Cameron County. Signage will be placed at each gap with contact information for legitimate landowners to gain access to their property. c. SpaceX will take all necessary measures to make TPWD-owned lands at Boca Chica accessible to researchers and all TPWD and/or USFWS-authorized personnel at all times except during ignition events. d. SpaceX will cover the cost of a contract with TPWD and/or Texas A&M Corpus Christi/Texas A&M system to develop specific protocols for test restoration of impacts to tidal/algal flats at Boca Chica resulting from the SN11 anomaly within 30 days of presentation of such a contract. The scope of the contract will include the cost of a principal investigator, one or two graduate students and all related equipment, materials, overhead, administrative, and publication costs. e. In the event Texas A&M University is unable to provide the services outlined above, TPWD staff will work in good faith to identify another academic institution or similarly qualified third party to undertake the proposed project and will keep SpaceX staff apprised of its progress. f. During the first “restoration season” as recommended by and following the study referenced in the preceding paragraphs, SpaceX, at its sole expense, will hire a qualified environmental firm to undertake a test restoration per the recommendations of the study, covering a minimum of five net acres of tidal/algal flats affected by the impacts of debris and debris retrieval following the SN11 anomaly. SpaceX will work cooperatively with TPWD to designate the specific footprint of the test restoration. g. SpaceX, at its sole cost, will pay for monitoring the success of the test restoration relative to success criteria described in the protocols developed in the study. If no such protocols have been developed, success of the test restoration will be monitored relative to success criteria developed by the implementing environmental firm and agreed to by TPWD. A report on the progress of the restoration will be submitted to TPWD not less than 22 nor more than 26 months after implementation. h. If the test restoration is determined to be successful, SpaceX, at its sole cost, will arrange the restoration of an additional 15 acres to be determined in consultation with TPWD and implemented no later than the restoration season following submission of the report referenced in paragraph #7.g above. i. If the test restoration is determined to be unsuccessful, SpaceX, at its sole cost, will consult with the investigators and/or authors of the report referenced in paragraph #7.d and #7.e above and based on that input will repeat the measures in paragraphs #7.f, #7.g and #7.h above. These steps will be repeated until successful restoration of 20 acres is achieved. TPWD may waive this condition if it advises FAA in writing that all reasonable attempts to restore habitat result in more harm than good. j. Once a successful restoration protocol is established, SpaceX will take steps to implement restoration of any new impacts that occur pursuant to activities permitted or licensed by the FAA immediately upon request by TPWD. <p>8. SpaceX would issue notifications prior to a planned access restriction and in accordance with its Access Restriction Notification Plan, including:</p> <ul style="list-style-type: none"> a. Providing a forecast of planned access restrictions one to two weeks in advance of the access restriction on the County’s website and/or send via email to the
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	<p>agency distribution list. Information about the proposed access restriction would be posted on Cameron County’s website.</p> <ul style="list-style-type: none"> b. Sending access restriction notifications to the regulatory and public land-managing agencies as plans finalize (typically 48 hours prior to the access restriction). The agencies would continue to receive updates immediately when the access restrictions go into place and when the access restrictions end, as well as cancellations of requested access restrictions. SpaceX personnel at the LLCC would send these notifications to ensure the most up-to-date information is distributed. c. Sending real time status and updates on access restrictions through a text message alert service. Subscribers can text “BEACH” TO 1-866-513-3475 to receive updates. <p>9. SpaceX will implement the following measures to limit access restrictions:</p> <ul style="list-style-type: none"> a. No SH 4 access restrictions on the following holidays: Memorial Day, Labor Day, July 4th, MLK Day, Presidents’ Day, Texas Independence Day, Cesar Chavez Day, Emancipation Day in Texas (also referred to as Juneteenth), Veteran’s Day, Good Friday, Easter, Father’s Day, Mother’s Day, Thanksgiving Day, Christmas Day, New Year’s Day (“Holidays”). <ul style="list-style-type: none"> i. Where any of the Holidays falls annually on a Monday or Friday, no Weekend Access Restrictions, as defined in 9.d below, shall be permitted. ii. Where any of the Holidays does not fall annually on a Monday or Friday, but falls on a Monday or Friday in a particular year, no Weekend Access Restrictions, as defined in 9.d, shall be permitted for that year. iii. For Thanksgiving, no access restrictions shall be permitted from Thanksgiving Day through the Sunday immediately following Thanksgiving. b. Except as provided in 9.d, from Memorial Day to Labor Day (the times of greatest visitor beach uses and enjoyment), no Weekend Access Restrictions from Friday at 6:00 a.m. through Sunday. Road access restrictions for any SpaceX activities would occur from Monday through Friday at 6:00 a.m. This predictive schedule ensures the public access to all open areas of the Refuge (e.g., Boca Chica Beach) from Friday at 6:00 a.m. through Sunday from Memorial Day through Labor Day. c. Except as provided in 9.d, from the day after Labor Day to the day before Memorial Day (throughout the winter months), no Weekend Access Restrictions on Saturday or Sunday. d. When a SpaceX activity requires at least one road access restriction between Fridays at 6:00 a.m. and Sundays from Memorial Day to Labor Day, or on weekends from the day after Labor Day to the day before Memorial Day, it is considered a “Weekend Access Restriction.” <ul style="list-style-type: none"> i. SpaceX may request a Weekend Access Restriction up to five times per calendar year. e. For any SH 4 road access restriction, SpaceX will request, at least 48 hours prior to the start of the access restriction period, that the Cameron County Commissioners Court implement the access restriction. This notice requirement is intended to give the public a minimum 48-hour notice to reduce impacts to the recreational users. Any requested Weekend Access Restriction shall count toward the total five annual Weekend Access Restrictions unless cancellation of the Weekend Access Restriction is publicized more than 24 hours prior to the start of the requested access restriction period. f. Exception to the above is for activities deemed to be anomalies per FAA regulations.
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	<p>School District. On the site tours, SpaceX will educate the students on the sensitive resources and habitat surrounding the SpaceX facilities. SpaceX would coordinate with the USFWS on the information to be shared relevant to the sensitive resources and habitat surrounding the SpaceX facilities. At the annual educational event, SpaceX will invite USFWS, TPWD, and NPS to speak to the importance of studying the Life and Physical Sciences.</p>
<p>Water Resources</p>	<p>The FAA would ensure that SpaceX implements the following measures to minimize impacts on water resources:</p> <ol style="list-style-type: none"> 1. SpaceX would implement its Spill Prevention, Control, and Countermeasures (SPCC) Plan to minimize the potential for accidental releases of polluting substances. 2. In conjunction with final design and Clean Water Act (CWA) permitting, SpaceX would submit a Notice of Intent to TCEQ for application of the general permit authorization for point source discharges of stormwater associated with industrial activity to surface water in the state. SpaceX would develop a Stormwater Pollution Prevent Plan (SWPPP) that would adhere to the permit effluent limitations and requirements applicable to the industrial activities. 3. If water treatment or retention is required, SpaceX would contain water in retention ponds. Retention ponds would be lined to prevent percolation of contaminants into the groundwater and would be maintained and monitored by SpaceX. 4. SpaceX would develop appropriate sampling protocols and water quality criteria in coordination with the TCEQ in accordance with Texas Surface Water Quality. 5. SpaceX would manage any deluge water according to state and local water quality requirements (e.g., pretreatment permits, National Pollutant Discharge Elimination System [NPDES] permits, etc.). 6. SpaceX would adhere to proper marine vessel operating procedures and use of appropriate BMPs in the event of a recovery operation discharge or spill. 7. SpaceX would employ proper design redundancies of commodity storage facilities, containment around all hydraulic systems, safety measures in launch vehicle processes, and spill response and clean-up measures. 8. Pursuant to CWA Section 404, SpaceX would coordinate with the USACE to develop an appropriate compensatory mitigation plan for unavoidable impacts to wetlands. 9. SpaceX would coordinate with Cameron County floodplain administrators to obtain a development permit in accordance with the National Flood Insurance Program as well as county regulations. 10. Following an anomaly, SpaceX would release the access restriction area west of the "All Hard Checkpoint" to allow visitors to continue to access the NHL and NWR while anomaly-response actions are taken. SpaceX would keep the "All Hard Checkpoint" in place to protect public safety and implement the measures outlined in its Anomaly Response Plan. 11. Debris removal would occur by a method as determined by TPWD and agreed to by SpaceX. 12. SpaceX must obtain a Special Use Permit on an emergency basis from USFWS as applicable, prior to clean-up activities for any anomaly debris on Refuge fee-owned or managed lands. 13. Restoration measures regarding any adverse impacts to landforms include monitoring disturbed areas for spread of non-native vegetation and removal upon discovery, spreading seeds found locally from preferred grass species, and regrading disturbed land to its pre-existing condition. Alternative restoration approaches may be considered as determined by TPWD and agreed to by SpaceX. 14. Restoration actions with respect to algal flats include grooming of tracks with the use of hand tools and ambient soils to prevent further impacts, removing fill, establishing the proper slope within the tidal range, and inoculating the soils with a

	<p>mixture of the dominant algal species, or any other approach as determined by TPWD and agreed to by SpaceX.</p>
<p>Biological Resources</p>	<p>The FAA would ensure that SpaceX implements the following measures to avoid, minimize, or mitigate impacts on biological resources:</p> <p>Construction Measures</p> <ol style="list-style-type: none"> 1. In conjunction with final design and CWA permitting, SpaceX will update its SWPPP to address the additional facilities proposed for the site and ensure compliance with its TCEQ stormwater permit. The updates will be completed before construction begins under the Proposed Action. The SWPPP identifies BMPs for erosion and sedimentation controls, including techniques to diffuse and slow the velocity of stormwater to reduce potential impacts (e.g., soil loss and sedimentation) to water quality during construction. All permitted construction activities with the potential to impact water quality from potential runoff from the site will be conducted in accordance with the stormwater permit, including measures identified in the SWPPP. SpaceX will provide a copy of the SWPPP for permitted construction activity under the Proposed Action to the FAA and USFWS before such construction begins and will provide the USFWS and FAA with written notice of updates to the SWPPP on a quarterly basis. 2. Prior to entry into or exit from unpaved areas of the VLA, SpaceX will ensure that heavy equipment (i.e., vehicles and machinery that are larger than a typical passenger truck) and vehicles to the maximum extent possible traverse over a construction shaker or rumble plates or rock bed located at the VLA to remove any sediment and dirt for purposes of preventing the introduction and spread of non-native plant species. SpaceX would inspect the equipment to ensure that hydraulic fittings are tight, hydraulic hoses are in good condition (and replaced if damaged), and there are no petroleum leaks. SpaceX will document the location(s) of the construction shakers or rumble plates installed at the VLA in its annual report to the USFWS. 3. SpaceX will implement a SPCC Plan. SpaceX will provide a copy of the SPCC Plan for permitted construction activity under the Proposed Action to the FAA and USFWS before such construction begins and will provide the USFWS and FAA with written notice of updates to the SPCC Plan on a quarterly basis. 4. SpaceX will not place excavated or fill material in delineated CWA Section 404 waters of the United States except as authorized by a permit from the USACE. SpaceX will ensure that discharged water associated with concrete mixing and placement activities does not reach surrounding water bodies or pools unless specifically authorized in a Department of Army permit. SpaceX will provide to the USACE written notice documenting completion of the activity authorized under Section 404 of the CWA; compliance with all associated terms and conditions; and implementation of any required compensatory mitigation for impacts to waters of the United States. SpaceX will provide the notice to USACE within 30 days of completion of the activities authorized by the USACE and will include a copy of this notification in its annual report to the USFWS. 5. SpaceX will continue contracting a qualified biologist to conduct pre-, during, and post-construction biological monitoring (vegetation and birds). This monitoring is ongoing and will continue to be conducted within 3 miles of construction areas. Monitoring reports will continue to be sent to the USFWS annually. 6. SpaceX will limit vehicle operation to existing paved and unpaved roads, parking areas, and authorized construction sites. Vehicle operators within the VLA will not exceed 25 miles per hour. 7. SpaceX would incorporate raptor protection measures into project design and any above-ground utility upgrades. For example, SpaceX would equip structures with

	<p>devices to discourage nest building and perching (e.g., monopole technology and visual fright devices).</p> <p>8. SpaceX will initiate coordination with the USFWS within 60 days of the start of construction under the Proposed Action to identify practicable opportunities to protect, restore, and/or enhance habitat for the ocelot, jaguarundi, piping plover, and/or red knot. SpaceX intends to continue coordination with the USFWS to complete one or more habitat protection, restoration, or enhancement projects to benefit the cats and the birds and contribute to the conservation of these species.</p> <p>9. Within six months of the issuance the BO, SpaceX will coordinate with the USFWS, USACE, and TxDOT to determine the feasibility of constructing wildlife crossings along SH 4 west of the first public hard checkpoint to benefit the ocelot and jaguarundi. If a wildlife crossing is deemed feasible by each of the coordinating parties, pending regulatory or other approvals from applicable agencies, SpaceX will fund the construction on one wildlife crossing west of the first public hard checkpoint within 1 year of the mutual determination of feasibility.</p> <p>10. SpaceX will make an annual contribution of \$5,000 to the Friends of Laguna Atascosa NWR Adopt-an-Ocelot Program within 3 months of the issuance of the BO and by March 1 of each year thereafter for the duration of the BO. Funds donated to the program are intended to pay for:</p> <ol style="list-style-type: none"> a. Wildlife guzzlers b. Camera trapping sets c. Special events to raise awareness about the ocelot d. Important supplies that allow biologist to monitor ocelot dispersal, behavior and habitat needs. <p>11. SpaceX will make an annual contribution of \$5,000 to the Peregrine Fund within 3 months of the issuance of the BO and by March 1 of each year thereafter for the duration of the BO. These funds will provide assistance with increased releases, repairing or replacing existing hack sites and/or nest boxes, or constructing new hack sites and/or nest boxes if falcons are observed in a new location.</p> <p>12. If proposed construction activities under the Proposed Action occur during the avian breeding season (February 15 through August 31), a biologist will search the proposed areas of construction activities, including laydown areas, for nests (in shrubs and on the ground) one time no more than two days before the start of construction within the surveyed area. If the biologist finds an active nest, construction workers and activity, including the operation of vehicles, equipment, or tools, within 50 meters (164 feet) of the nest will be avoided until the biologist determines the nest is no longer in use. SpaceX will mark the avoidance zone with flagging, fencing, or similar signage within 24 hours of detecting the nest and will inspect the marking daily, repairing or replacing as needed, to ensure that it remains intact and visible through the duration of the nesting activity. SpaceX will document inspections and provide a summary of inspections and avoidance actions to the FAA and USFWS with the annual report.</p> <p>Operational Measures</p> <p>13. SpaceX will operate an employee shuttle between Brownsville and the project site and between parking areas at LLCC and the VLA to reduce the number of project-related vehicles traveling to and from the project site. SpaceX will encourage employees to use the shuttle by providing information on shuttle operation in new hire onboarding materials, routine staff communications (such as staff meetings), and in contractor environmental trainings. SpaceX will mandate use of the shuttle as practicable.</p> <p>14. SpaceX will update its Lighting Management Plan to account for Starship/Super Heavy launches and related infrastructure that is the subject of the Proposed Action.</p>
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	<p>These updates will be completed at least 30 days before the beginning of sea turtle nesting season.</p> <p>Consistent with safety and security needs, SpaceX will initiate coordination with the USFWS and TPWD with the intent of incorporating the agencies' recommendations for minimizing lighting effects on ESA-listed species. This measure will minimize the modification of sea turtle habitat and minimize the likelihood of false crawls and disoriented hatchlings. Upon agreement with the USFWS and TPWD, SpaceX will implement the updated Lighting Management Plan. At a minimum, the plan will include:</p> <ol style="list-style-type: none"> a. Directing, shielding, or positioning facility lighting to avoid or minimize visibility from the beach, minimize lateral light spread, and minimize uplighting without compromising safety and security of personnel. b. Turning off lights when not needed to maintain a safe and secure facility. c. Using low pressure sodium lights, to the extent practicable, during sea turtle nesting season. Limitations to the use of low-pressure sodium include the use of white lighting required for protection and safety of SpaceX personnel for ground support operations performed 24/7 throughout the year and the use of bright spotlighting during nighttime launch activities. d. Installing new lighting with multiple levels of control (i.e., some, all, or none of the lights can be turned on) so that lighting levels can be matched with specific activities. e. Where lighting is not essential to safety or security of personnel, installing timers to switch lights off in the evening. Where applicable and not a threat to security, installing motion-detector switches. <ol style="list-style-type: none"> 15. SpaceX will continue contracting a qualified biologist to conduct pre- and post-launch biological monitoring (vegetation and birds). Monitoring will be conducted within 1 mile of the VLA up to a week before a Starship or Super Heavy launch and the day after the launch. Monitoring reports will be sent to the USFWS within two weeks following compilation and analysis of the data. 16. SpaceX will continue to collaborate with Sea Turtle, Inc. by supplying and storing field equipment and to provide sea turtle survey data within the action area to the USFWS annually. This measure supports activities that reduce the likelihood of death or injury to individual sea turtles. 17. Upon USFWS and SpaceX agreement of locations alongside SH 4 or other identified roads where the footprint is disturbed, SpaceX will fund the purchase of vehicle barrier materials to prevent trucks or ATVs from entering the refuge. The amount needed in any given year will be determined by NWR staff and is not to exceed \$10,000 annually. SpaceX will install the barriers and USFWS staff will perform general maintenance and repairs of the barriers. Funds will be issued within 3 months from the issuance of the BO, and by March 1 of each year afterwards for the duration of the BO. SpaceX will be responsible for replacing or restoring damaged barriers caused by SpaceX personnel or an anomaly. 18. In coordination with NWR staff, SpaceX will develop a protocol (e.g., Access Restriction Notification Plan) providing as much advance notice as practicable to minimize disruption to refuge and land management activities. 19. SpaceX would coordinate with the USFWS to fund additional resources or projects to enforce the access restrictions required for launch operations. 20. SpaceX would implement any applicable avoidance or minimization measures included in NMFS's Letter of Concurrence when operating in the marine environment.
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	<p>Environmental Worker Educational Briefings</p> <p>21. SpaceX will develop educational training materials and submit to the USFWS for approval. Once approved, SpaceX will provide all on-site personnel, including staff and contractors, with an environmental worker education briefing(s) prior to the start of construction activities that will include the following topics: species identification, instruction on implementing the conservation measures described in the BO, wildfire prevention measures, information regarding noxious or invasive weeds, requirements for safe handling and disposal of hazardous waste, proper disposal of litter and garbage, and the employee shuttle. SpaceX will also provide this environmental worker education briefing on an ongoing basis to all new hires of on-site staff and contractors before starting on-site work and will offer refresher briefings to all on-site staff and contractors on an annual basis. SpaceX will document completion of these educational briefings in its annual report to the USFWS.</p> <p>Anomaly Measures</p> <p>22. If an anomaly occurs, prior to taking action to recover debris on land outside the VLA, SpaceX will notify the appropriate emergency personnel, land-managing agencies, and water regulatory authorities, as required. In addition, SpaceX will comply with the terms of the MOA between TPWD and SpaceX, including coordinating with TPWD and the USFWS prior to debris removal and clean-up and consulting with TPWD and/or the USFWS prior to any anomaly-response activity that may impact sensitive wildlife habitat.</p> <p>23. In the event of an anomaly that creates debris on Refuge fee-owned or managed lands, SpaceX would be required to obtain a Special Use Permit on an emergency basis from the USFWS, as applicable, for clean-up activities.</p> <p>24. If an anomaly occurs, SpaceX will comply with its Anomaly Response Plan, Security Plan, and Fire Mitigation and Response Plan, as applicable.</p> <p>Essential Fish Habitat Conservation Recommendations</p> <p>25. Prior to any in-water work (i.e., debris recovery or sinking), SpaceX will ensure all ballast and vessel hulls do not pose a risk of introducing new invasive species and that project implementation will not increase abundance of invasive species present at the project site. SpaceX will sanitize any equipment that has been previously used in an area known to contain invasive species prior to its use for project activities.</p> <p>26. The FAA will coordinate with NMFS in the case of a launch failure and any vessel grounding to determine if consultation re-initiation is appropriate.</p> <p>BO Terms and Conditions</p> <p>27. The FAA will ensure that any license or permit to SpaceX related to the Proposed Action will include a condition that SpaceX implement all of the terms and conditions of the BO.</p> <p>28. SpaceX will implement the conservation measures, many of which include related monitoring and reporting measures, described in the Proposed Action that address aspects of construction, operation, anomaly response, educational briefings, and other conservation measures and voluntary offsets. These measures minimize habitat modification, which can cause take via harm, for the ocelot, jaguarundi, northern aplomado falcon, piping plover, red knot, and/or sea turtles. These conservation measures require implementation, with updates as described, of certain facility and operational plans:</p> <ol style="list-style-type: none"> a. Lighting Management Plan b. Fire Mitigation and Response Plan c. SPCC Plan d. SWPPP
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	<ul style="list-style-type: none"> e. Anomaly Response Plan f. Access Restriction Notification Plan g. Site Security Plan h. Traffic Control Plan i. Biological Monitoring Plan <p>SpaceX will provide the USFWS and FAA with written notice of updates to these plans on a quarterly basis.</p> <p>29. SpaceX will conduct quarterly SH 4 clean-up efforts east of the first public hard checkpoint to reduce garbage and litter along the road. The clean-up efforts will take place within the SH 4 right-of-way. SpaceX will keep all vehicles used to support cleanups on designated roadways. SpaceX will report the dates of the cleanups in the annual monitoring report submitted to the USFWS. This measure minimizes the severity of habitat modifications (i.e., the presence of litter or garbage) that may attract animals that prey on or compete with northern aplomado falcons, piping plovers, red knots, or sea turtles. This measure also benefits ocelots and jaguarundis by minimizing the likelihood or severity of increased prey concentrations along SH 4 that could lead to increased vehicle collision mortality.</p> <p>30. SpaceX will ensure that staff and contractors place non-hazardous waste materials, litter, and other discarded materials, such as construction waste, on the VLA in containers until removed from the site. All trash containers will have predator-proof secured lids and be kept closed at all times and trash will be removed regularly. This measure minimizes the severity of habitat modifications (i.e., the presence of litter or garbage) that may attract animals that prey on or compete with northern aplomado falcons, piping plovers, red knots, or sea turtles. This measure also benefits ocelots and jaguarundis by minimizing the likelihood or severity of increased prey concentrations along SH 4 that could lead to increased vehicle collision mortality.</p> <p>31. SpaceX will perform quarterly beach cleanups of Boca Chica Beach to reduce the likelihood of attracting predators (i.e., minimizing habitat modification) of the piping plover, red knot, and sea turtles to the beach. SpaceX will perform these beach cleanups for 1.5 miles north and south of the VLA. SpaceX will provide the opportunity for resource agencies (i.e., TGLO, USFWS) to participate and teach the community about the area's wildlife, sensitive areas, beach debris, and beach clean-up. SpaceX will report the dates of the cleanups in the annual monitoring report submitted to the USFWS.</p> <p>32. SpaceX will coordinate with TxDOT to help ensure that the shoulders of SH 4 east of the first public hard checkpoint are maintained by regular mowing and trimming to keep vegetation shorter than 12 inches. SpaceX will notify TxDOT that maintenance may be warranted when vegetation along SH 4 exceeds approximately 9 inches. TxDOT will be responsible for performing roadway vegetation maintenance. This measure minimizes vegetation cover along SH 4 and minimizes the likelihood of vehicle collisions with ocelots or jaguarundis.</p> <p>33. SpaceX will construct a barrier along the northern boundary of the VLA to assist in keeping debris from entering the refuge, help deflect off-gassing of liquid nitrogen, reduce sound transmission. Construction of the barrier wall will be completed prior to the start of launch operations. This measure will minimize the extent and severity of habitat modification for piping plovers and red knots that use areas adjacent to the VLA.</p> <p>34. Cryogenic testing and other pressure tanks used under the Proposed Action will be tethered by cables when practicable to the VLA site to help prevent debris from leaving the VLA. This measure will minimize the extent and severity of habitat modification for piping plovers and red knots that use areas adjacent to the VLA.</p>
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	<p>35. SpaceX will minimize noise from generators that may be used during construction and/or operations at the VLA under the Proposed Action. SpaceX will ensure that generators are placed within baffle boxes (a sound-resistant box that is placed over or around a generator), have an attached muffler, or use another noise-abatement method consistent with industry standards. This measure minimizes the severity of habitat modification for piping plovers and red knots that use areas adjacent to the VLA.</p> <p>36. SpaceX will perform inspections of the lighting installed as part of the Proposed Action on a biweekly basis during the sea turtle nesting and hatching season (March 15 to October 1) to ensure that the minimization measures specified in the Lighting Management Plan are installed and in good working order. SpaceX will document compliance with the Lighting Management Plan and note any deviations. SpaceX will address deviations with the USFWS on a timely manner to implement corrective actions. SpaceX will report any deviations and responsive actions to the USFWS in its annual report. This measure minimizes the severity of habitat modification for sea turtles.</p> <p>37. SpaceX will monitor nighttime light levels on the beach within 1.5 miles of the VLA at least once before the start of the sea turtle nesting season and biweekly during the sea turtle nesting and hatching season (March 15 to October 1). SpaceX will perform this monitoring at least once per year at a time when there is a launch vehicle at the VLA (i.e., a condition when more lighting at the site is needed for safety and security), even if this monitoring event occurs outside of the sea turtle nesting and hatching season. SpaceX will perform this monitoring between 9:00pm and 5:00am. SpaceX will use the information to identify any practicable opportunities for modifying lighting at the VLA (with updates to the Lighting Management Plan, as appropriate) that reduce light levels at the beach while maintaining operational needs for safety and security. SpaceX will document and summarize its monitoring and any responsive actions in the annual report to the USFWS. This measure minimizes the severity of habitat modification for sea turtles.</p> <p>38. SpaceX will implement the water resources mitigation measures described in PEA Section 3.9.5. These measures address compliance with TCEQ TPDES permits, updates and/or implementation of its SPCC Plan and SWPPPs, and development and implementation of associated water quality monitoring in coordination with TCEQ.</p> <p>39. SpaceX will seek input from the USFWS on updates to its SWPPP prior to the start of construction activities under the proposed action. SpaceX will ensure that the updated SWPPP includes best practices appropriate to coastal ecosystems that minimize the transport of sediment and the discharge of freshwater runoff outside of the VLA and maximize the retention or infiltration of runoff within the VLA. This measure will minimize modification of habitat for piping plovers and red knots that use areas adjacent to the VLA (e.g., habitat modification resulting from discharges of sediment and freshwater runoff into the wind tidal flats adjacent to the VLA).</p> <p>40. SpaceX will clearly demarcate the perimeter of all areas to be disturbed during construction activities under the Proposed Action using flagging or temporary construction fence and no disturbance outside that perimeter will be authorized. This measure minimizes the extent of habitat modification for the piping plover and red knot that use area adjacent to the VLA.</p> <p>41. SpaceX shall use areas within the project boundary or other area subject to prior disturbance for staging, parking, and equipment storage in connection with the Proposed Action. This measure minimizes the extent of habitat modification for the piping plover and red knot that use area adjacent to the VLA.</p> <p>42. SpaceX will obtain any gravel or topsoil needed during construction activities under the Proposed Action from existing developed or previously used sources, and not from undisturbed areas that provide habitat for the ocelot, jaguarundi, piping</p>
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	<p>plover, or red knot. The measure minimizes the extent of habitat modification for ocelots, jaguarundis, piping plovers and red knots.</p> <p>43. Consistent with TCEQ stormwater permit conditions, during construction activities associated with the Proposed Action, SpaceX will ensure that best practices are applied at the VLA that minimize the deposit of eroded materials outside the boundary of the VLA. This measure minimizes the severity of habitat modification for the piping plover and red knot (via deposit of materials that could alter the microtopography of adjacent flats) that use areas adjacent to the VLA.</p> <p>44. In coordination with TxDOT and the USFWS, SpaceX will install five signs along SH 4 to inform the public on areas (such as sensitive areas of the NWR and the dunes) where they may not watch ongoing activities and launches. Signs would be installed within 6 months of issuance of the BO.</p> <p>45. SpaceX will initiate coordination with TxDOT within 30 days of issuance of the BO regarding the installation of up to five additional wildlife crossing signs along SH 4 for a total of ten signs (five in each direction) to reduce the risk of collision mortality for ocelots and jaguarundis. SpaceX has already installed five wildlife crossing signs. Pending TxDOT approval, SpaceX will purchase and install the additional five signs. Installation of the signs will be completed within 6 months of issuance receiving TxDOT approval of the sign locations.</p> <p>46. SpaceX security patrol vehicles or other necessary SpaceX vehicles on Boca Chica Beach will be driven above the “wet line” (i.e., the line on the beach where waves reach and repeatedly wet the sand at the time the driver passes by) and at a speed not to exceed 15 miles per hour. This measure minimizes the severity of habitat modification for piping plovers and red knots.</p> <p>47. SpaceX will continue to implement the SpaceX Boca Chica Launch Site Biological Monitoring Plan to survey for sea turtles, birds, and vegetation changes. Monitoring reports will be included as part of the SpaceX’s annual monitoring report submitted to the USFWS. After five years of monitoring, and when SpaceX applies for a renewal or extension of its license or permit, the USFWS, FAA, and SpaceX will evaluate the need to modify, adapt, or discontinue the monitoring. Sea turtle monitoring on Boca Chica Beach will be conducted prior to implementation of access restrictions and security sweeps for, and as soon as practicable after, suborbital and orbital launches. Post-launch monitoring can be conducted by Sea Turtle Inc.; however, the use of drones is acceptable if Sea Turtle Inc. is unable to conduct monitoring in-person. Findings will be included in the annual report to the USFWS.</p> <p>48. SpaceX will continue to offer enhanced satellite monitoring via solar powered Starlink to the Peregrine Fund for continuous video coverage of northern aplomado falcon habitat to aid in biological monitoring.</p> <p>49. If sea turtle nests are discovered prior to closure and security sweeps, SpaceX will coordinate with Sea Turtle Inc. to remove eggs prior to launch. Findings will be included in the annual report to the USFWS.</p> <p>50. SpaceX will provide a dedicated space for Sea Turtle, Inc. volunteers on SpaceX property to monitor Boca Chica Beach use and to conduct pre-and post- launch surveys at Boca Chica Beach.</p> <p>51. If SpaceX plans to conduct more than two of the ten annual launches under the Proposed Action at night during the sea turtle nesting and hatching season (March 15th – October 1st), SpaceX and the FAA will contact the USFWS within 30 days of the third nighttime launch (and any subsequent nighttime launches planned during that year) to discuss if there is a need for additional take authorization.</p> <p>52. SpaceX will submit an annual monitoring report to the USFWS by March 1st for the preceding calendar year. The annual report will include monitoring results, measures implemented during project activities, success of such measures, incidences, and any recommendations on improvements to those measures. Reports</p>
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	<p>should be sent to: U.S. Fish and Wildlife Service, Texas Coastal Ecological Services Field Office, ATTN: Field Supervisor, 4444 Corona, Suite 215, Corpus Christi, Texas 78411 or email to dawn_gardiner@fws.gov.</p> <p>53. If the FAA issues SpaceX a vehicle operator license for Starship/Super Heavy launch operations at the Boca Chica Launch Site, the BO would expire concurrent with the expiration of the FAA’s license. SpaceX will notify the USFWS if SpaceX plans to continue FAA-licensed activities (i.e., applying for license renewal or a new license) no later than 6 months before FAA’s license expires. The FAA would conduct its consultation obligations as required under ESA Section 7 as part of its evaluation of SpaceX’s license application.</p>
Coastal Resources	None.
Land Use	<p>The FAA would ensure that SpaceX implements the following measure to minimize impacts related to land use:</p> <ol style="list-style-type: none"> 1. SpaceX would notify and coordinate with the oil and gas operators prior to any launch (including landing). 2. The measures listed under <i>Department of Transportation Act Section 4(f)</i> would also mitigate land use impacts.
Hazardous Materials, Solid Waste, and Pollution Prevention	<p>SpaceX would implement the following measures to minimize impacts related to hazardous materials, solid waste, and pollution prevention:</p> <ol style="list-style-type: none"> 1. SpaceX would handle any release of a hazardous material according to the management procedures described in its Anomaly Response Plan. 2. SpaceX would comply with all applicable federal, state, and local rules and regulations pertaining to the proper storage, handling, and use of hazardous materials. 3. SpaceX would implement its SPCC Plan to prevent and address accidental spills or releases of hazardous materials. 4. SpaceX would report any release of a hazardous material in the Gulf of Mexico through the U.S. Coast Guard National Response Center; releases in tidal waters would also be reported to TGLO. 5. SpaceX would comply with the International Convention for the Prevention of Pollution from Ships Annex IV and the CWA NPDES Program regarding vessel discharge of large commercial vessels for offshore landings on platforms. 6. SpaceX would implement the appropriate handling and management procedures for hazardous materials when venting residual LOX and LCH4. 7. Hazardous materials such as fuels, ordnance, chemicals, and payload components would be transported over public transportation routes to the appropriate facilities in accordance with DOT regulations. 8. SpaceX would treat or remove any soils adversely affected by spills in accordance with applicable federal and state regulations. 9. In the event of an anomaly, SpaceX would respond to all accidental releases of polluting substances quickly and implement appropriate clean-up measures in accordance with applicable laws to minimize impacts to the environment. 10. SpaceX would store solid wastes in covered receptacles until disposal to avoid offsite deposition, recycle solid wastes to the extent practicable, and dispose of the remaining solid waste in appropriately permitted landfills. 11. SpaceX would collect, store, and dispose of hazardous materials, substances, and wastes used and generated as part of recovery operations using practices that minimize the potential for accidental releases or contact with storm or marine water and in accordance with the Hazardous Materials and Emergency Response Plan, SWPPP, and SPCC Plan, as well as Resource Conservation and Recovery Act and Occupational Safety and Health Administration regulations.

	12. SpaceX would assemble an emergency response team that would be responsible for responding to hazards and spills for all Starship/Super Heavy propellants.
Natural Resources and Energy Supply	None.
Socioeconomics, Environmental Justice, and Children's Environmental Health and Safety Risks	The measures listed above under <i>Department of Transportation Act, Section 4(f)</i> , specifically item #9, would mitigate any potential impacts on an environmental justice population. Further, the FAA will continue providing Spanish translations of vital project-related documents and information, and oral interpretation services for public meetings, or by request, in the future.