Federal Aviation Administration

Draft Tiered Environmental Assessment for SpaceX Starship Reentry Contingency Operations in the Pacific Ocean and Additional Starship Landing Trajectory

July 2026

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

This draft Tiered Environmental Assessment (EA) was prepared in accordance with FAA Order 1050.1G, FAA National Environmental Policy Act Implementing Procedures (30 June 2025) and Department of Transportation (DOT) Order 5610.1D, DOT's Procedures for Considering Environmental Impacts (1 July 2025), to meet the agency's obligations under section 102(2)(C) of the National Environmental Policy Act of 1969 (NEPA), 42 United States Code [U.S.C.] §§ 4321- 4336, as amended.

DEPARTMENT OF TRANSPORTATION, FEDERAL AVIATION ADMINISTRATION: FAA is evaluating Space Exploration Technologies Corp.'s (SpaceX) proposal for Starship reentry contingency operations in the Pacific Ocean as well as airspace closures for an additional Starship reentry trajectory for landing at Starbase in Texas. SpaceX must obtain a modification of their existing vehicle operator license from FAA to analyze new Starship trajectory reentry operations. Issuing a permit or license is considered a major federal action subject to environmental review under NEPA. FAA's issuance of temporary airspace closures supporting the licensed reentry operations are also considered major federal actions subject to environmental review under NEPA. This Tiered EA evaluates the potential environmental impacts of activities associated with the federal action of modifying SpaceX's vehicle operator license (see Section 2.0 for a more detailed description). The completion of the environmental review process does not guarantee that FAA will issue a license modification to SpaceX for the Proposed Action. SpaceX's license application must also meet FAA safety, risk, and financial responsibility requirements per 14 Code of Federal Regulations Chapter III.

PUBLIC REVIEW PROCESS: FAA is initiating a public review and comment period for the draft Tiered EA. Public comments can be submitted electronically to www.regulations.gov under Docket No. FAA-2026-6968, or by postal mail to Ms. Amy Hanson, FAA Environmental Protection Specialist, c/o ICF, 1902 Reston Metro Plaza, VA 20190. The public comment period for the Draft Tiered EA will close on July 27, 2026.

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CONTACT INFORMATION: Questions regarding the Tiered EA can be addressed to Environmental Program – Operational Support Branch, ASA-140, Federal Aviation Administration, 1200 New Jersey Ave., SE, Washington, DC 20590; project email address: SpaceXBocaChica@icf.com.

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ACRONYMS AND ABBREVIATIONS

AHA	Aircraft Hazard Area
BA	Biological Assessment
BCO	Biological Conference Opinion
BMP	Best Management Practice
CBO	Conference and Biological Opinion
CFR	Code of Federal Regulations
COMDTINST	Commandant Instruction
COPVs	Composite Overwrapped Pressure Vessels
dB	decibel(s)
DOT	Department of Transportation
DOW	Department of War
DPS	Distinct Population Segment
EA	Environmental Assessment
EEZ	Economic Exclusion Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
E.O.	Executive Order
FAA	Federal Aviation Administration
FONSI	Finding of No Significant Impact
ft	foot or feet
GA	General Aviation
GOA	Gulf of Alaska
HAPC	Habitat Areas of Particular Concern
IHA	Incidental Harassment Authorization
iPaC	Information for Planning and Consultation
kHz	Kilohertz
km	kilometer(s)
LAA	Limited Access Areas
LOC	Letter of Concurrence
LOI	Letter of Intent
LOX	Liquid Oxygen
m	meter(s)
MBTA	Migratory Bird Treaty Act
mi	mile(s)
MMPA	Marine Mammal Protection Act
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MT	Metric Tons
n/a	Not Applicable
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NE	Northeast
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NM	Nautical mile(s)
NMFS	National Marine Fisheries Service
NOTAM	Notice to Airmen
NOTMAR	Notice to Mariners
NR	National Registry
NWR	National Wildlife Refuge
PBFs	physical and biological features
PEA	Programmatic Environmental Assessment
psf	pounds per square foot
RNA	Regulated Navigation Areas
ROD	Record of Decision
RTLS	Return to Launch Site
SE	Southeast
SEL	sound exposure level
SHA	Safety Hazard Area
SpaceX	Space Exploration Technologies Corporation
SPL	Sound Pressure Level
TL	Transmission Loss
TX	Texas
U.S.	United States
U.S.C.	United States Code
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
WR	Written Revaluation
VLA	Vertical Launch Area

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1. INTRODUCTION

Space Exploration Technologies Corporation (SpaceX) is seeking to obtain a modification of its existing vehicle operator license from the Federal Aviation Administration (FAA) to account for Starship reentry contingency operations in the Pacific Ocean as well as an additional Starship reentry trajectory for landing at the Boca Chica Launch Site in Starbase, Texas (TX). SpaceX must obtain a license modification from FAA to land the Starship vehicle in the Northern Pacific Basin (south of the Aleutian Islands), as well as information for airspace closures for an additional trajectory which includes landing at the Boca Chica Launch Site in Starbase, TX. SpaceX also intends to expand the previously evaluated landing areas in the Hawaii and Central Pacific Basin (southwest of the Hawaiian Islands) and the Southeast (SE) Pacific (off the coast of Chile) as additional contingency landing locations for Starship.

Issuing a license modification is considered a major federal action under the National Environmental Policy Act of 1969, as amended (NEPA; 42 United States Code [U.S.C.] 4321, et seq.) and requires an environmental review. This Draft Tiered Environmental Assessment (EA) evaluates the potential environmental impacts of activities associated with the Federal Action of issuing a license modification[1] to SpaceX. See Section 2.1 for a more detailed description. This Draft Tiered EA also evaluates the potential environmental impacts associated with FAA's approval of related airspace closures.

This Draft Tiered EA was prepared in accordance with NEPA; DOT Order 5610.1D, *DOT's Procedures for Considering Environmental Impacts*; and FAA Order 1050.1G, *FAA National Environmental Policy Act Implementing Procedures*. FAA is the lead agency for the preparation and coordination of the Tiered EA; the U.S. Coast Guard (USCG) and National Aeronautics and Space Administration (NASA) are cooperating agencies.

The affected environment and environmental impacts of Starship-Super Heavy operations at the Boca Chica Launch Site were first analyzed in the 2022 Final Programmatic Environmental Assessment for the SpaceX Starship-Super Heavy Launch Vehicle Program at the SpaceX Boca Chica Launch Site in Cameron County, Texas (2022 PEA; FAA 2022). FAA issued a Mitigated Finding of No Significant Impact (FONSI)/Record of Decision (ROD) based on the 2022 PEA on 13 June 2022.

The completion of the environmental review process does not guarantee that FAA will issue a license modification to SpaceX for Starship reentry contingency operations in the Pacific Ocean as well as new trajectory for landing Starship at Starbase TX. SpaceX's license modification application must also meet FAA safety, risk, and financial responsibility requirements per 14 Code of Federal Regulations (CFR) Chapter III.

1.1. Background

This draft Tiered EA tiers from the 2022 PEA and subsequent Tiered EAs described below, all of which analyzed the construction and operations (including launches and landings) of the Starship-Super Heavy launch vehicle program at SpaceX's Starbase in Boca Chica, TX.

[1] The proposed modification to the existing vehicle operator license includes the additional Starship reentry trajectory for landing at Starbase, TX, and the inclusion of Kennedy Space Center Launch Complex 39A as an additional launch and reentry location.

The 2022 PEA analyzed the environmental impacts associated with the Starship-Super Heavy program including landings of the Starship at Starbase, TX, on a floating platform in the Gulf of America or Pacific Ocean or expended in the Gulf of America or Pacific Ocean. In November 2023, FAA issued a Written Re-evaluation (WR) that evaluated additional information received from SpaceX about the operation of the deluge system, the addition of a forward heat shield to the Starship-Super Heavy vehicle, and the expansion of the area of potential effects for cultural resources (FAA 2023a). In March 2024, FAA issued a FONSI/ROD based on an EA tiered from the 2022 PEA evaluating the potential environmental impacts of SpaceX's proposal to land the Starship in the Indian Ocean (FAA 2024a). In October 2024, FAA issued a WR that evaluated additional information received from SpaceX about updates to the forward heat shield interstage landing area, sonic boom coverage, use of the deluge system during return to launch site landings, and use of U.S. Coast Guard safety zones (FAA 2024b).

In April 2025, FAA issued a Mitigated FONSI/ROD based on an EA tiered from the 2022 PEA evaluating the potential environmental impacts of SpaceX's proposal to increase the number of Starship-Super Heavy operations at the Boca Chica Launch Site to 25 per year (2025a Tiered EA). In May 2025, FAA issued a FONSI/ROD based on an EA tiered from the 2022 PEA and April 2025 Tiered EA evaluating the potential environmental impacts of updated Aircraft Hazard Areas (AHAs) associated with the Flight 9 mission profile (2025b Tiered EA). SpaceX then provided FAA with additional details regarding airspace closures and additional launch trajectories. FAA evaluated the new information, and a Tiered EA for Updates to Airspace Closures for Additional Launch Trajectories and Starship Boca Chica Landings of the SpaceX Starship-Super Heavy Vehicle at the SpaceX Boca Chica Launch Site in Cameron County, TX was completed in February 2026 (2026 Tiered EA).

This Tiered EA analyzes the impacts of the activities associated with SpaceX's Starship vehicle reentry contingency landing operations in the Northern Pacific as well as expanding the previously approved contingency landing areas in the Hawaii and Central Pacific Basin and SE Pacific. The contingency landing area in the Northern Pacific Basin necessitates airspace analysis for an additional trajectory for Starship landing at the Boca Chica Launch Site in Starbase, TX. This Tiered EA provides a "tiered" environmental review which incorporates the impacts and analysis regarding the reentry operation and associated impacts for the Starship contingency landings in a location not previously analyzed in the 2022 PEA.

Based on the updated contingency landing areas and the additional Starship reentry trajectory, this action would necessitate FAA to close airspace over portions of the Pacific Ocean identified below, via an AHA and associated Notice to Airmen (NOTAM), as well as western portions of the U.S., during Starship reentry operations.

1.2. Federal Agency Roles

1.2.1. Federal Aviation Administration

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

FAA is also responsible for creating airspace closure areas consistent with the statutory mandate in 49 U.S.C. § 40103 to ensure the safe and efficient use of the National Airspace System (NAS). FAA carries out this mandate in accordance with FAA Order 7400.2R, Procedures for Handling Airspace Matters, to ensure public safety.

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

Regarding potential international environmental impacts, FAA coordinated with the U.S. State Department, Mexico, Canada, Peru and Chile in accordance with Executive Order (E.O.) 12114, *Environmental Effects Abroad of Major Federal Actions*, 44 *Fed. Reg.* 1957 (9 January 1979).

1.2.2. Cooperating Agencies

The USCG is a cooperating agency[2] because the USCG has regulatory authority over waters subject to jurisdiction of the U.S. pursuant to the Ports and Waterways Safety Act, 46 U.S.C., Subtitle VII, Chapter 700, regulatory authority of U.S. and foreign-flagged vessels as outlined in CFR Titles 33 and 46, and expertise to review all reentry site evaluation risk assessments with a focus on vessel navigation safety. The USCG supports early warning communication to the maritime industry with Notices to Mariners (NOTMARs) as outlined in 33 CFR Part 72. The USCG evaluates every reentry activity with potential risk to the marine transportation system. The USCG and FAA maintain an MOU establishing a process for USCG input into FAA's process for issuing licenses and permits for commercial space launch and reentry activities specific to operations in, on, and immediately adjacent to the navigable waters of the U.S. This includes matters of public health, safety of property, safe navigation, and national security as they relate to those waters.

NASA serves as a cooperating agency because it provides special expertise with respect to potential environmental impacts from space launches and the operation of a launch site. SpaceX's Proposed Action is critical to the fulfillment of NASA's statutory mission to lead civilian space exploration and fulfill the objectives of the Artemis Program. Under the National Aeronautics and Space Act (51 U.S.C. § 20101), NASA is mandated to seek the most effective means of space transportation to support its science and exploration goals. Furthermore, NASA and FAA maintain a formal agreement to coordinate on the licensing of commercial space activities that support NASA missions, ensuring that launch cadences and capability directly align with federal schedules.

1.3. Purpose and Need

The purpose of SpaceX's Proposed Action is to provide greater mission capability to NASA and the Department of Defense. SpaceX's activities would continue to fulfill the U.S. expectation that increased capabilities and reduced space transportation costs will enhance exploration (including within the Artemis and Human Landing System programs), support U.S. national security, and make space access more affordable. The Space Transportation section of the National Space Transportation Policy of 1994

[2] The term ''cooperating agency'' means any Federal, State, Tribal, or local agency that has been designated as a cooperating agency under section 107(a)(3). (42 U.S.C. 4336e(2)).

addressed the commercial launch sector, stating that "assuring reliable and affordable access to space through U.S. space transportation capabilities is a fundamental goal of the U.S. space program." Additionally, the 2021 Space Priorities Framework's Mission states, "The United States will bolster the health and vitality of our space sectors – civil, commercial, and national security – for the benefit of the American people and leverage that strength to lead the international community in preserving the benefits of space for future generations" (White House 2021). Moreover, E.O. 14335*, Enabling Competition in the Commercial Space Industry*, states, as follows: "Ensuring that United States operators can efficiently launch, conduct missions in space, and reenter United States airspace is critical to economic growth, national security, and accomplishing Federal space objectives."

SpaceX's Proposed Action is needed to facilitate reentry and landing operations to allow iterative development of Starship to achieve rapid reuse capability and increase operational efficiency, capabilities, and cost effectiveness of Starship. Satisfaction of these needs benefits government and public interests and reduces operational costs. Public interests largely intersect with the government interests identified, including greater mission capability for space exploration and advancing reliable and affordable access to space which in turn advances the scientific and national security benefits of the U.S. space program as a whole. By providing a reusable vehicle that returns to a landing site, the Proposed Action would deliver greater access to space and enabling cost-effective and efficient delivery of cargo and people to the Moon and Mars. SpaceX's Proposed Action would satisfy requirements for more efficient and effective space transportation methods and continue the U.S. goal of encouraging activities by the private sector to strengthen and expand U.S. space transportation infrastructure.

1.4. Documents Incorporated by Reference

In accordance with Sections 3.2 and 3.5 of FAA Order 1050.1G, FAA encourages incorporation of relevant material into environmental documents by reference when the effect is to cut down on bulk without impeding agency and public review of the action. Accordingly, Table 1.4-1 lists those documents incorporated by reference. Relevant portions of those documents are summarized where appropriate in this Tiered EA.

Table 1.4-1. Documents Incorporated by Reference

DOCUMENT	RELEVANCE
Final Programmatic EA for the SpaceX Starship-Super Heavy Launch Vehicle Program at the SpaceX Boca Chica Launch Site in Cameron County, Texas (2022 PEA; FAA 2022)	Initial analysis of Starship-Super Heavy operational activities, including similar operational activities as those proposed in this Tiered EA. Provides information regarding baseline/existing conditions and potential effects.
WR of the 2022 Final PEA for the SpaceX Starship/Super Heavy Launch Vehicle at the Boca Chica Site in Cameron County, TX for the Deluge System Operation, Addition of a Forward Heat Shield Interstage, and Expansion of the Area of Potential Effects for Cultural Resources (FAA 2023a)	Evaluated operation of the deluge system, a forward heat shield to the Starship-Super Heavy vehicle, and the expansion of the area of potential effects for cultural resources.

WR of the 2022 Final Programmatic Environmental Assessment for the Starship-Super Heavy Launch Vehicle Program at the Boca Chica Launch Site in Cameron County. Texas. Starship-Super Heavy Vehicle Ocean Landings and Launch Pad Detonation Suppression System (FAA 2023b).	Evaluated Starship-Super Heavy Vehicle Ocean Landings and Launch Pad Detonation Suppression
Tiered EA for SpaceX Starship Indian Ocean Landing (FAA 2024a)	Evaluated the potential environmental impacts of SpaceX's proposal to land the Starship in the Indian Ocean.
WR of the PEA of the 2022 PEA for the SpaceX Starship/Super Heavy Launch Vehicle at the Boca Chica Site in Cameron County, TX (FAA 2024b)	Evaluated updates to the Forward Heat Shield Interstage Landing Area, sonic Boom coverage, use of the deluge system during return to launch site landings, and use of USCG Safety Zones
Final Tiered EA for SpaceX Starship-Super Heavy Vehicle Increased Cadence at the SpaceX Boca Chica Launch Site in Cameron County, Texas. April 2025 (2025a Tiered EA; FAA 2025a)	Analyzed operational activities associated with increased cadence of Starship-Super Heavy, as addressed in this document (including current RTLS projections for Starship). Provided information regarding baseline/existing conditions and potential effects.
Final Tiered EA for Updates to Airspace Closures for the Flight 9 Mission Profile of the SpaceX Starship-Super Heavy Vehicle at the SpaceX Boca Chica Launch Site in Cameron County, Texas. May 2025 (2025b Tiered EA; FAA 2025b)	Analyzed similar operational activities, including updates to airspace closures, as addressed in this document. Provided information regarding baseline/existing conditions and potential effects.
Final Tiered EA for Updates to Airspace Closures for Additional Launch Trajectories and Starship Boca Chica Landings of the SpaceX Starship-Super Heavy Vehicle at the SpaceX Boca Chica Launch Site in Cameron County, Texas. (2026 Tiered EA; FAA 2026a)	Analyzed similar operational activities for contingency landings and Starship return to launch site operations as addressed in this document.
Final Environmental Impact Statement (EIS) SpaceX Starship-Super Heavy Launch Vehicle at Launch Complex LC-39A, February 2026 (2026 EIS; FAA 2026b)	Analyzed launch and landing activities at Kennedy Space Center LC-39A. Provided information regarding baseline/existing conditions and potential effects associated with operational activities.
Conference and Biological Opinion on SpaceX Starship-Super Heavy Operations in the North Atlantic	Analyzed similar operational activities as addressed in this document. Provided

Ocean, Gulf of Mexico (non-U.S. waters), Gulf of America, North Pacific Ocean, South Pacific Ocean and Indian Ocean Authorized by the Federal Aviation Administration dated 16 April 2025 (2025a NMFS Conference Biological Opinion [CBO]; NMFS 2025a).	information regarding baseline/existing conditions and potential effects associated with expendable activities.
Reinitiation of the Conference and Biological Opinion on SpaceX Starship-Super Heavy Operations in the North Atlantic Ocean, Gulf of Mexico (non-U.S. waters), Gulf of America, North Pacific Ocean, South Pacific Ocean and Indian Ocean Authorized by the Federal Aviation Administration dated 16 September 2025 (2025b NMFS CBO; NMFS 2025b).	Analyzed similar operational activities as addressed in this document. Provided information regarding baseline/existing conditions and potential effects associated with expendable activities.

1.5. Other Licenses, Permits and Approval

In addition to completing the NEPA review and satisfying the licensing regulations in 14 CFR Chapter III, FAA has identified the following additional environmental requirements for SpaceX's proposal, but others may be required.

- **Endangered Species Act (ESA).** In accordance with ESA Section 7, FAA is reinitiating consultation with National Marine Fisheries Service (NMFS) and the United States Fish and Wildlife Service (USFWS). ESA Section 7 requires all Federal agencies to ensure that any action authorized, funded, or carried out is not likely to jeopardize the continued existence of any listed species or destroy or adversely modify designated critical habitat. FAA reinitiated consultation with the NMFS on this Proposed Action. Refer to Appendix A, Reinitiated Biological and Conference Opinion. The 2025a Tiered EA, analyzed the band-rumped storm-petrel (*Oceanodroma castro*), Hawaiian petrel (*Pterodroma sandwichensis*), Newell's shearwater (*Puffinus auricularis newelli*) and short-tailed albatross (*Phoebastria albatrus*) and determined that noise, light, activity, sonic booms, vibration, heat and vapor plume exposure may affect, but is not likely to adversely affect each of these species. FAA consulted with the USFWS during the 2025a Tiered EA, who concurred with these conclusions (Appendix A of 2025a Tiered EA; Consultation Number 02ETCC00- 2012-F-0186-R001; 2023-0087412). FAA reinitiated consultation with USFWS on this Proposed Action and greater detail can be found in Section 3.5 as well as Appendix B.
- **Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA).** The MSFCMA requires the identification of the potential effects of, and conservation recommendations for, actions that may adversely affect essential fish habitat (EFH). In accordance with the MSFCMA, FAA submitted an EFH assessment to consult with NMFS for potential effects to EFH. NMFS initiated consultation with FAA as of June 24, 2026 (Consultation Number OHC-2026-01306). See Appendix D for further information.
- **Marine Mammal Protection Act (MMPA).** FAA will evaluate the MMPA-protected marine mammals that have the potential to be disturbed during ocean landing operations. SpaceX would coordinate with NMFS prior to any landing activity that may impact species protected under MMPA. Additionally, SpaceX is coordinating with NMFS for an Incidental Harassment Authorization (IHA) for MMPA and, if deemed necessary by NMFS, will obtain an IHA prior to

landing activities that may impact MMPA species. Please see Section 3.5.2 and Appendix C for further information.

- **Migratory Bird Treaty Act (MBTA).** Birds, both migratory and most native-resident bird species, are protected under the MBTA. Under the MBTA, it is unlawful by any means or in any manner, to pursue, hunt, take, capture, kill; attempt to take, capture, or kill; or possess migratory birds or their nests or eggs at any time, unless permitted by regulation. Effects to migratory birds and compliance with the MBTA are addressed as part of the NEPA process; FAA will consider measures to reduce effects as required by E.O. 13186, which directs Federal agencies to act to further implement the MBTA.

2. DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

NEPA requires that FAA consider the purpose and need for the Proposed Action and from that, "study, develop, and describe appropriate alternatives to recommend courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources." (42 U.S.C. § 4332(2)(H)). As discussed in Section 3, FAA has not identified any unresolved conflicts concerning alternative uses of available resources associated with SpaceX's proposal. Therefore, in accordance with NEPA and FAA Order 1050.1G, § 1.5(b)(ii), this Tiered EA considers the No Action Alternative and Proposed Action.

2.1. Proposed Action

FAA's Federal Action are to modify SpaceX's existing vehicle operator license to authorize:

1. SpaceX's Proposed Action to expand two contingency landing locations, abutting the previously approved Hawaii and Central Pacific Contingency Landing Area and SE Pacific Contingency Landing Area (NMFS 2025a and NMFS 2025b). This is a Starbase-to-Starbase mission profile and represents the first orbital flight and longer duration, since all previous flights have been suborbital and of shorter duration. The requested expanded area is located along the nominal orbital trajectory to ensure an appropriate and safe landing option is available if needed during the orbital flight.
2. SpaceX to expand Starship in additional contingency landing areas, not previously analyzed, in the NE Pacific for an Eastern Range to Starbase trajectory. The Northern Pacific Contingency Landing Area also allows temporary airspace closures for an additional Starship reentry trajectory for landing at the Boca Chica Launch Site in Starbase, TX. The Northern Pacific Contingency Landing Area location would be necessary if something impedes use of the catch tower, and if there are issues with vehicle operating parameters, or other extenuating safety circumstances preventing Starship landing operations at the Boca Chica Launch Site in Starbase, TX.

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

- Pre-flight Operations (Section 2.1.3.2 of the 2022 PEA)
- Nominal Operational Access Restrictions (Section 2.1.3.5 of the 2022 PEA)
- Anomalies (Section 2.1.3.7 of the 2022 PEA)
- Redundant Launch Pad and Commodities (Section 2.1.4.1 of the 2022 PEA)

- Redundant Landing Pad (Section 2.1.4.2 of the 2022 PEA)

FAA's authority under the Commercial Space Launch Act only extends to licensed launch activities. Additional activities in and around the Boca Chica Launch Site, such as production and manufacturing, engine, stage, and tank testing that are not within the scope of the license are not included in this analysis. The effects of such activities are considered as part of the environmental baseline and in conjunction with the effects of the Proposed Action (see Section 3).

2.1.1. Proposed Contingency Landing Locations

2.1.1.1. Hawaii and Central Pacific Contingency Landing Area (southwest of the Hawaiian Islands)

The 2025b NMFS CBO analyzed no more than 25 in-flight breakups, 25 soft water landings, and 20 explosive events of Starship in each portion of the action area analyzed within that document (Figure 2.1-1, Hawaii and Central Pacific Approved Landing Area, purple region). The new Proposed Hawaii and Central Pacific Contingency Landing Area (Figure 2.1-1, green region) would be absorbed into the greater Approved Landing Area (Figure 2.1-1, purple region) and include the already approved 25 in-flight breakups, 25 soft water landings, and 20 explosive events.

The Proposed Hawaii and Central Pacific Contingency Landing Area contains the same species and densities as in the Final Tiered EA for SpaceX Starship-Super Heavy Vehicle Increased Cadence at the SpaceX Boca Chica Launch Site in Cameron County, TX dated April 2025 (2025a Tiered EA), 2025a NMFS CBO, 2025b NMFS CBO and will therefore not be reanalyzed. The Proposed Hawaii and Central Pacific Contingency Landing Area is greater than 200 nautical miles (NM) from the Hawaiian Islands and outside of the Economic Exclusion Zone (EEZ). The Papahānaumokuākea Marine National Monument has an additional 50 NM buffer around the Marine Monument in addition to the 200 NM EEZ (Figure 2.1-1) buffer.

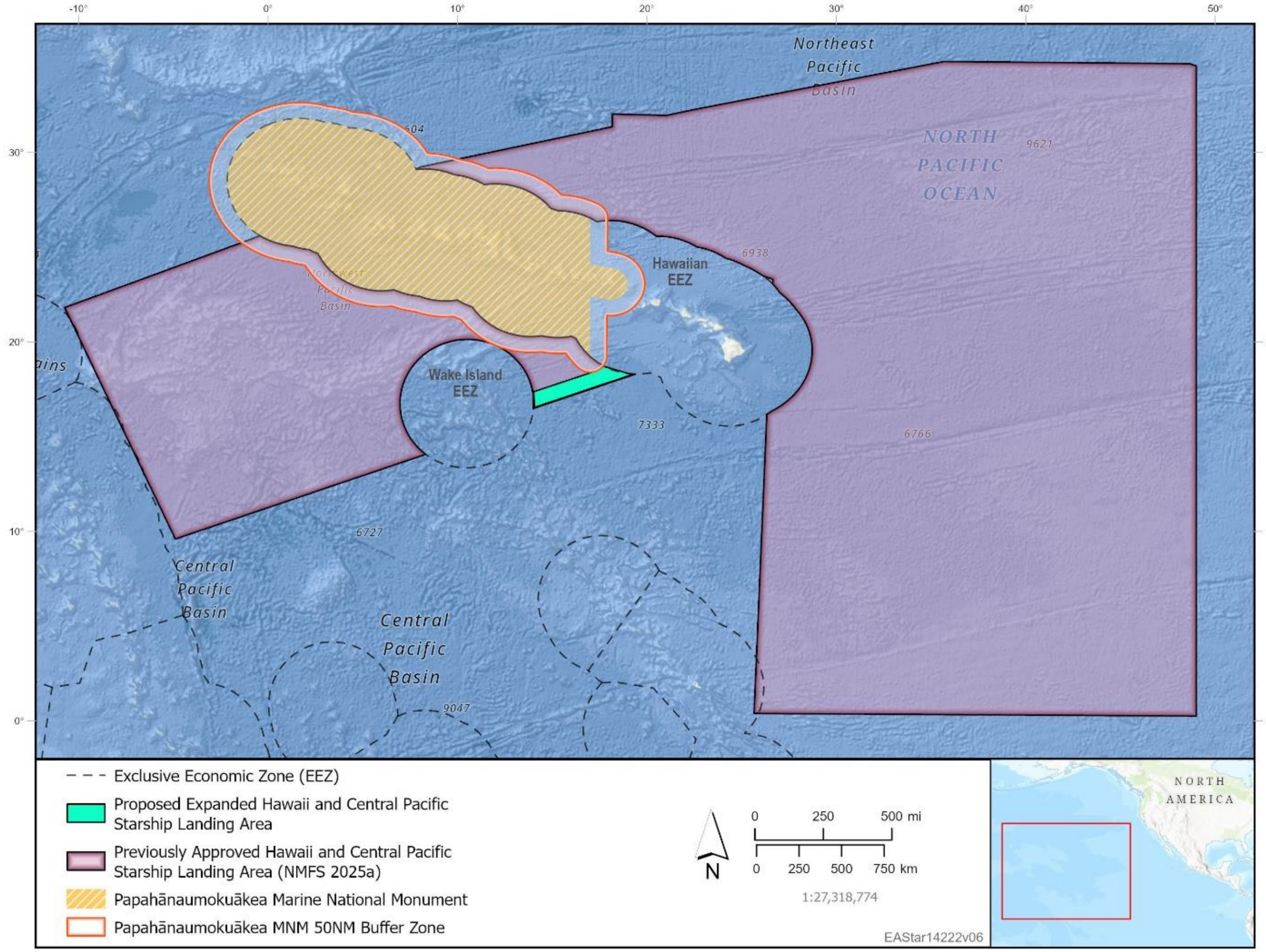

Figure 2.1-1. Hawaii and Central Pacific Proposed Contingency Landing Area and Previously Approved Contingency Landing Area

2.1.1.2. SE Pacific Contingency Landing Area

Similar to the Hawaii and Central Pacific Contingency Landing Area, the 2025b NMFS CBO analyzed no more than 25 in-flight breakups, 25 soft water landings, and 20 explosive events of Starship in the SE Pacific portion of the action area analyzed within that document (Figure 2.1-2, SE Approved Landing Area, purple region). The new Proposed SE Pacific Contingency Landing Area (Figure 2.1-2, green region) would be absorbed into the greater Approved Landing Area (Figure 2.1-2, purple region) and include the already approved 25 in-flight breakups, 25 soft water landings, and 20 explosive events for the entire SE Pacific region.

The Proposed SE Pacific Contingency Landing Area contains the same species as in the Final Tiered EA for SpaceX Starship-Super Heavy Vehicle Increased Cadence at the SpaceX Boca Chica Launch Site in Cameron County, TX dated April 2025 (2025a Tiered EA), 2025a NMFS CBO, 2025b NMFS CBO. The 2025a Tiered EA had very limited systematic marine species survey data in the South Pacific, particularly for offshore areas, including the Proposed SE Pacific Contingency Landing Area therefore no density estimates are available for the marine species in the already approved landing area and the Proposed SE Pacific Contingency Landing area (Kaschner et al. 2006). The Proposed SE Pacific Contingency Landing Area is greater than 200 NM (outside the EEZ) from the Chilean mainland and greater than 200 NM from all islands.

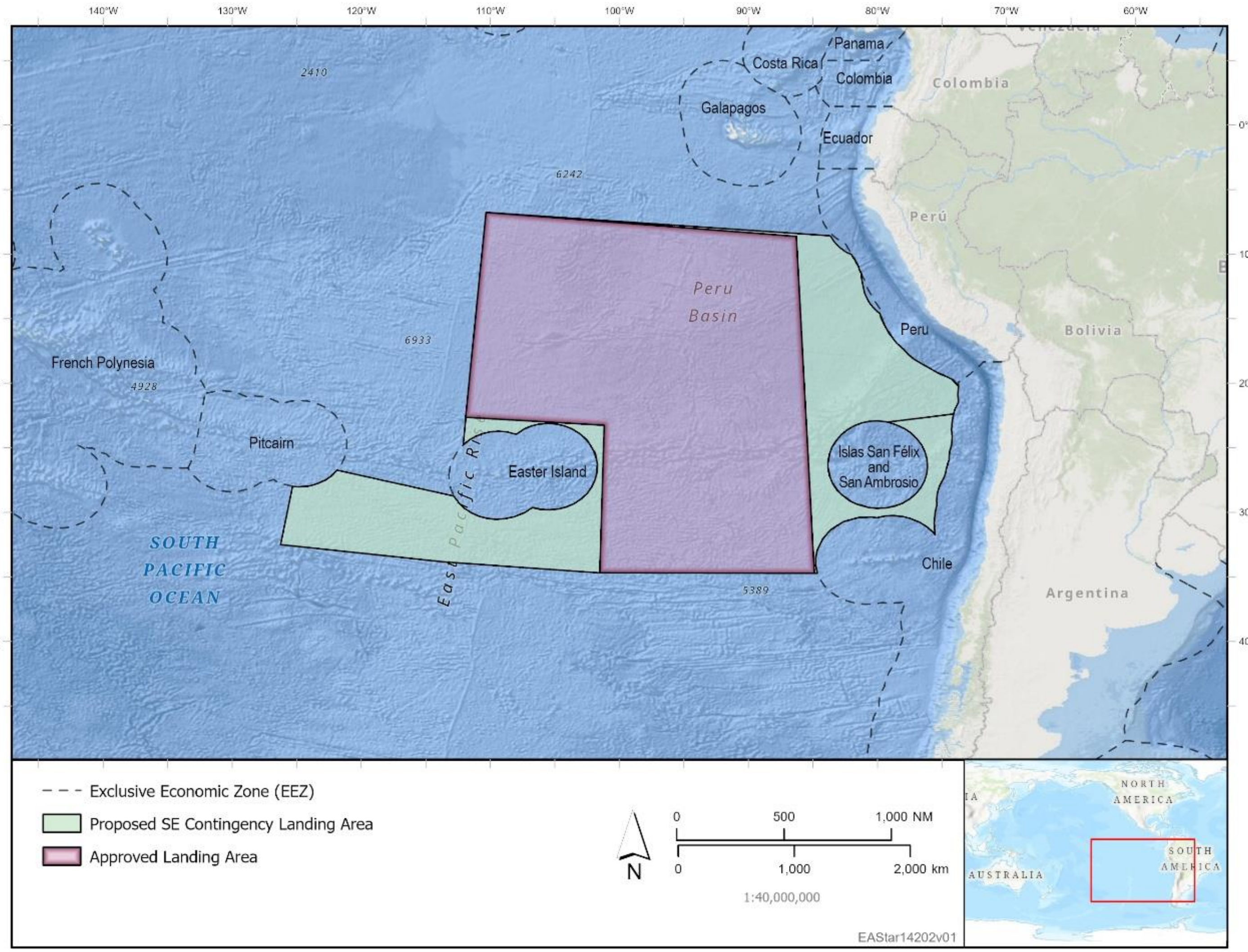

Figure 2.1-2 Southeast Proposed Contingency Landing Area and Previously Approved Landing Area

2.1.1.3. Northern Pacific Contingency Landing Area (south of the Aleutian Islands and west of Oregon and California)

This Tiered EA analyzes up to 25 in-flight breakups, 25 soft water landings, and 20 explosive events of Starship in the new Proposed Northern Pacific Contingency Landing Area (Figure 2.1-3). Nominal reentry and recovery operations would be performed within the Proposed Northern Pacific Contingency Landing Area and occur no closer than 70 NM south of the Aleutian Islands and 70 NM west of Oregon and California in the designated yellow area in Figure 2.1-3 within the Northern Pacific Basin. A buffer of 70 NM from any land mass, including the Alaska Maritime National Wildlife Refuge (NWR), will be established. The Proposed Northern Pacific Contingency Landing Area is within the U.S. EEZ south of Alaska and west of the contiguous U.S. (Figure 2.1-3).

Starship Reentry Operations

SpaceX anticipates recovery operations to be an infrequent occurrence given the goals of the reusable concept. The timeframe for recovery of Starship, if needed, within the Proposed Northern Pacific Contingency Landing Area would be dependent on the location of occurrence and the rapidity of the SpaceX recovery team's mobilization. If SpaceX assets are in the vicinity, an attempt would be made to recover or scuttle Starship. SpaceX has a requirement to surveil the splashdown area before committing to launch and will stand down in the event the area cannot be confirmed to be clear of vessel traffic. SpaceX recovery personnel would follow standard salvage procedures in compliance with applicable state and Federal requirements for the salvage activity.

SpaceX and FAA implement numerous protocols and procedures to assess, avoid, mitigate, and minimize potential risks to public safety and the environment during reentry operations, which are discussed in the 2022 PEA, 2025a Tiered EA, 2025a NMFS CBO and 2025b NMFS CBO.

During reentry, Starship would deorbit and perform a controlled descent using atmospheric resistance to slow the vehicle down and guide it to its landing location. Guidance systems are used to maneuver the vehicle, and the trajectory determines the flight paths. Starship may expend within the contingency landing location under the following conditions:

1. In-flight breakup/disposal: Starship breaking up during reentry, resulting in debris falling into the northern Pacific region of the action area.
2. Explosive event: Starship lands in the ocean either at terminal velocity, breaking up upon impact with debris contained within approximately 0.6 mi (1 km) of the landing point, or conducts a soft water landing and tips over, impacting the ocean. Both result in an explosive event at the surface of the water.
3. Soft water landing: Starship conducts a soft water landing, tips over, and sinks to the bottom of the ocean.

The Hawaii and Central Pacific and SE Pacific Contingency Landing Areas are additions to previously evaluated areas; therefore, the descriptions of reentry operations and associated contingency landing scenarios for those areas are incorporated by reference (2025a Tiered EA; NMFS 2025a; NMFS 2025b).

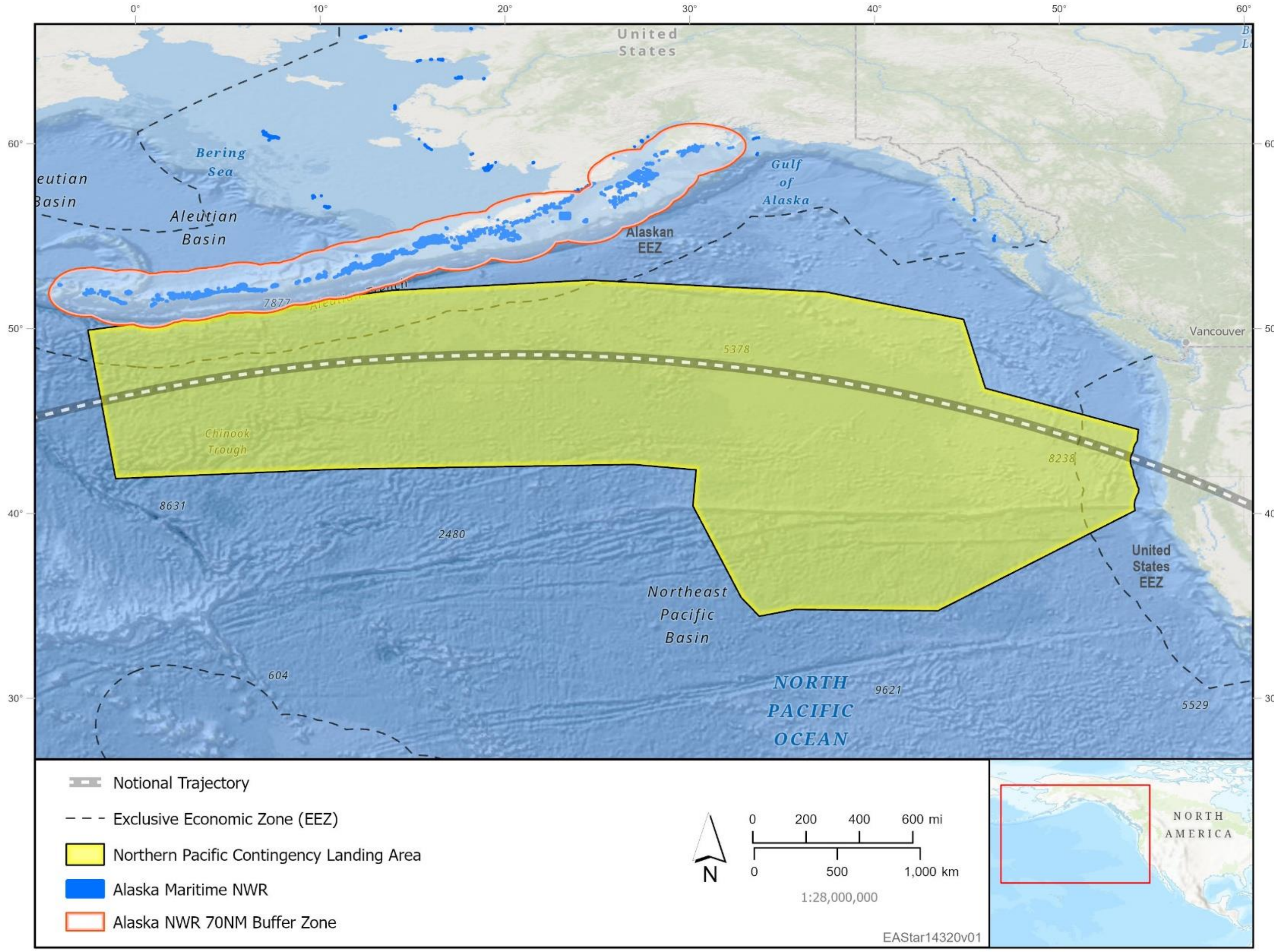

Figure 2.1-3. Notional Trajectory for the Northern Pacific Contingency Landing Area and Starship Landing at Starbase TX

The notional reentry trajectory would not alter the dimensions (shape and altitude) of the airspace (see Figure 2.1-3). Starship reentries would impact air routes extending from the Northern Pacific Basin into southern Oregon, northern California, Nevada, Arizona, New Mexico through Texas and extending into the Gulf of America. AHAs may necessitate the closure of deep-water oceanic airways, coastal and inland areas over the southwestern U.S. as well as the Pacific Ocean. This could include requiring the rerouting of aircraft to avoid the AHAs. Airspace Flow Programs could be necessary to control traffic in the southwestern U.S. Landing Starship at Starbase, TX would impact the Gulf of America and Mexico and has been previously analyzed in the 2022 PEA, 2025a Tiered EA and 2025b Tiered EA.

Starship is designed to be fully reusable, but while working towards reliability for Starship, landing site potential issues could necessitate (e.g. the tower catch mechanism fails, etc.), Starship could be expended in Northern Pacific Contingency Landing Area up until October 2030.

2.1.2. Airspace Coordination/Closures

As described in the 2025b Tiered EA, all reentry operations, irrespective of its proposed landing location, would comply with necessary notification requirements, including issuance of NOTAMs, as defined in agreements required for a launch license issued by FAA. The previously approved landing locations have had Airspace Coordination/Closures analyzed in the 2025a and 2025b Tiered EA as well as the 2026 Tiered EA and will not be reanalyzed.

A NOTAM provides notice of unanticipated or temporary future closures to components of, or hazards in, the National Airspace System NAS. Specifically, NOTAMs contain information about the AHAs that define the temporarily closed airspace prior to the launch/reentry. The size of the AHA could shrink over time due to an increase in the reliability of the vehicle (as demonstrated by other launch vehicles, such as Falcon) and the availability of empirical data. The location and size of airspace closures for commercial space operations also vary with each mission type.

These temporary closures are determined at least 72 hours prior to a launch or reentry activity in the airspace; the corresponding NOTAM is subsequently issued to notify pilots and other interested parties of temporary conditions. Air Navigation Service Providers also use NOTAMs to provide notice of temporary airspace closures in foreign airspace. Advance notice via NOTAMs and the identification of AHAs assist pilots in scheduling around any temporary disruption of flight activities in the area of operation.

2.1.3. Northern Pacific Contingency Landing Area National Airspace System (NAS) Assessment

FAA conducted a NAS assessment of the notional AHA (Figure 2.1-4) for the additional Starship reentry trajectory from the Northern Pacific Contingency Landing Area to the Boca Chica Launch Site at Starbase, TX, based on 2025 commercial aircraft data. The Starship reentry AHA could affect up to a maximum of 600 commercial aircraft per hour, during peak daily travel periods. The April 2025 Tiered EA assumed that up to 22 Starship landings would occur at the Boca Chica Launch Site during the day (7:00 AM to 10:00 PM), and none would occur during the nighttime hours (10:00 PM to 7:00 AM). FAA implements tactical actions to support the actual duration of the mission. Table 2.1-1 shows a range of the approximate number of commercial aircraft affected per hour and per year for the total operations proposed.

It is assumed that a Starship reentry AHA would occur for approximately 30 minutes. The duration provided for the AHA extends beyond the reentry and includes:

- Time required to reroute aircraft away from the AHA before the launch or reentry occurs, such that the AHA is clear of aircraft at the scheduled AHA activation time; and
- Time required, once the launch or reentry has gone through the affected airspace, to put aircraft back on a course to their intended destination that may or may not go through the previously established AHA.

FAA activates AHAs in accordance with the timing of approved launch or reentry windows and deactivates the affected airspace as necessary to ensure the safety of the other stakeholders of the NAS. FAA minimizes the time for rerouting aircraft by opening affected airspace within minutes of the launch or reentry vehicle exiting affected airspace sectors. Table 2.1-1 shows a range of the approximate number of commercial aircraft affected per hour and per year for the total operations proposed.

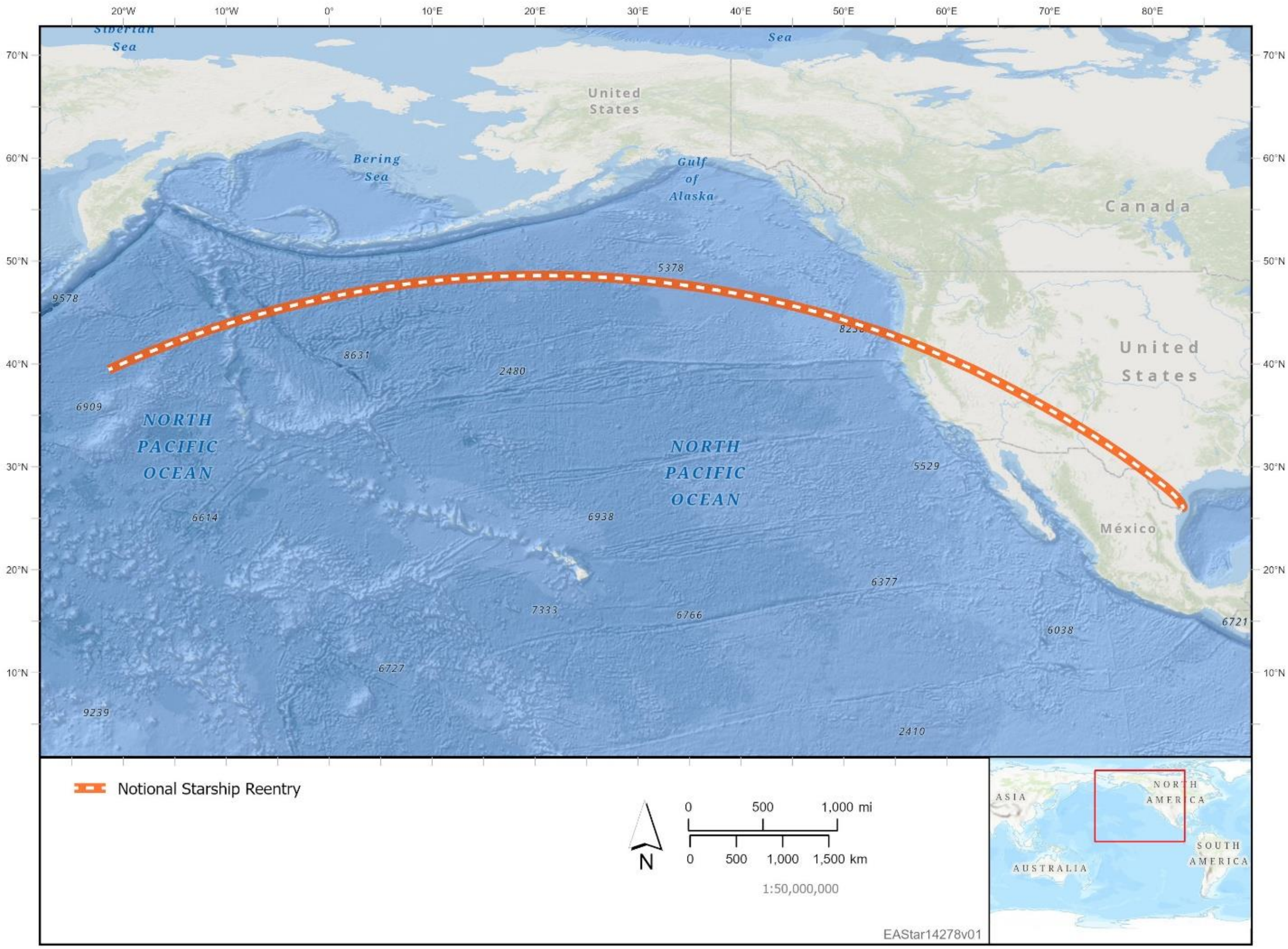

Figure 2.1-4. Notional Starship Reentry AHA

Table 2.1-1. Potential Commercial Aircraft Affected by the Notional AHA for the Additional Starship Reentry Landing Trajectory to the Boca Chica Launch Site in Starbase, TX

Maximum Starship Landings Per Year at the Boca Chica Launch Site	Time of Day	Maximum Aircraft per Hour	Anticipated Starship Reentry (AHA Duration)	Maximum Number of Aircraft Affected per Starship Reentry	Maximum Number of Aircraft Affected per Year
22	7:00 AM to 10:00 PM Central	600	30 minutes	300	6,600

Table Note: AHA = Aircraft Hazard Area

International over flights between western Mexico and Canada as well as international flights that transit between the Pacific Ocean and traverse to the east of the hazard area would be impacted. Flights that normally utilize high-altitude transcontinental and Western jet routes may require extensive lateral reroutes. Given the extensive length of the notional Starship reentry AHA, flights unable to accept reroutes due to fuel or time constraints may opt to delay their departures.

The notional reentry AHA could bisect a significant portion of U.S. airspace, impacting over 90 high-altitude air traffic routes. Additionally, it could constrain numerous low-altitude airways, RNAV corridors (i.e., an invisible, precise highway in the sky that allows aircraft to fly a direct, highly efficient flight path), and transition routes routinely used by commercial, cargo, business, and international operators.

Integrating SpaceX Starship reentry operations into the NAS may require traffic management initiatives, such as miles-in-trail spacing and aircraft rerouting around the AHA. Domestic transcontinental flights could face delays, including potential ground or departure stops at major airports within the Oakland, Los Angeles, and Albuquerque FAA Air Traffic Control Centers—notably impacting hubs like Harry Reid International, Salt Lake City International, Phoenix Sky Harbor, Dallas/Fort Worth International, and George Bush Intercontinental. Although the AHA does not directly overlay any Core 30 airports, it may still disrupt conflicting arrival and departure routes. The western U.S. airspace consists of complex terrain, military operations, and dense terminal traffic; therefore, appropriate traffic management initiatives will be implemented to support the duration of the reentry window, which could be shorter in duration than the NOTAM airspace closure.

General Aviation (GA) operations face rerouting and delay constraints like commercial aviation; however, the absence of rigid schedules may offer GA pilots greater flexibility to adjust flight paths or departure times around active reentry windows. There are approximately 60 GA airports located directly within the notional AHA, as a result, flight operations at these underlying locations would be temporarily suspended for the duration of the reentry.

2.1.4. Maritime Closures

All landing maritime activities are covered under the 2022 PEA as well as 2025a FAA Tiered EA. All reentry operations would comply with necessary notification requirements, including issuance of NOTMARs, as defined in agreements required for a launch license issued by FAA. A NOTMAR provides a notification regarding a temporary hazard within a defined area (a Ship Hazard Area [SHA]) to ensure public safety during proposed operations. A NOTMAR itself does not alter or restrict vessel movement; rather, the NOTMAR disseminates relative information regarding maritime activity and temporary hazards within a defined area to ensure public awareness and safety during the proposed operations.

To comply with FAA's licensing requirements, SpaceX has agreed through a Letter of Intent (LOI) with the USCG to establish procedures for the issuance of a NOTMAR prior to a launch or reentry, as well as other measures necessary to protect public health and safety, promoting safe operations over navigable waters. The LOI describes the required responsibilities and procedures for both SpaceX and the USCG during the event, which may include a launch, landing, and/or reentry operation resulting in the issuance of a NOTMAR.

The USCG publishes NOTMARs through multiple media platforms, to include Local NOTMAR, Broadcast NOTMAR, and Navigational Telex, as needed, to inform the maritime community of temporary changes in condition, Limited Access Areas (LAAs), Regulated Navigation Areas (RNAs), and hazards on navigable waterways. Notices in international areas are published by the National Geospatial Intelligence Agency. Advance notice via a NOTMAR and the identification of SHAs would assist mariners in voyage planning and scheduling around any temporary operation.

The USCG has broad authority to establish LAAs, which may include Safety or Security Zones, and RNAs on navigable waters subject to U.S. authority and schedule in advance to minimize interruption to the maritime community. Reentries would be of short duration and scheduled in advance to minimize interruption to ship traffic.

All landing operations would comply with necessary notification requirements, including issuance of NOTMARs by the USCG, as defined in agreements required for a vehicle operator license issued by FAA. The USCG maintains authority to establish and enforce LAAs and RNAs as needed to support public health and safety during these events. A NOTMAR provides a notification regarding a temporary hazard and any additional safety measures within a defined area (a SHA) to ensure public safety during proposed operations.

Several spotter aircraft, including drones, and surveillance vessels (or boats) are used during reentry activities to ensure that designated hazard areas are clear of nonparticipating crafts. Combinations of radar, visual spotter aircraft, surface surveillance, and law enforcement vessels may be deployed prior to reentry. Most fixed-wing aircraft operate at altitudes of 15,000 feet (ft) (4,572 meters [m]) but may drop to 1,500 ft (457 m) to obtain a call sign visually from a nonparticipating vessel.

2.2. No Action Alternative

Under the No Action Alternative, FAA would continue authorizing SpaceX's activities under its existing license but would not modify it to include additional Starship contingency landing areas or additional Starship reentry trajectory for landing at the Boca Chica Launch Site in Starbase, TX, including updates to the airspace closure areas. Without these updates, SpaceX would not be able to continue the iterative development of Starship-Super Heavy and strive towards its goal of providing greater mission capability for the government and commercial space sector. This alternative does not meet the purpose and need of the Proposed Action but provides the basis for comparing the environmental consequences of the Proposed Action.

3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

The analysis in this Tiered EA is focused on the environmental impact categories with the potential to be affected by the Proposed Action in accordance with FAA 1050.1G.[3] These environmental impact categories include: noise and noise compatible land use; aviation emissions and air quality; hazardous materials, solid waste and pollution prevention; socioeconomics; biological resources; Department of Transportation Act Section 4(f) and Land and Water Conservation Fund (Referred to as "Section 6(f)"); and National Historic Preservation Act (NHPA) Section 106. Potential effects to natural resources and energy supply; visual resources; water resources; children's health and safety risks; and farmlands were analyzed in the 2025a Tiered EA and 2025b Tiered EA and are not implicated by the Proposed Action. Additionally, contingency landing operations would occur at substantial distances from coastal resources and designated coastal zone boundaries.[4] Therefore, these environmental impact categories are not analyzed in this Tiered EA

The Hawaii and Central Pacific Contingency Landing Area is greater than 200 NM offshore of the Hawaiian Islands and outside of the U.S. EEZ (Figure 2.1-1). Operations under this Proposed Action will continue to avoid areas of unique biodiversity and cultural significance near Hawaii, such as World Heritage Sites and the Papahānaumokuākea Marine National Monument, thereby minimizing risks to marine life and ecosystems. The likelihood of debris dispersion affecting the Hawaiian Islands and surrounding waters would continue to be expected to be negligible, but if needed, debris recovery operations would remain the same as evaluated in the 2025a NMFS CBO and 2025b NMFS CBO.

The SE Pacific Ocean between mainland Chile and Easter Island is dominated by an intraoceanic volcanic region. The macro- region of this large water mass represents one of the least explored areas of the world, with relatively little information on the ocean floors, waters characteristics and dynamics of the marine flora and fauna that live there.

The Proposed Northern Pacific Contingency Landing Area is bordered by the Aleutian Islands to the north and by Oregon and California to the east. The Aleutian Islands are a chain of small islands that separate the Bering Strait from the main portion of the Pacific Ocean in the south. The islands extend in an arc southwest, then northwest, for about 1,100 miles (mi) (1,800 kilometers [km]) from the tip of the Alaska Peninsula to the Attu Island in Alaska. The Aleutian Islands form a segment of the circum-Pacific chain of volcanoes (often called the Ring of Fire). The area immediately south of the Aleutian Islands is considered part of the Ring of Fire primarily due to the Aleutian Trench where the deep waters contain active tectonic margins and volcanoes, faults and frequent earthquakes. The Proposed Northern Contingency Landing

[3] Significance thresholds for each environmental impact category can be found in Appendix A of FAA 1050.1G.

[4] This separation reduces the potential for debris associated with a contingency landing event to reach coastal environments, sensitive marine resources, or coastal uses. Given the offshore location of the contingency landing area and the infrequent, contingency-based nature of these operations, impacts to coastal resources are not expected.

Area is within the U.S. EEZ south of Alaska and west of the contiguous U.S. and no closer than 70 NM south of the Aleutian Islands and 70 NM west of Oregon and California (Figure 2.1-3).

The Northern Pacific Basin, off the coast of Oregon and California, is part of an extensive and often unexplored deep-sea geography. It is characterized by low surface salinity, remote seamounts and deep trenches. (Gonzalez-Bernat, 2022).

3.1. Noise and Noise Compatible Land Use

3.1.1. Hawaii and Central Pacific Contingency Landing Area

The 2022 PEA and 2026 Tiered EA determined the Proposed Action would not be expected to result in significant impacts to noise and noise compatible land use during a launch and Starship landing event, and that sonic boom and other noise would not significantly impact any resources, including biological, cultural, or Section 4(f) resources.

3.1.2. SE Pacific Contingency Landing Area

The 2022 PEA and 2026 Tiered EA determined the Proposed Action would not be expected to result in significant impacts to noise and noise compatible land use during a launch and Starship landing event, and that sonic boom and other noise would not significantly impact any resources, including biological, cultural, or Section 4(f) resources.

3.1.3. Northern Pacific Contingency Landing Area

Sonic booms and reentry noise are associated with any Starship reentry due to the vehicle speed transitioning from supersonic to subsonic speeds, causing a sonic boom during landing. Sonic boom and noise are not dependent on location; therefore, the same analysis is used in the 2022 PEA, and 2026 Tiered EA, represents the best analysis to date. It should be noted that the closest 4(f) resource to the Proposed Northern Pacific Contingency Landing Area is the Alaska Maritime NWR, which is greater than 70 NM to the west. No cultural resources exist within the Proposed Northern Pacific Contingency Landing Area. For all environmental resource categories, the affected environment near the launch site and landing site at Starbase TX remains the same as discussed in the 2022 PEA and 2026 Tiered EA.

The only change to noise and noise compatible land use not covered in the 2022 PEA and 2026 Tiered EA is noise associated with airspace closures and noise impacts to biological resources in the Proposed Northern Contingency Landing Area. Airspace closures for the Northern Pacific Contingency Landing Area Proposed trajectory are discussed in the following paragraph, while noise impacts to biological resources are discussed in Section 3.5 and Appendices A, B, and C.

Airspace closures associated with the Northern Pacific trajectory could result in temporarily grounded aircraft at affected airports and rerouting of enroute flights on established alternate flight paths. Aircraft could be temporarily grounded if airspace above or around the airport is closed. Ground delays can also be used under some circumstances by FAA to avoid airborne reroutes. If aircraft were grounded, noise levels at the airport could temporarily increase if the planes sit idle; some aircraft would likely shut down engines altogether until the closure has lifted. Also, depending on the altitude at which aircraft approach an airport, there could be temporary increases in noise levels in communities around the airports. Aircraft would travel on existing routes and flight paths that are used on a daily basis to account for weather and other temporary restrictions. Any incremental increases in noise levels at individual airports would only last the duration of the airspace closure and are not expected to meaningfully change existing day-night average sound levels at the affected airports and surrounding areas. Therefore, airspace closures caused by the Proposed Action are not expected to result in significant noise impacts.

Based on the above findings, the data and analyses are consistent with those discussed in the 2022 PEA and 2026 Tiered EA. The Proposed Action due to airspace closures and effects to biological resources would not result in significant impacts to noise and noise compatible land use.

3.2. Aviation Emissions and Air Quality

3.2.1. Hawaii and Central Pacific Contingency Landing Area

This area was previously analyzed in the 2022 PEA and 2025a Tiered EA and it was determined that the Action would not result in significant impacts to air quality from aviation emissions.

3.2.2. SE Pacific Contingency Landing Area

This area was previously analyzed in the 2022 PEA and 2025a Tiered EA and it was determined that the Action would not result in significant impacts to air quality from aviation emissions.

3.2.3. Northern Pacific Contingency Landing Area

As stated in the 2025a Tiered EA, SpaceX anticipates that recovery equipment and vehicles would be operated for approximately five days for each recovery, irrespective of the contingency landing location, and would produce negligible ambient pollutant emissions in a widely dispersed area. Therefore, the only change to aviation emissions and air quality not covered in the 2022 PEA, 2025a Tiered EA and 2026 Tiered EA is the difference in the amount of aircraft rerouting and delays. Based on Table 2.1-1, it is anticipated that up to 300 aircraft could be rerouted or delayed for each mission during the daytime up to 30 minutes.

Airspace closures, rerouting and delays associated with the Northern Pacific trajectory could lead to increased emissions from aircraft. This is mainly because aircraft would need to take pre-established alternative flight routes. This would result in the usage of more fuel and therefore increases in emissions. Rerouting would be a short-lived scenario for affected aircraft and commensurate with the timing of the airspace closures. Emissions released above the altitude of the atmospheric mixing layer do not affect ground-level pollutant concentrations. FAA guidance establishes 3,000 ft (914 m) as the nominal height of the mixing layer (FAA 2024c). Most of the additional emissions of re-routed aircraft would occur while the aircraft are at an altitude of higher than 3,000 ft; therefore, there would be negligible air quality impacts at ground level from airspace closures. Emissions from aircraft on the ground or flying at less than 3,000 ft (914 m) could affect air quality. However, airlines seek to minimize fuel consumption and would be likely to accommodate delays by holding aircraft at the gate with their engines off. For these reasons, the potential air quality impacts of airspace closures due to the reentries, considering the number of aircraft affected, would not be significant.

Based on the above findings, the Proposed Action is consistent with those discussed in the 2022 PEA and 2026 Tiered EA therefore, the Proposed Action would not result in significant impacts to air quality from aviation emissions.

3.3. Hazardous Materials, Solid Waste and Pollution Prevention

3.3.1. Hawaii and Central Pacific Contingency Landing Area

This area was previously discussed in the 2022 PEA and 2025a Tiered EA and was determined that the Action would not result in significant impacts to hazardous materials, solid waste and pollution prevention.

3.3.2. SE Pacific Contingency Landing Area

This area was previously discussed in the 2022 PEA and 2025a Tiered EA and was determined that the Action would not result in significant impacts to hazardous materials, solid waste and pollution prevention.

3.3.3. Northern Pacific Contingency Landing Area

The Proposed Action is consistent with the impacts discussed in the 2022 PEA and 2026 Tiered EA. The only change to hazardous materials, solid waste and pollution prevention not covered in the 2022 PEA and 2026 Tiered EA is the location of the Proposed Northern Pacific Contingency Landing Area.

A landing could result in debris and hazardous materials being distributed below the AHA. The size of the AHA can grow or shrink as reliability is either decreased or increased with results and analysis from each launch. If any anomalies occurred during the operation, SpaceX would respond to all accidental releases of polluting substances quickly and implement appropriate cleanup measures in accordance with applicable laws to minimize impacts to the environment.

A near-surface vehicle explosion or a high-altitude breakup of the Starship vehicle would create a debris field comprised of mostly heavy-weight metals and some composite (e.g., carbon fiber) materials. If deposited in the water, most of these materials would sink rapidly through the water column, while some items may stay buoyant on the surface or suspended in the water column before sinking towards the seafloor.

Starship is constructed primarily of stainless steel, which is non-toxic and inert. Other debris includes thermal heat tiles composed of silica, which has similar properties to glass and is highly resistant to degradation. The heat tiles are considered inert. Impacts on air quality or water chemistry are not expected. Starship's propellants are liquid oxygen and liquid methane. Residual propellant is anticipated to evaporate or be diluted quickly due to surface currents and ocean mixing. Starship would have approximately 34 gallons of hydraulic fluid, a hazardous substance. In the event of an anomaly, hydraulic fluid may remain contained in the vehicle, ignite, or be released. There are no changes from the Proposed Action that would affect solid waste or pollution prevention.

Based on the above findings and data outlined above, the Proposed Actions are consistent with those discussed in the 2022 PEA and 2025a Tiered EA and the Proposed Action would not result in significant impacts to hazardous materials, solid waste and pollution prevention.

3.4. Socioeconomics

3.4.1. Hawaii and Central Pacific Contingency Landing Area

This area was previously analyzed in the 2022 PEA, 2025a Tiered EA, 2025b Tiered EA and 2026a Tiered EA, and it was determined that the Action would not result in significant socioeconomic impacts.

3.4.2. SE Pacific Contingency Landing Area

This area was previously analyzed in the 2022 PEA, 2025a Tiered EA and the April 2025 Tiered EA, and it was determined that the Action would not result in significant socioeconomic impacts.

3.4.3. Northern Pacific Contingency Landing Area

The only change to socioeconomics not covered in the 2022 PEA and 2026 Tiered EA is how airspace impacts, and ground stop delays would be managed and assessed by FAA in the Proposed Northern Pacific trajectory. The economic impacts remain unknown because they would vary significantly based on aircraft/vessel type, operational flexibility, alternative routing options, scheduling constraints, and any buffers within these operational scenarios.

Airspace impacts and ground stop delays cost airlines and passengers every year. Typical delay causes are weather, equipment issues, staffing, etc. However, estimating the economic impact that the Proposed Action may have on airspace and maritime activities is challenging and is unlikely to produce reasonable and defensible estimates. Any estimate of the economic impact to airspace and maritime users resulting from space launch or re-entry activity is sensitive to the timing of prelaunch notification as well as the timing and duration of the closure, which itself may be further impacted by any off-nominal launch-related events.

The economic impacts would vary significantly based on aircraft/vessel type, operational flexibility, alternative routing options, scheduling constraints, and any buffers within these operational scenarios. Furthermore, as Starship-Super Heavy operations become more reliable at the Boca Chica launch site, the effect on airspace and maritime activities with each launch/reentry operation may decline due to the implementation of numerous protocols and procedures, compliance with necessary notification requirements (i.e., NOTAMS and NOTMARS), and airspace coordination activities between SpaceX, FAA, and USCG. Economic theory also recognizes that self-interested entities whose decisions are primarily driven by gain, logical analysis and preferences may adjust their behavior to recurring, predictable constraints. As such, airlines and other users of the airspace may incorporate known operational constraints from repeated launch and reentry operations as they become more reliable and predictable into their routing, scheduling, and pricing decisions.

Given these factors and the high sensitivity of impacts to unpredictable operational variables, the lack of stable causal relationships, and the potential adaptation of affected users over time, any present attempt to estimate the long-term economic impact of airspace and maritime closures for the Proposed Action may be overstated and unreliable, and as such, too speculative, to reasonably inform the decision-maker’s choice among potential alternatives.

Though the Proposed Action would include these economic impacts from airspace closures, there would be no change in the number of operational personnel or taxes to commercial airlines, expected economic activity, personal income, employment, population, sustenance, public services, and/or social conditions.

Consistent with the data and analyses contained in the 2022 PEA, 2025a Tiered EA, 2025b Tiered EA, and the 2026a Tiered EA, the Proposed Action would not result in significant socioeconomic impacts.

3.5. Biological Resources

Biological resources are divided by terrestrial and marine biological impacts and are described in Sections 3.5.1, 3.5.2 and Appendices A-C. Each section identifies how it relates to the 2022 PEA and 2026 Tiered EA or where it differs from those references.

3.5.1. Terrestrial Biological Impacts

Terrestrial biological impacts related to the Proposed Action are comparable to those discussed in the 2022 PEA and 2025a Tiered EA. According to the Birds of Conservation Concern 2021, the bird conservation regions for all proposed areas, spanning terrestrial habitats and extending into the marine environment, do not reach greater than 70 NM from shore from the Aleutian Islands, Oregon or California or greater than 200 NM from the Proposed Hawaii and Central Pacific and SE Pacific Contingency Landing Areas. Since the Proposed Action includes contingency landings in the Northern Pacific Basin greater than 70 NM offshore and greater than 200 NM in the Hawaii and Central Pacific and SE Pacific region, terrestrial biological resources are not analyzed in this Tiered EA.

3.5.2. Marine Biological Impacts

The following statutes with corresponding regulations applicable to marine biological resources within the Contingency Landing Area for the Proposed Action include the following: (1) ESA, (2) MMPA and (3) MSFCMA.

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

In April 2025, FAA proposed to modify and issue a vehicle operator license authorizing SpaceX to conduct Starship-Super Heavy launch and reentry operations, with Super Heavy landings in the North Atlantic Ocean, Gulf of Mexico (non-U.S. waters), and Gulf of America, and Starship landings in the North Atlantic Ocean, Gulf of Mexico (non-U.S. waters), Gulf of America, North Pacific Ocean, South Pacific Ocean, and Indian Ocean (2025a NMFS LOC). After the biological opinion was issued on 18 April 2025 concluding consultation, FAA and SpaceX notified NMFS of a need to include Cape Canaveral Space Force Station Space Launch Complex 37, as a launch site under the current license. They also provided new information on vehicle specifications, and new information on debris generated during the recent Starship and Super Heavy mishaps and anomalies. (2025b NMFS LOC).

NMFS issued a CBO on SpaceX Starship-Super Heavy Increased Launch Cadence and Operations in the North Atlantic Ocean, Gulf of Mexico (non-U.S. waters), Gulf of America, North Pacific Ocean, South Pacific Ocean, and Indian Ocean dated 18 April 2025 (2025a NMFS Programmatic Biological Opinion). FAA proposed new information on vehicle operations and debris which substantively changed exposures and effects to ESA-listed species and critical habitat. Reinitiation of the CBO on SpaceX Starship-Super Heavy

Operations in the North Atlantic Ocean, Gulf of Mexico (non-U.S. waters), Gulf of America, North Pacific Ocean, South Pacific Ocean and Indian Ocean occurred on 16 September 2025 (2025b NMFS CBO).

3.5.2.1. Hawaii and Central Pacific Contingency Landing Area

As stated in Section 2.1.1.1, the Proposed Hawaii and Central Pacific Contingency Landing Area contains the same species and densities for ESA and MMPA listed species as in the 2025a Tiered EA, 2025a NMFS CBO, 2025b NMFS CBO and will therefore not be reanalyzed.

Since the Contingency Landing Area is greater than 200 NM from any shoreline, an EFH Assessment is not required for the Proposed Hawaii and Central Pacific Contingency Landing Area.

3.5.2.2. SE Pacific Contingency Landing Area

As stated in section 2.1.1.2, the Proposed SE Pacific Contingency Landing Area contains the same species for ESA and MMPA as in the 2025a Tiered EA, 2025a NMFS CBO, 2025b NMFS CBO. The 2025a Tiered EA had very limited systematic marine species survey data in the South Pacific, particularly for offshore areas, including the Proposed SE expansion area, therefore no density estimates are available for the marine species in the already approved landing area and the Proposed SE Contingency Landing Area (Kaschner et al. 2006). An addendum for the Proposed SE Pacific Contingency Landing Area for the 2025b NMFS CBO has been completed by FAA, see Appendix E for further information.

Similar to the Hawaii and Central Pacific Contingency Landing Area, the SE Contingency Landing Area is greater than 200 NM from any shoreline, therefore, an EFH Assessment is not required for the Proposed SE Pacific Contingency Landing Area.

3.5.2.3. Northern Pacific Contingency Landing Area

Marine biological impacts related to the Proposed Northern Pacific Contingency Landing Area have not been previously assessed. Marine biological impact regulations applicable in the Northern Pacific Contingency Landing Area related to the Proposed Action include the following: (1) ESA, (2) MMPA and (3) EFH.

ESA-Listed Species

The list of ESA-listed endangered and threatened species with potential occurrence in the Proposed Northern Pacific Contingency Landing Area that may be affected by the Proposed Action were developed by reviewing NMFS endangered species web sites, USFWS Information for Planning and Consultation (IPaC) species list, scientific literature, and available reports, and consulting with species experts. Table 3.5-1 lists the ESA-listed species under NMFS jurisdiction that may be affected by the Proposed Action. There is no designated critical habitat in the Proposed Northern Pacific Contingency Landing Area. As discussed in Section 1.5, the 2025a Tiered EA analyzed the band-rumped storm-petrel, Hawaiian petrel, Newell's shearwater, and short-tailed albatross within the Hawaii and Central Pacific Contingency Landing Area near Hawaii. To ensure both analyzed operational regions are covered, this section incorporates the baseline data and effects analysis for these same four ESA-listed seabird species within the Proposed Northern Pacific Contingency Landing Area. Outside of their primary nesting and nearshore feeding habitats, their at-sea distribution spans pelagic waters that intersect with the notional reentry trajectory.

As indicated by NMFS's BCO, the potential for *take* is greatest from an explosive event at the surface during Starship reentry and landing. Specie densities (i.e., number of animals per unit area) are needed to quantitatively estimate the number of potential exposures of ESA-listed species to impulsive noise from the Proposed Action. Densities are only available for marine mammals and sea turtles; densities for fish and invertebrates are not available in scientific literature. Data on species abundances and distributions are derived from systematic marine species surveys and are needed to estimate species densities with an acceptable level of uncertainty.

For all marine species, a significant amount of effort is required to collect and analyze data to produce a density estimate, and many ocean regions have not been surveyed in a manner that supports the derivation of a quantitative density estimate (Kaschner et al., 2011). The action area includes regions that have been extensively surveyed (e.g., the U.S. West Coast EEZ), and other areas where there has been little to no systematic survey effort, including the North Pacific Ocean south of the Gulf of Alaska and Aleutian Islands. Available density data include robust, spatially-explicit density estimates derived from habitat-based density models or species distribution models developed from multiple years of systematic survey data (Becker et al., 2022a; Becker et al., 2022b; Roberts et al., 2016) along the West Coast, as well as uniform density estimates from the Gulf of Alaska that were extrapolated into the Action Area where no density data exist.

Table 3.5-1. Endangered Species and Status within the Northern Pacific Contingency Landing Area

Species	Stock (DPS)	ESA Status	MMPA Status	Density (animals/km^2)	
				Max	Mean
Fishes					
Giant manta ray (*Manta birostris*)	n/a	Threatened	n/a	n/a	n/a
Oceanic whitetip shark (*Carcharhinus longimanus*)	n/a	Threatened	n/a	n/a	n/a
Scalloped hammerhead shark (*Sphyrna lewini*)	(Eastern Pacific)	Endangered	n/a	n/a	n/a
Chum Salmon (*Oncorhynchus keta*)	Hood Canal Summer-Run ESU	Threatened	n/a	n/a	n/a
	Columbia River ESU	Threatened	n/a	n/a	n/a
Sockeye Salmon (*Oncorhynchus nerka*)	Ozette Lake ESU	Threatened	n/a	n/a	n/a
	Snake River ESU	Endangered	n/a	n/a	n/a
Steelhead *(Oncorhynchus*	(Puget Sound)	Threatened	n/a	n/a	n/a

Species	Stock (DPS)	ESA Status	MMPA Status	Density (animals/km^2)	
				Max	Mean
mykiss)	(Upper Columbia River)	Endangered	n/a	n/a	n/a
	(Middle Columbia River)	Threatened	n/a	n/a	n/a
	(Lower Columbia River)	Threatened	n/a	n/a	n/a
	(Upper Willamette River)	Threatened	n/a	n/a	n/a
	(Snake River Basin)	Threatened	n/a	n/a	n/a
	(Northern California)	Threatened	n/a	n/a	n/a
	(California Central Valley)	Threatened	n/a	n/a	n/a
	(Central California Coast)	Threatened	n/a	n/a	n/a
Sea Turtles					
Leatherback sea turtle (*Dermochelys coriacea*)	n/a	Endangered	n/a	0.002	0.002
Seabirds					
Band-rumped Storm Petrel (*Hydrobates castro)*	Hawaii	Endangered	n/a	n/a	n/a
Hawaiian Petrel (*Pterodroma sandwichensis)*	-	Endangered	n/a	n/a	n/a
Newell's Shearwater (*Puffinus newelli)*	-	Endangered	n/a	n/a	n/a
Short-tailed Albatross (*Phoebastria albatrus)*	-	Endangered	n/a	n/a	n/a
Marine Mammals					
Sei whale (*Balaenoptera borealis)*	Eastern North Pacific	Endangered	Depleted	0.0004	0.00038

Species	Stock (DPS)	ESA Status	MMPA Status	Density (animals/km^2)	
				Max	Mean
Blue whale (*Balaenoptera musculus*)	Eastern North Pacific	Endangered	Depleted	0.000821	0.00041
Fin whale (*Balaenoptera physalus)*	CA/OR/WA	Endangered	Depleted	0.019306	0.010606
	Northeast Pacific	Endangered	Depleted		
North Pacific right whale (*Eubalaena japonica*)	Eastern North Pacific	Endangered	Depleted	0.00003	0.000019
Humpback whale *(Megaptera novaeangliae*)	Mexico- North Pacific (Mexico)	Threatened	Depleted	0.19267	0.01873
	Mainland Mexico-CA-OR-WA (Mexico)	Threatened	Depleted		
	Central America-Southern Mexico-CA-OR-WA (Central America)	Endangered	Depleted	0.00501	0.05154
	Western North Pacific (Western North Pacific)	Endangered	Depleted	0.001	0.001
Sperm whale (*Physeter macrocephalus*)	CA/OR/WA	Endangered	Depleted	0.004076	0.001480
	North Pacific	Endangered	Depleted		
Guadalupe fur seal (*Arctocephalus townsendi*)	Mexico	Threatened	Depleted	0.22007	0.08764
Gray whale (*Eschrichtius robustus*)	Western North Pacific (Western North Pacific)	Endangered	Depleted	0	0
Steller sea lion (*Eumetopias jubatus*)	Western (Western)	Endangered	Depleted	0	0

DPS = Distinct Population Segment, ESU = Evolutionarily Significant Unit, n/a = Not Applicable, ESA = Endangered Species Act, CA = California, OR = Oregon, WA = Washington

The density estimates presented in Table 3.5-1 include both an average of all density values and the maximum density for each species in the Northern Pacific Contingency Landing Area. The maximum density was used in the analysis as a conservative approach to estimating potential exposures, but the maximum density is not representative of species distributions throughout the landing area and likely overestimates potential effects from the action. For example, a maximum density estimate for humpback whale is from nearshore waters along the West Coast and over the continental shelf, while densities farther offshore, in deep waters that make up most of the action area, are orders of magnitude lower. To address higher than expected exposure estimates for specific species, a mean or average density estimate was also calculated for each species and used in the analysis to present a more representative assessment of potential effects. The data sources and methods used to derive average and maximum density estimates are described below.

Three species have designated critical habitat adjacent to but not within the action area: humpback whale (Central America Distinct Population Segment [DPS] and Mexico DPS), Steller sea lion (Western DPs), and leatherback sea turtle. All critical habitats are located outside of the Northern Pacific Contingency Landing Area and would not be affected by the action; therefore, critical habitat is not discussed further in this document.

Steller sea lions from the Western DPS and gray whales from the Western North Pacific DPS prefer nearshore habitat and are not expected to occur offshore in the Proposed Northern Pacific Contingency Landing Area. Critical habitat for Steller sea lions extends only to 20 NM from shore off the coast of Alaska and is indicative of their habitat preferences (NMFS 1993). Gray whales in the Western North Pacific DPS are mainly distributed in the western North Pacific off the coast of Russia. While they do occur off the coast of North America, their abundance is very low, and they follow the same nearshore migratory routes as gray whales in the larger eastern North Pacific DPS and are expected to remain shoreward of the Proposed Contingency Landing Area (Becker et al., 2022a; Becker et al., 2022b; Roberts et al., 2016). Neither of these species are described further in this document.

Calculating the potentially affected area within which ESA-listed species could be affected is one of the required inputs for conducting a quantitative analysis of potential impacts to marine species. Data on the abundance and distribution of marine mammals in the potentially affected area is also required to conduct a quantitative analysis of potential impacts. The summary presented below is consistent with the 2022 PEA and 2026 Tiered EA. The 2025a NMFS LOC identified potential stressors to ESA-listed species due to Starship activities. These potential stressors, which would still apply under the Proposed Action, include the following summary (a more detailed analysis for each relevant stressor can be found in Appendix A for ESA-listed marine species, Appendix B for ESA-listed seabirds, Appendix C for marine mammals, and Appendix D for EFH):

(1) **Sonic booms and impulse noise generated during launches and landings**: Sonic booms are associated with any Starship reentry due to the vehicle speed transitioning from supersonic to subsonic speeds, causing a sonic boom during landing. Sonic boom analysis is consistent with the 2022 PEA and 2026 Tiered EA as the occurrence of sonic booms are not dependent on location. ESA-listed marine mammals in the action area could be exposed to the overpressures from sonic booms and impulse noise in the air when they are surfacing to breathe. However, the chance of both events happening at the same time (i.e., an animal surfacing and a sonic boom/impulse noise occurring) is extremely low, considering the duration of the sonic boom is less than 1 second (less than 300 milliseconds) and the duration of an ocean landing is less than 1 minute. Starship sonic booms can range from 1 to 2 pounds per square foot (psf). An overpressure of 1 psf is equivalent to a sound

exposure level (SEL) of 102 C-weighted decibels[5] (dBC; Rylander, 1974) and a 128 peak sound pressure level decibels (dB). An overpressure of 2 psf (134 peak sound pressure level dB) is similar to thunder from 1 km. Most sonic boom studies on animals were conducted between 1960 and 1990 due to interest in commercial supersonic travel and generally focused on 1 to 2 psf sonic booms, which are typical of aircraft. As discussed in the 2026 Tiered EA single-event impulse noise levels and sonic booms would not affect ESA-listed species as little energy is transferred into the water column as a result of these events (FAA 2017). FAA has also ensured that the Proposed Action minimizes overlap with protected marine habitats and whale migration corridors. Mitigation measures include designated avoidance areas (see Figure 3.5-1). Therefore, any effect from the sonic booms or impulse noise on ESA-listed marine mammals at the surface of the water would be discountable because exposure of these animals to the stressor is extremely unlikely to occur.

ESA-listed seabird species within the vicinity of the recovery area may be exposed to sonic booms during a landing event. While diving, birds would not be exposed to these noises. The hearing capabilities of these species have not been measured; therefore, their hearing capabilities are inferred from other species. The majority of the published literature on bird hearing focuses on terrestrial birds and their ability to hear in air. A review of 32 terrestrial and marine species indicates that birds generally have greatest hearing sensitivity between 1 and 4 kilohertz (kHz; Beason 2004; Dooling 2002). Very few seabird species can hear below 20 Hertz, most have an upper frequency hearing limit of 10 kHz, and none exhibit hearing at frequencies higher than 15 kHz (Dooling 2002). Hearing capabilities have been studied for only a few seabirds (Beason 2004; Beuter et al. 1986; Crowell et al. 2015; Johansen et al. 2016; Maxwell et al. 2017; Mooney et al. 2019; Thiessen 1958; Wever et al. 1969); these studies show that seabird hearing ranges and sensitivity in air are consistent with what is known about bird hearing in general (USFWS 2026 BA).

Sonic booms may cause temporary physiological or behavioral disturbances to ESA-listed seabird species. These disturbances would be short in duration and may startle individuals, causing minor behavioral disruptions. The potential effects would vary among individuals due to temperament, sex, age, and prior experience with noise, as well as the distance to the noise source. Due to the short-term, transient nature of sonic booms and low densities of ESA-listed seabird species within the Action Area, the potential effects are only anticipated to be behavioral and temporary. These behavioral reactions would likely be short term (minutes) and would be unlikely to cause long-term consequences for individuals or populations.

(2) **Direct impact by fallen objects (Starship debris):** In the case of an in-flight breakup, pieces of Starship falling from the sky have the potential to affect ESA-listed species in the water. The primary concern is direct impact from these objects striking an ESA-listed species. Strikes may result in injury or mortality to the individuals struck. Because NMFS estimates that the probability a vehicle will land in a specific location within a portion of the action area is equal across that portion, the highest monthly mean species density across all portions of the action area are used as a proxy for all species considered in this consultation. The highest maximum species density is 0.19267 animals/km^2 for the Mexico DPS of humpback whale in the summer months at the extreme eastern boundary of the Proposed Northern Pacific Contingency Landing Area off of the Oregon coast. Multiplying the species density by the vehicle area, 0.00063 km^2, results in an extremely small number of individuals that

[5] C-weighting is a frequency weighting that measures the impact of loud noises on the human ear. C-weighting is used for peak sound pressure measurements, such as measuring impulse noise.

may be exposed to a direct impact from a falling object (0.00012 animals). Thus, the likelihood that an ESA-listed species will be in the exact location at the surface at the exact same time when a piece of the Starship lands in the water is extremely unlikely, and thus, discountable.

Starship debris from 1) an in-flight breakup, 2) a breakup upon landing in the ocean (for which debris is expected to be contained within 1 km of the landing location), or 3) a mishap will be smaller than Starship itself. Falling objects may disturb the sea surface as they impact the ocean, disturb the seafloor as they settle, and affect physical and biological conditions including water and sediment quality. Falling objects may also temporarily displace prey species as objects sink through the water column and temporarily affect prey availability as prey disperses away from the object. However, the temporary sinking of debris or the vehicle itself through the water column is not expected to affect the overall density, abundance, availability, or accessibility of prey in a manner that would measurably affect any ESA-listed species. Debris resting on the seafloor in deep offshore waters below the euphotic zone would not affects ESA-listed fish, marine mammal, and sea turtle species which do not inhabit or forage in deepwater benthic habitat. In summary, the potential effects to ESA-listed species from a direct impact by falling objects are discountable

(3) **Impacts from unrecovered debris:** Debris from Starship could include stainless steel, thermal (heat) tiles and matting, Composite Overwrapped Pressure Vessels (COPVs), cork, plastic, and adhesive. Stainless steel fragments are expected to sink due to their density. While it is possible that a stainless-steel sheet may float under certain sea conditions, it is likely to eventually sink due to wave action. Thermal tiles and matting are made of silica and are expected to float. Unrecovered debris may be ingested by ESA-listed species foraging in the landing area. In a recent global review on ingested marine debris, a majority of 46 mortalities in marine mammals were caused by ingestion of film-like plastic (e.g., plastic bags), plastic fragments (hardness not specified), rope/nets, and fishing debris (Roman et al. 2021). Based on the aforementioned studies on debris ingestion, it appears unlikely that ESA-listed species would ingest the following debris types: stainless steel, thermal tiles, matting, and COPVs. Cork, plastic, and adhesives would likely float if not destroyed during the explosive event. Given that plastic is flammable, it is likely that any plastic on Starship would be incinerated and would not survive to the ocean. Cork is a well-known insulation material, especially for thermal insulation, and studies show that cork and composite cork have relatively low flammability and may be useful in fire retardants and thermal protection, but during an explosive event, it is unlikely that cork would survive due to the breakdown of the cork into dust, which becomes extremely flammable. Given the large expanse of ocean, distribution over which ESA-listed species may occur and be foraging in those areas, and relatively small addition of Starship debris to the overall debris in the ocean, it is unlikely that ESA-listed species would encounter a piece of Starship debris and ingest it. In summary, the potential effects to ESA-listed species from unrecovered debris are discountable. The potential effects to designated critical habitat from unrecovered debris are insignificant.

(4) **Impacts from pollution (vessel and vehicle emissions, propellant):** Pollutants emitted by vessels used during Starship-Super Heavy surveillance or recovery operations can include exhaust (carbon dioxide, nitrogen oxides, and sulfur oxides), and fuel or oil spills or leaks. These pollutants may affect air-breathing ESA-listed species such as marine mammals. it is unlikely that pollutants in the air would have a measurable impact on ESA-listed species given the relatively short duration of vessel operations (approximately five days for each launch with a recovery), dispersion of pollutants in the air, and the brief amount of time that marine mammals spend at the water's surface to breathe. Thus, the effects of pollutants in the water on ESA-listed species due to the Proposed Action will be so small

as to be immeasurable. Therefore, the effects to ESA-listed species from pollutants from vessel activities are discountable. In the event that Starship residual propellant ends up in the ocean, residual propellant is expected to evaporate or be diluted relatively quickly due to surface currents and ocean mixing. It is unlikely that residual propellant would measurably contribute to the overall pollutant levels in the Northern Pacific Contingency Landing Area given the limited number of times Starship will be expended (and residual propellant would reach the ocean), and the large action area. The effects of residual propellant in the ocean on ESA-listed species are immeasurable and, thus, insignificant.

(5) **Vessel presence, strike, and noise:** Vessel presence may disturb animals, vessel strike may result in injury or mortality, and vessel noise may cause disturbance because of elevated noise levels. The duration of vessel operations lasts approximately five days for recovery. The Proposed Action has a limited amount of vessel activity, especially compared to the amount of recreational and commercial vessel traffic. Given the relatively small contribution of the vessels associated with the Proposed Action to the overall vessel activity, effects from vessel presence are expected to be so minor that they cannot be meaningfully evaluated and are thus insignificant. The potential for a vessel striking an ESA-listed species is unlikely because the Proposed Action consists of relatively little vessel use. Furthermore, ESA-listed marine mammals may spend time at or near the ocean surface but generally spend most of their time underwater where they would not be exposed to vessel strikes. Noise from vessels may produce an acoustic disturbance or otherwise affect ESA-listed species that spend time near the surface which may generally disrupt their behavior. Studies have shown that vessel operation can result in changes in the behavior of marine mammals however, vessel noise will not exceed that of larger commercial shipping vessels and will only be temporary. The potential effects to ESA-listed species from vessel presence, strike and noise are discountable or insignificant.

(6) **Aircraft overflight**: Noise from aircraft overflight may enter the water, but as stated in relation to sonic booms and impulse noise, very little of that sound is transmitted into water. Sound intensity produced at high altitudes is reduced when it reaches the water's surface. At lower altitudes, the perceived noise will be louder, but it will decrease rapidly as the aircraft moves away. ESA-listed species that occur at or very near the surface at the time of an overflight could be exposed to some level of elevated sound. There could also be a visual stimulus from the overflight that could potentially lead to behavioral response. Both noise and visual stimulus impacts would be temporary and only occur if an individual is surfing or very close to the surface and at the same time an aircraft is flying over. Studies have shown minor behavioral effects (e.g., longer time to first vocalization, abrupt dives, shorter surfacing periods, breaching, tail slaps) in marine mammals exposed to repeated fixed wing aircraft overflights (Patenaude et al. 2002b; Richter et al. 2003a; Smultea et al. 2008b; Würsig et al. 1998). However, most of these responses occurred when the aircraft was below altitudes of approximately 250 m, which is lower than the altitude to be flown by aircraft during surveillance for the activities considered. Given the limited and temporary behavioral responses documented in available research, the potential effects to ESA-listed species from aircraft overflight are insignificant.

(7) **In-air acoustic effects from vehicle landings and explosive events**: ESA-listed species that surface to breathe may be exposed to the in-air acoustic effects from a Starship contingency landing or explosive event. To be exposed to this stressor, ESA-listed marine mammals would have to be in the exact same place at the exact same time that Starship lands, or an explosive event subsequently occurs. ESA-listed marine mammals spend very little time at the surface, and generally only spend a few seconds to breathe before diving back underwater. Landings, whether they result in an explosive event or not,

of Starship will only occur 25 times in the Northern Pacific Contingency Landing Area. Therefore, given the limited number of landings and explosive events, and the large areas over which ESA-listed species can be distributed, it is extremely unlikely that ESA-listed species will be exposed to in-air acoustic effects from vehicle landings and explosive events and, thus, the effects are discountable.

(8) **Heat from vehicle landings and explosive events:** Heat from a vehicle landing (produced by engines during the landing burn) or explosive event may affect ESA-listed marine mammals. An explosive event would result in a temporary but significant increase in temperatures at the surface of the ocean because of the burning of propellant. To be exposed to this stressor, ESA-listed species would have to be in the exact same place at the exact same time that Starship lands or an explosive event subsequently occurs. ESA-listed species spend a vast majority of time underwater, and it is unlikely species will occur at the surface at the same time. Therefore, given the limited number of landings and explosive events and limited time ESA-listed marine mammals spend at the surface, it is extremely unlikely that ESA-listed species will be exposed to heat from vehicle landings and explosive events.

(9) **Underwater acoustic effects from explosive events:** Calculating the potentially affected area within which ESA-listed animals could be affected is one of the required inputs for conducting a quantitative analysis of potential impacts to ESA species. Data on the abundance and distribution of ESA-listed species in the potentially affected area is also required to conduct a quantitative analysis of potential impacts. This data can be found in the Reinitiation of the Biological Conference Opinion for SpaceX Starship Reentry Operations to Support ESA Section 7 Consultation with NMFS (Appendix A). The results of the model for a landing event in the Proposed Northern Pacific Contingency Landing Area results in no exposures exceeding either the maximum auditory injury (AINJ) or temporary threshold shift (TTS) thresholds. Therefore, underwater acoustic effects from explosive events may affect, but are not likely to adversely affect ESA-listed marine species (see Appendix A).

FAA reinitiated consultation with NMFS on this Proposed Action (Appendix A.) FAA previously consulted with the USFWS during the 2025a Tiered EA for the same potential impacts on the band-rumped storm-petrel, Hawaiian petrel, Newell's shearwater and short-tailed albatross (Appendix A of 2025a Tiered EA; Consultation Number 02ETCC00- 2012-F-0186-R001; 2023-0087412). The USFWS concurred that the Proposed Action in the 2025a Tiered EA may affect but is not likely to adversely affect each of these species. FAA reinitiated consultation with USFWS on this Proposed Action (Appendix B).

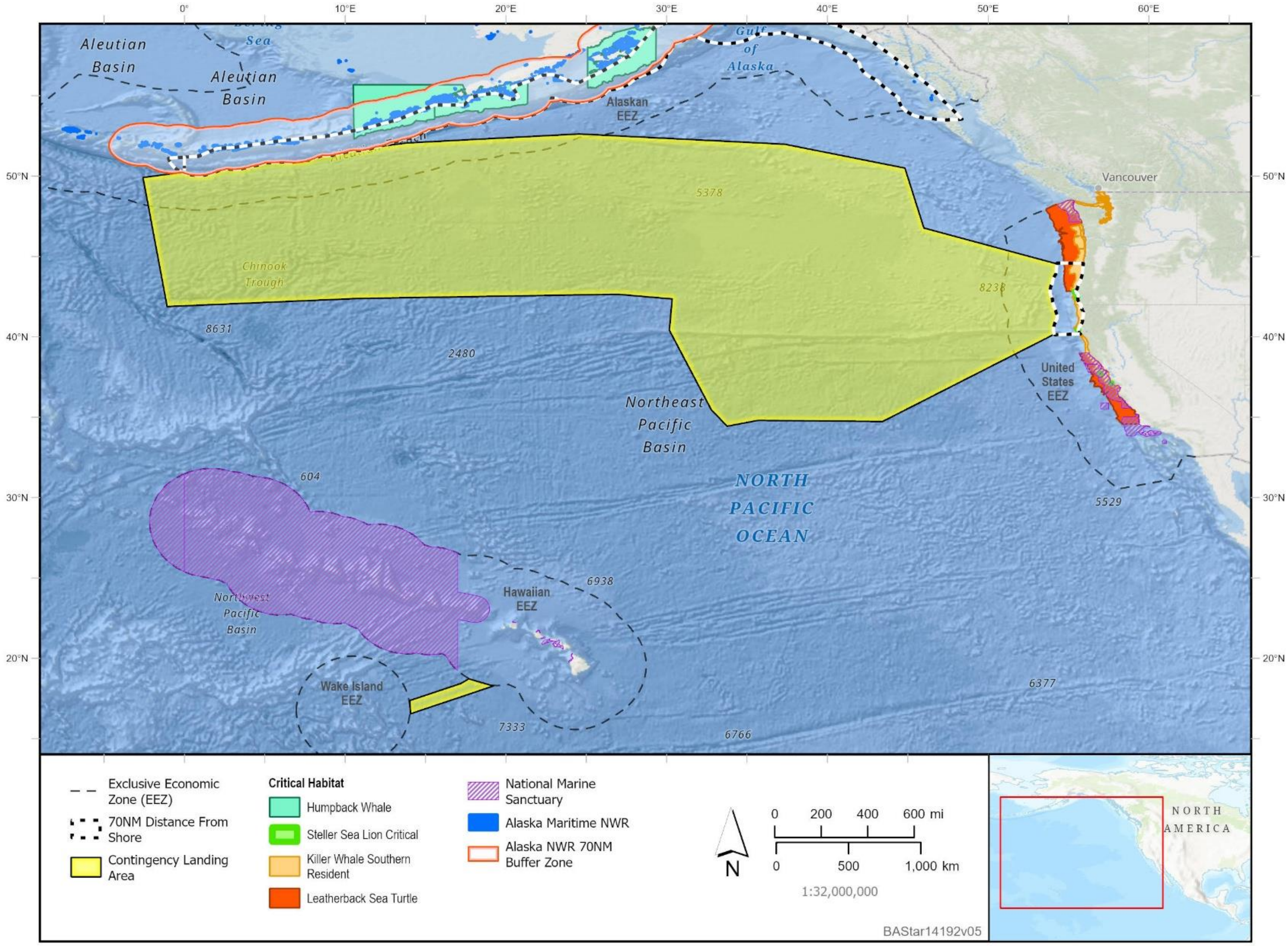

Figure 3.5-1 Northern Pacific Contingency Landing Area Mitigation Measures and Avoidance Map

Marine Mammals

Under the MMPA, 16 U.S.C. Section 1361 *et seq.*, the Secretary of Commerce shall allow, upon request, the incidental, but not intentional, taking of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographic region. The term “take" means “to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal” (16 U.S.C. § 1362[13]).

A total of 27 cetaceans and other marine mammal species potentially occur within the Northern Pacific Contingency Landing Area (Table 3.5-2). The 2026 NMFS CBO contains additional information on each species’ status, population trends, and distribution within the Northern Pacific Contingency Landing Area.

Table 3.5-2. Marine Mammal Species Expected to Occur in the Northern Pacific Contingency Landing Area

Taxonomic Name	Common Name
Balaenoptera acutorostrata	Common minke whale
Megaptera novaeangliae	Humpback whale
Kogia breviceps	Pygmy sperm whale
Kogia sima	Dwarf sperm whale
Aethalodelphis obliquidens	Pacific white-sided dolphin
Delphinus delphis delphis	Short-beaked common dolphin
Globicephala macrorhynchus	Short-finned pilot whale
Grampus griseus	Risso’s dolphin
Lissodelphis borealis	Northern right whale dolphin
Orcinus orca	Killer whale
Stenella coeruleoalba	Striped dolphin
Tursiops truncatus	Common bottlenose dolphin
Phocoenoides dalli	Dall’s porpoise
Berardius bairdii	Baird’s beaked whale
Mesoplodon carlhubbsi	Hubbs’ beaked whale
Mesoplodon densirostris	Blainville’s beaked whale
Mesoplodon ginkgodens	Ginkgo-toothed beaked whale
Mesoplodon perrini	Perrin’s beaked whale
Mesoplodon peruvianus	Pygmy beaked whale
Mesoplodon stejnegeri	Stejneger's beaked whale
Ziphius cavirostris	Goose-beaked/Cuvier’s beaked whale
Arctocephalus townsendi	Guadalupe fur seal
Callorhinus ursinus	Northern fur seal
Eumetopias jubatus	Steller sea lion
Mirounga angustirostris	Northern elephant seal
Phoca vitulina richardii	Pacific Harbor seal
Zalophus californianus	California sea lion

MMPA impacts are determined through the IHA process with NMFS. SpaceX submitted a letter to NMFS stating that the Proposed Action is not likely to result in the incidental take of marine mammals under

NMFS's jurisdiction. SpaceX is coordinating with NMFS to determine if proposed action will require an IHA (Appendix C).

Essential Fish Habitat

SpaceX and FAA implement numerous protocols and procedures to assess, avoid, mitigate, and minimize potential risks to EFH during reentry operations, which are discussed in the 2022 PEA 2026 FAA EIS, and 2025a and 2025b NMFS BCO. The Proposed Hawaii and Central Pacific Contingency Landing Area occurs entirely outside the Hawaii Economic Exclusion Zone and, therefore, does not contain EFH (Figure 3.5-2). Therefore, only the Proposed Northern Pacific Contingency Landing Area will be analyzed with respect to EFH. As described in the 2022 PEA, in the event of an explosive event, there could be potential impact on marine species and EFH when Starship vehicle debris falls into the ocean. Starship could sink but would not result in permanent changes to physical parameters (temperature, salinity, oxygen concentration, etc.) of the water column. The probability of an expended vehicle impacting EFH would remain negligible. SpaceX expects fuel onboard the launch vehicle to be consumed during vehicle breakup, as well as all residual propellant, which would combust. Any remaining structural debris would be made of inert materials and are not anticipated to affect water quality and EFH. A summary of the potential impacts from the Proposed Action on EFH and Habitat Areas of Particular Concern (HAPC) among the Fishery Management Council regions did not exceed a determination of minimal. Table 3.5-3 presents the effects determinations for EFH and HAPC within the Study Area. FAA submitted an EFH assessment to consult with NMFS for potential effects to EFH. NMFS initiated consultation with FAA as of June 24, 2026 (Consultation Number OHC-2026-01306). See Appendix D for further information

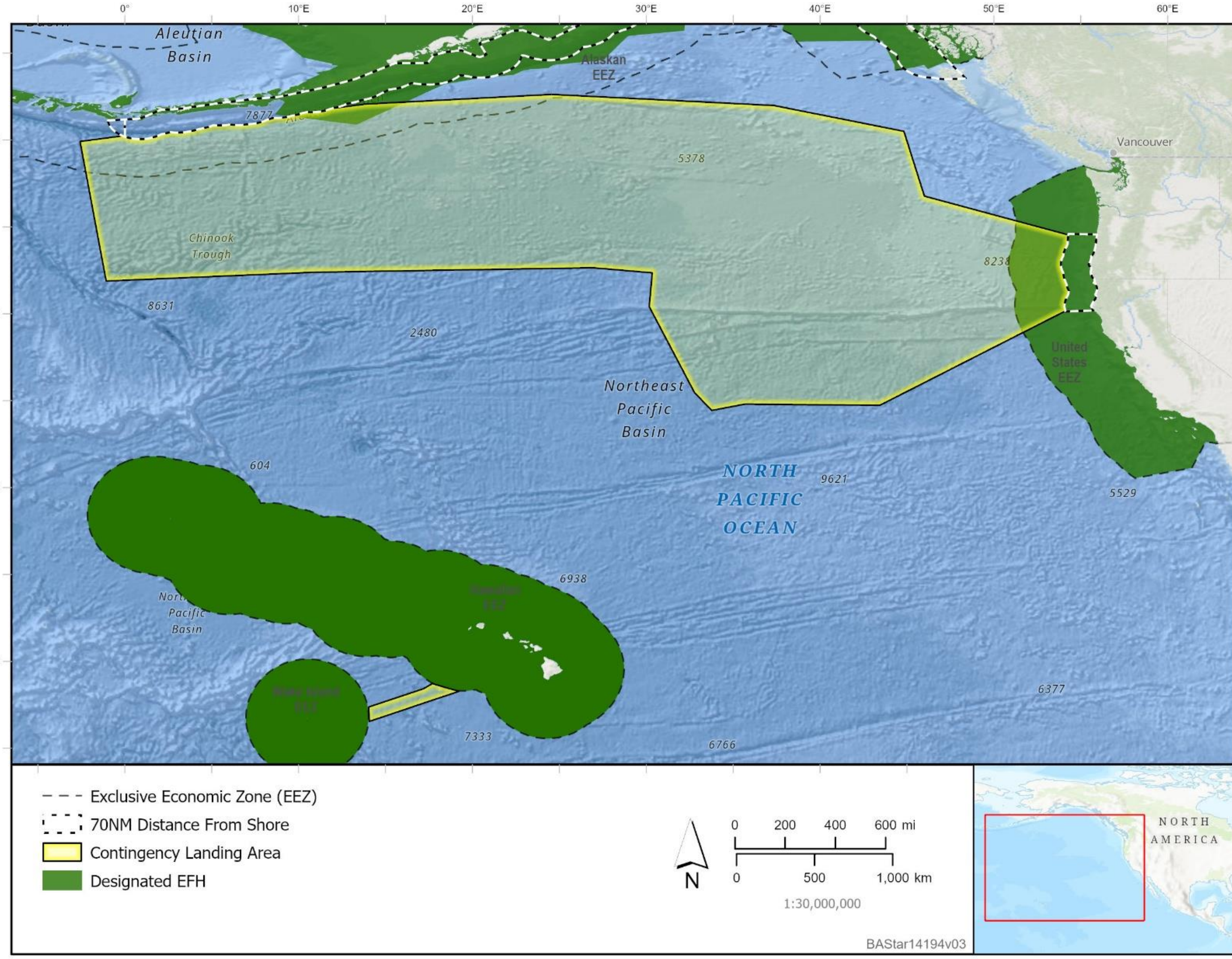

Figure 3.5-2. Proposed Northern Pacific and Hawaii and Central Pacific Contingency Landing Areas

Table 3.5-3. Potential Impacts of Reentry Operations on Essential Fish Habitat and Habitat Areas of Particular Concern Within the Study Area

Stressors	*Water Column*	*Abiotic Bottom Habitat*	*Biogenic Habitat*	*HAPC*
Explosive Stressors				
Explosions at or near the surface	Adverse effect (Minimal and temporary)	Adverse effect (Minimal and temporary)	Adverse effect (Minimal and temporary)	No effect
Physical Disturbance and Strike Stressors				
Expended materials	Adverse effect (Minimal and temporary)	Adverse effect (Minimal and short term to permanent)	Adverse effect (Minimal and short term to permanent)	Adverse effect (Minimal and temporary)
Contaminant Effects				
Rocket propellent and other chemical pollutants	Adverse effect (Minimal and temporary)	No effect	No effect	No effect

Note: HAPC = Habitat Areas of Particular Concern

3.6. Department of Transportation Act Section 4(f) and Section 6(f)

Section 4(f) of the U.S. DOT Act of 1966 (now codified at 49 U.S.C. §303) protects significant publicly owned parks, recreational areas, wildlife and waterfowl refuges, and public and private historic sites. Section 4(f) provides that the Secretary of Transportation may approve a transportation program or project requiring the use of publicly owned land of a public park, recreation area, or wildlife or waterfowl refuge of national, state, or local significance; or land of a historic site of national, state, or local significance; only if there is no feasible and prudent alternative to the using that land and the program or project includes all possible planning to minimize harm resulting from the use.

Section 4(f) resources are typically terrestrial or nearshore (e.g., coastal parks, refuges, beaches). Section 6(f) of the Land and Water Conservation Act (LWCF) requires that the conversion of lands or facilities acquired with Land and Water Conservation Act funds under the State Assistance program be coordinated with the National Park Service.

3.6.1. Hawaii and Central Pacific Contingency Landing Area

There are zero Section 4(f) or Section 6(f) resources within the Hawaii and Central Pacific Contingency Landing Area. The Proposed Action would not impair the qualities that qualify a wildlife or waterfowl area, public parks and recreation or historic resources due to all actions being greater than 200 NM from the shoreline and greater than 250 NM from the Papahānaumokuākea Marine National Monument. The Proposed Action would not result in a use via permanent or temporary incorporation of any Section 4(f) property. It would not impair the Papahānaumokuākea Marine National Monument, waterfowl areas or public parks and recreation areas or and publicly or privately owned historic sites listed on or eligible for the National Register (NR) of Historic Places because Section 4(f) resources are not within the Proposed action area.

3.6.2. SE Pacific Contingency Landing Area

There are zero Section 4(f) or Section 6(f) resources within the Proposed Southeast Pacific Contingency landing area. The Proposed action would not impair the qualities that qualify a wildlife or waterfowl area, public parks and recreation or historic resources due to all actions being greater than 200 NM from the shoreline.

The Proposed Action would not result in a use via permanent or temporary incorporation of any Section 4(f) or Section 6(f) property. It would not impair wildlife, waterfowl, public parks, recreation areas or publicly and privately owned historic sites listed on or eligible for NR of Historic Places because Section 4(f) resources do not exist in the SE Pacific Contingency Landing Area.

3.6.3. Northern Pacific Contingency Landing Area

FAA Order 1050.1G Desk Reference outlines the requirements for inclusion of Section 4(f) and Section 6(f) analyses in the Tiered EA for the Northern Pacific Region (greater than 70 NM from shore) to the Aleutian Islands, Oregon and California coast. There are zero Section 4(f) or Section 6(f) resources within the Northern Pacific Contingency Landing Area, but because a Starship landing could occur 70 NM from the shore, an analysis due to noise is outlined below. The study area for wildlife and waterfowl refuges was established using the NEPA study area for biological resources. This area considers the introduction of noise due to Starship reentry operations in the Northern Pacific region. The biological resources study area was set based on areas that would experience the introduction of no less than 1 psf overpressure. Current data on Starship reentry shows a maximum level of 4 psf. Noise exposure from sonic booms that exceeds the significance threshold of C-weighted day-night average noise level 60 dBC for impulsive noise sources (equivalent to day-night level 65 A-weighted dB) is a significant impact (FAA 2020, FAA 2022, Galloway et. al 1981). In general, sonic booms in the 0.2 to 0.3 psf range could be heard by someone who is expecting them and listening for them but usually would not be noticed. Sonic booms of 0.5 psf are more likely to be noticed, and sonic booms of 1.0 psf and above are certain to be noticed (1 psf is similar to a clap of thunder). Assuming a sonic boom from Starship reentry is approximately 4 psf (140 dB sound pressure level [SPL]) at its source, sound levels would decrease substantially with distance. Because the nearest portion of the Alaska Maritime NWR is more than 70 NM from the Northern Pacific Contingency Landing Area, the estimated sound level at the refuge would be approximately 38 dB SPL, which is below the threshold at which sonic booms are generally perceptible to people.[6] Therefore, the Alaska Maritime NWR would not be expected to experience audible sonic boom effects from Starship reentry operations. The Proposed Action does not include potential closures or restrictions to the Alaska Maritime NWR, nor should the Alaska Maritime NWR experience a sonic boom event from Starship reentry.

Starship is constructed primarily of stainless steel, which is non-toxic and inert. Other debris includes thermal heat tiles composed of silica that are highly resistant to degradation. The heat tiles are composed primarily of silica, with similar properties to glass, and are therefore inert and resistant to chemical or biodegradation. Heat tiles are expected to exhibit similar physical properties to glass, which is known to shatter or break apart into smaller pieces. It is not anticipated that debris would wash up on shore due to wave geometry, surface currents and ocean mixing. The Proposed Action would not result in a use via permanent or temporary incorporation of any Section 4(f) or Section 6(f) property. It would not impair

[6] Transmission loss (TL) using the spherical spreading inverse square law is $TL = 20\log_{10}(R)$, where R = 70 nm. Therefore, TL = 102.25 dB. Because the Alaska NWR is located no less than 70 nm from the contingency landing area, the resulting sound level would be approximately 140dB-102.25dB=37.75dB which equates to 3.22x10-5 psf, well below the .2-.3 psf level for hearing.

the Alaska Maritime NWR, waterfowl areas or public parks and recreation areas or and publicly or privately owned historic sites listed on or eligible for the NR of Historic Places because Section 4(f) resources would be temporary and of short duration and would not result in a constructive use of Section 4(f) or Section 6(f) resources.

3.7. National Historic Preservation Act (NHPA) Section 106

Section 106 of the NHPA requires Federal agencies to consider the effect of Federal undertakings on historic properties, including historic, archaeological, and cultural resources. Historic sites listed in, or eligible for inclusion in, the NRHP are also protected under the DOT Act, Section 4(f). Analyses and findings made in accordance with Section 106 may support DOT Section 4(f) determinations. Findings of no historic properties present or affected, or no historic properties adversely affected, under Section 106 support determinations of no use (either constructive or physical) under Section 4(f) of the DOT Act. Historic properties are defined for land (buildings, structures, archaeological sites, traditional cultural properties).

3.7.1. Hawaii and Central Pacific Contingency Landing Area

No Historic sites were identified and since no historic properties are present within the Proposed Action area, a finding of no use is determined for the Hawaii and Central Pacific Contingency Landing Area. Additionally, landing operations in Hawaii and Central Pacific Contingency Landing Area would occur at substantial distances from any cultural resources.

The Papahānaumokuākea Marine National Monument has an additional 50 NM buffer around the Marine Monument in addition to the already established 200 NM buffer due to sensitive marine or cultural resources.

3.7.2. SE Pacific Contingency Landing Area

No Historic sites were identified in the 2 psf contour APE within the SE Pacific Contingency Landing Area, similar to the Hawaii and Central Pacific Contingency Landing Area, since no historic properties are present and contingency landing operations would occur at substantial distances from cultural sites, a finding of no use is determined for the SE Pacific Contingency Landing Area.

3.7.3. Northern Pacific Contingency Landing Area

The study area of the Northern Pacific Contingency Landing Area is approximately 7,225 mi^2 in the Northern Pacific Ocean. It has already been determined that the closest point to shore is greater than 70 NM away and the amount of noise at the shoreline would be approximately 37.75 dB SPL, which equates to a quiet library, soft whispering or a fridge humming. Additionally, contingency landing operations would occur at substantial distances (greater than 70 NM) from coastal resources, designated coastal zone boundaries and cultural resources. Therefore, the Proposed Action would have no historic, archeological or cultural resources affected, including the Alaska Maritime NWR

4. CONCLUSION

The 2022 PEA and 2025a Tiered EA examined the potential for significant environmental impacts from Starship landing contingency operations as well as airspace closures and defined the regulatory setting for impacts associated with Starship. The areas evaluated for environmental impacts in this Tiered EA include noise and noise-compatible land use; aviation emissions and air quality; hazardous materials, solid waste, and pollution prevention; socioeconomics; biological resources; Department of Transportation Act

Section 4(f) and Section 6(f); and National Historic Preservation Act Section 106. In each of these areas, FAA has concluded that no significant impacts would occur as a result of SpaceX's Proposed Action.

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

5.1. List of Preparers

Name	Title	Area of Contribution
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5.2. List of Independent Evaluators

FAA reviewed the Tiered EA.

5.3. List of Agencies and Persons Consulted

Federal Agencies

- NMFS
- USFWS

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APPENDIX A

NMFS REINITIATED CONFERENCE AND BIOLOGICAL OPINION

Reinitiation of Endangered Species Act Consultation for SpaceX Starship Reentry Operations in the Hawaii and Central Pacific and Northern Pacific Ocean

OPR-2025-02468

12 June 2026

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ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
°F	degrees Fahrenheit
AUD INJ	auditory injury
BA	Biological Assessment
BCO	Conference and Biological Opinion
CL	Confidence Level
COPV	composite overwrapped pressure vessel
CV	Coefficient of Variation
dB	decibel(s)
DPS	Distinct Population Segment
ENP	Eastern North Pacific
ESA	Endangered Species Act
ESU	Evolutionarily Significant Units
FAA	Federal Aviation Administration
ft^2	square feet
FR	Federal Register
kg	kilogram(s)
km	kilometer(s)
km^2	square kilometers
m	meter(s)
m^2	meters squared
mi.	mile(s)
MMPA	Marine Mammal Protection Act
N	North
nm	nautical mile(s)
NMFS	National Marine Fisheries Service
psf	pounds per square foot
S	South
SpaceX	Space Exploration Technologies Corporation
TTS	Temporary Threshold Shift
U.S.	United States
USFWS	United States Fish and Wildlife Service
YOY	young-of-the-year

1 Introduction

The purpose of this Biological Assessment (BA) is to evaluate potential impacts on species listed under the Endangered Species Act (ESA) under the authority of the National Marine Fisheries Service (NMFS) resulting from changes to Space Exploration Technologies Corporation's (SpaceX) Starship-Super Heavy operations authorized by the Federal Aviation Administration (FAA). FAA is currently evaluating SpaceX's proposal to expand its Starship contingency landing area abutting the previously approved Hawaii and Central Pacific Ocean for orbital missions. FAA previously analyzed Starship landings in portions of the Pacific Ocean (OPR-2025-02468). SpaceX plans to land its Starship vehicle at its launch site in Boca Chica, Texas (referred to as Starbase). In situations where SpaceX is unable to land Starship at Starbase, SpaceX would use the northern Pacific Ocean as a contingency landing area. SpaceX is proposing to add another Starship reentry trajectory, which requires adding another contingency landing area in the northern Pacific Ocean.

2 Description of the Action and Action Area

FAA's federal action is to issue a new license or modify SpaceX's existing vehicle operator license (VOL 23-129). SpaceX is seeking to request additional landing area abutting the previously approved Hawaii and Central Pacific Ocean (Figure 2-1) for orbitals flight of Starship as well as a proposed new contingency landing area in the Northern Pacific region. (Figure 2-2). The areas abutting the previously approved Hawaii and Central Pacific are for Starbase-to-Starbase mission profiles and represent the first orbital flight and longer duration, since all previous flights have been suborbital and of shorter duration.

The new Proposed Northern Pacific contingency landing area is necessary if something impedes use of the catch tower located at Starbase TX; there are issues with vehicle operating parameters; or other extenuating safety circumstances prevent Starship landing operations at Starbase TX.

The 2025 consultation (OPR-2025-02468) analyzed 25 in-flight breakups, 25 soft water landings, and 20 explosive events of Starship in the Hawaii and Central Pacific Landing Area (see Figure 2-1, purple area). The Proposed Hawaii and Central Pacific Landing Area (see green area in Figure 2-1, southwest of Hawaii) would be absorbed into the greater Hawaii and Central Pacific Landing Area and include the already approved 25 in-flight breakups, 25 soft water landings, and 20 explosive events for the entire Hawaii and Central Pacific Landing Area.

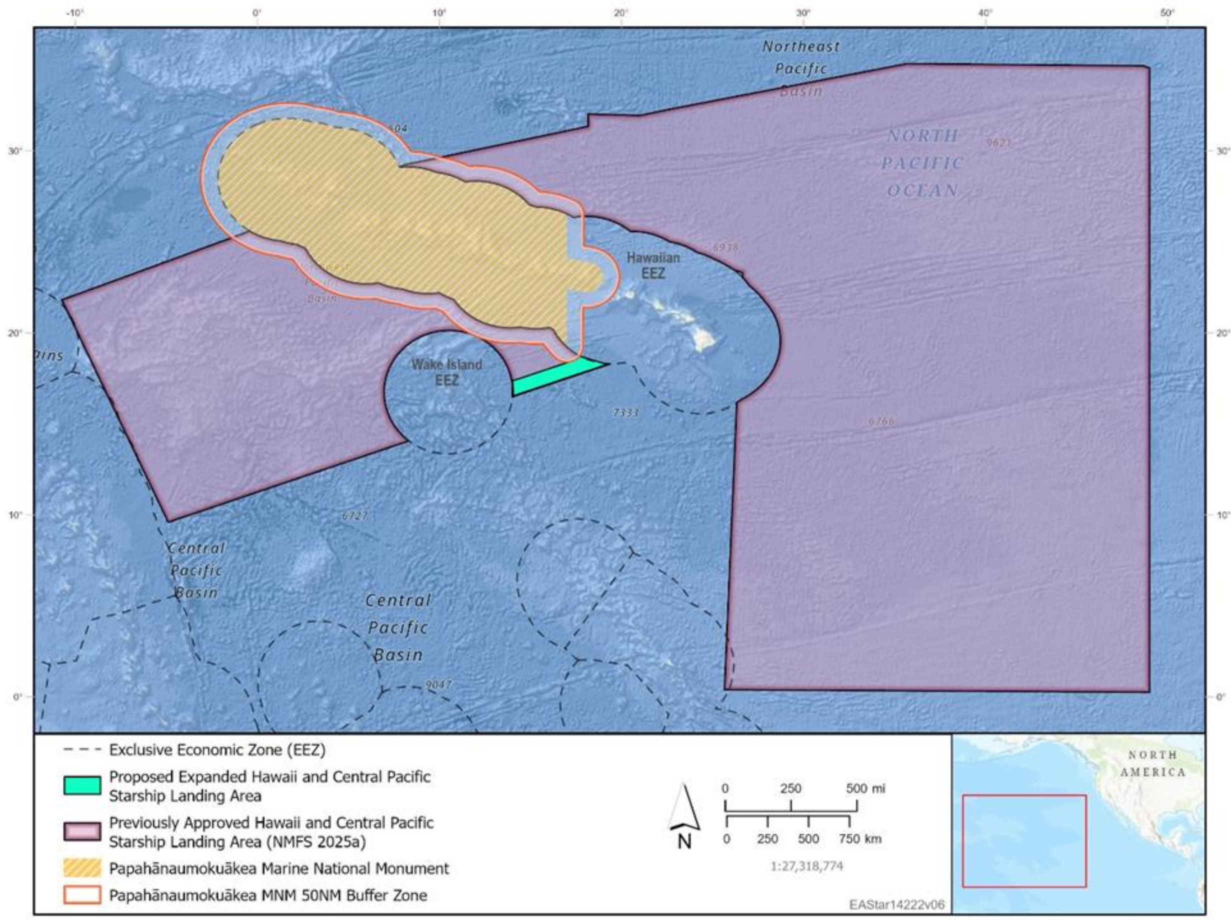

Figure 2-1: Proposed Hawaii and Central Pacific Contingency Landing Area and Previously Approved Hawaii and Central Pacific Contingency Landing Area

The Hawaii and Central Pacific Contingency Landing Area has been previously analyzed and contains the same species and densities as in the 2025 consultation and is not reanalyzed. NMFS's Conference and Biological Opinion (BCO) concluded that Starship-Super Heavy operations would not result in *take* of ESA-listed species in this portion of the action area. The analysis and potential effects on ESA-listed species are the same as those previously analyzed for the landing area closest to Hawaii. No adverse effects are expected.

The Proposed Northern Pacific Contingency Landing Area occurs south of the Aleutian Islands and Gulf of Alaska and extends to the United States (U.S.) West Coast off Oregon and Northern California within the eastern North Pacific Basin (Figure 2-2). The shoreward boundary of the landing area is approximately 70 nautical miles (nm) from the Oregon coast and the Aleutian Islands and includes Starship nominal reentry and recovery operations (Figure 2-2).

The Aleutian Islands are a chain of small islands that separate the Bering Strait from the main portion of the Pacific Ocean in the south. The islands extend in an arc southwest, then northwest, for about 1,100 miles (mi.) (1,800 kilometers [km]) from the tip of the Alaska Peninsula to the Attu Island in Alaska. The Aleutian Islands form a segment of the circum-Pacific chain of volcanoes (often referred to as the Ring of Fire). The area immediately south of the Aleutian Islands is considered part of the Ring of Fire primarily due to the Aleutian Trench where the deep waters contain active tectonic margins and volcanoes, faults and frequent earthquakes.[1] The Northern Pacific Basin is part of an extensive and often unexplored deep-sea geography. It is characterized by low surface salinity, remote seamounts and deep trenches.(Gonzalez-Bernat, 2022).

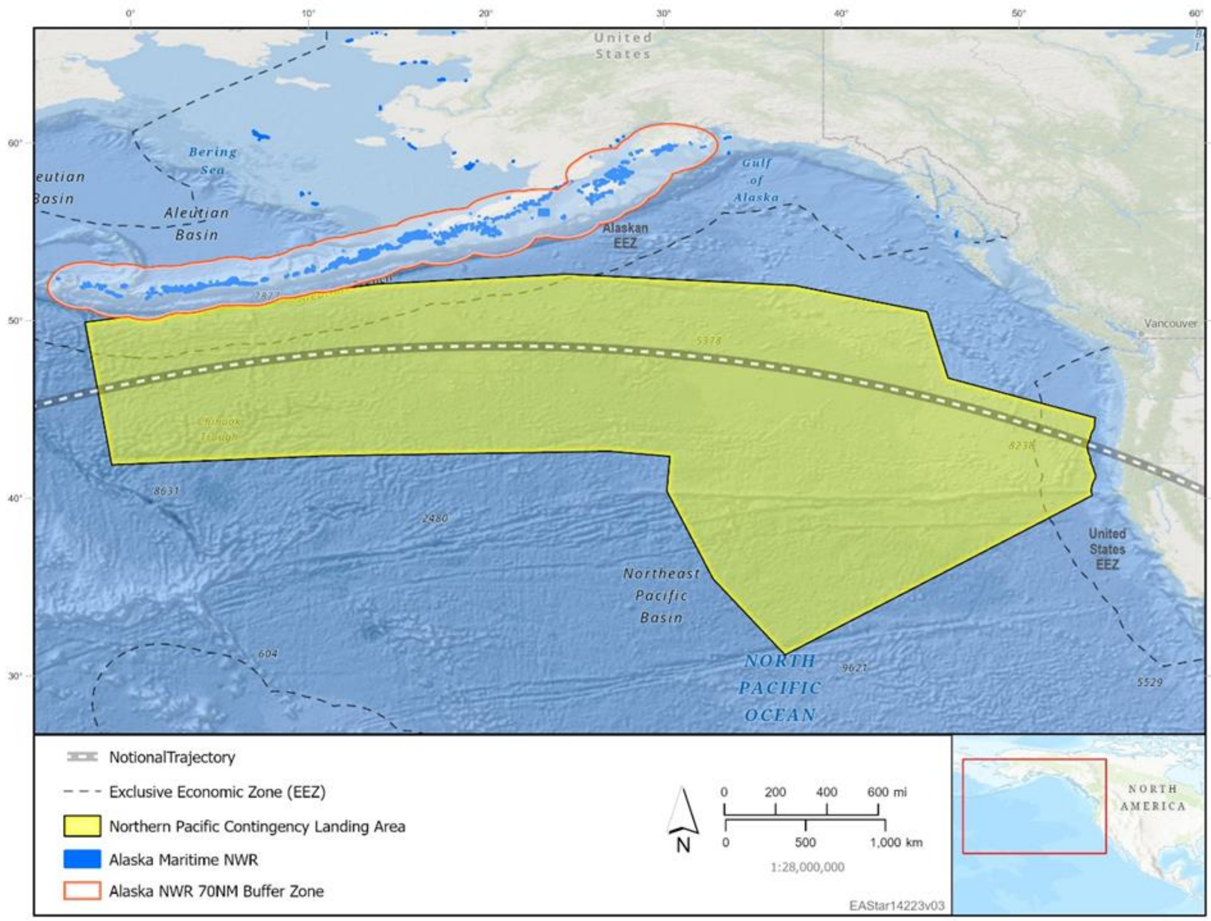

Figure 2-2: Proposed Northern Pacific Contingency Landing Area with Notional Trajectory

SpaceX and the FAA implement numerous protocols and procedures for the Hawaiian and Central Pacific region, as well as all the Pacific regions (including the Proposed new Northern Contingency Landing Area) to assess, avoid, mitigate, and minimize potential risks to ESA-listed species and the environment during reentry operations, which are discussed in the 2025 consultation and include the following:

- All vessel operators will be on the lookout for and attempt to avoid collision with ESA-listed and Marine Mammal Protection Act (MMPA)-protected species. A collision with an ESA-listed species will require reinitiation of consultation.
- Vessel operators will ensure the vessel strike avoidance measures and reporting are implemented, and will maintain a safe distance by following these measures:
    - All vessels will be in compliance with all area restrictions.

[1] An Introduction to the Geology of the Aleutian Islands, National Oceanic and Atmospheric Administration, Ocean Exploration dated 25 July 2023.

- All vessels will slow to 10 knots or less when mother/calf pairs or groups of marine mammals are observed.
- All vessels will maintain, at minimum, a distance of 90 meters (m) from all ESA-listed marine mammals (except for greater distances specified below), and 50 m from sea turtles. If this distance becomes less than 90 m or 50 m, the vessel will slow down and shift the engine to neutral until the animal(s) have left the area.
- All vessels will attempt to remain parallel to or transit away from an ESA-listed species' course when sighted while the vessel is in transit and avoid excessive speed or abrupt changes in direction until the animal(s) has left the area.

During reentry, Starship would deorbit and perform a controlled descent using atmospheric resistance to slow the vehicle down and guide it to its landing location. Guidance systems are used to maneuver the vehicle, and the trajectory determines the flight paths. Starship may expend within the contingency landing location under the following conditions:

1. In-flight breakup/Disposal: Starship breaking up during reentry, resulting in debris falling into the northern Pacific region of the action area.
2. Explosive event: Starship lands in the ocean either at terminal velocity, breaking up upon impact with debris contained within approximately 0.6 mi (1 km) of the landing point, or conducts a soft water landing and tips over in the ocean. Both scenarios are expected to result in an explosive event at the surface of the water.
3. Soft water landing: Starship conducts a soft water landing, tips over, and sinks to the bottom of the ocean (no explosive event).

Of the above scenarios, SpaceX anticipates no more than 25 in-flight breakups, 25 soft water landings, and 20 explosive events of Starship in the eastern North Pacific Basin from July 2026-October 2030. Reentry operations would occur day or night, at any time during the year.

Nearshore sensitive habitats are located adjacent to and shoreward of the Proposed Northern Contingency Landing Area. These areas, including designated critical habitat, would be avoided and are not part of the action area. Therefore, the action would have no effect on designated critical habitat or other sensitive marine habitats closer to shore.

There are no proposed changes to the conservation measures included in the 2025 consultation (OPR-2025-02468). Those conservation measures applicable to Starship reentry and landing in the Pacific Ocean would be implemented by SpaceX.

3 Description of the Species

3.1 ESA-Listed Species and Species' Density Estimates

The list of ESA-listed species with potential occurrence in the proposed Contingency Landing Area that may be affected by the Proposed Action was developed by reviewing NMFS endangered species web sites, scientific literature, and available reports, and consulting with species experts. Table 3-1 lists the ESA-listed species under NMFS jurisdiction that may be affected by the Proposed Action.

As indicated by NMFS's BCO, the potential for *take* is greatest from an explosive event at the water's surface during Starship reentry and landing. Species densities (i.e., number of animals per unit area) are needed to quantitatively estimate the number of potential exposures to impulsive noise from explosive events. Densities are only available for marine mammals and sea turtles; densities for fishes and invertebrates are not available in the scientific literature. Data on species abundances and distributions are derived from systematic marine species surveys and are needed to estimate species densities with an acceptable level of uncertainty.

For all marine species, a significant amount of effort is required to collect and analyze data to produce a density estimate, and many ocean regions have not been surveyed in a manner that supports the derivation of a quantitative density estimate (Kaschner et al., 2011). The action area includes regions that have been extensively surveyed (e.g., the U.S. West Coast EEZ), and other areas where there has been little to no systematic survey effort, including the North Pacific Ocean south of the Gulf of Alaska and Aleutian Islands. Available density data include robust, spatially-explicit density estimates derived from habitat-based density models or species distribution models developed from multiple years of systematic survey data (E. A. Becker et al., 2022; Elizabeth A. Becker et al., 2022; Roberts et al., 2016) along the West Coast, as well as uniform density estimates from the Gulf of Alaska that were extrapolated into the Action Area where no density data exist.

Table 3-1: ESA-listed Species Occurring or Potentially Occurring in the Proposed Northern Pacific Contingency Landing Area

Species	Stock (DPS)[1]	ESA Status	MMPA Status	Density (animals/km^2)	
				Max	Average
Fishes					
Giant manta ray (*Manta birostris*)	n/a	Threatened	n/a	n/a	n/a
Oceanic whitetip shark (*Carcharhinus longimanus*)	n/a	Threatened	n/a	n/a	n/a
Scalloped hammerhead shark (*Sphyrna lewini*)	Eastern Pacific	Endangered	n/a	n/a	n/a
Chum Salmon (*Oncorhynchus keta*)	Hood Canal Summer-Run ESU	Threatened	n/a	n/a	n/a
	Columbia River ESU	Threatened	n/a	n/a	n/a
Sockeye Salmon (*Oncorhynchus nerka*)	Ozette Lake ESU	Threatened	n/a	n/a	n/a
	Snake River ESU	Endangered	n/a	n/a	n/a
Steelhead	Puget Sound	Threatened	n/a	n/a	n/a

Species	Stock (DPS)[1]	ESA Status	MMPA Status	Density (animals/km^2)	
				Max	Average
(*Oncorhynchus mykiss*)	Upper Columbia River	Endangered	n/a	n/a	n/a
	Middle Columbia River	Threatened	n/a	n/a	n/a
	Lower Columbia River	Threatened	n/a	n/a	n/a
	Upper Willamette River	Threatened	n/a	n/a	n/a
	Snake River Basin	Threatened	n/a	n/a	n/a
	Northern California	Threatened	n/a	n/a	n/a
	California Central Valley	Threatened	n/a	n/a	n/a
	Central California Coast	Threatened	n/a	n/a	n/a
Sea Turtles					
Leatherback sea turtle (*Dermochelys coriacea*)	n/a	Endangered	n/a	0.002	0.002
Marine Mammals					
Sei whale (*Balaenoptera borealis)*	Eastern North Pacific	Endangered	Depleted	0.0004	0.00038
Blue whale (*Balaenoptera musculus*)	Eastern North Pacific	Endangered	Depleted	0.000821	0.00041
Fin whale (*Balaenoptera physalus)*	CA/OR/WA	Endangered	Depleted	0.019306	0.010606
	Northeast Pacific	Endangered	Depleted		
North Pacific right whale (*Eubalaena japonica*)	Eastern North Pacific	Endangered	Depleted	0.00003	0.000019
Humpback whale (*Megaptera novaeangliae*)	Mexico- North Pacific (Mexico)	Threatened	Depleted	0.19267	0.01873
	Mainland Mexico-CA-OR-WA (Mexico)	Threatened	Depleted		
	Central America-Southern Mexico-CA-OR-WA (Central America)	Endangered	Depleted	0.05154	0.00501
	Western North Pacific (Western North Pacific)	Endangered	Depleted	0.001	0.001
Sperm whale (*Physeter macrocephalus*)	CA/OR/WA	Endangered	Depleted	0.004076	0.001480
	North Pacific	Endangered	Depleted		
Guadalupe fur seal (*Arctocephalus townsendi*)	Mexico	Threatened	Depleted	0.22007	0.08764

Species	Stock (DPS)[1]	ESA Status	MMPA Status	Density (animals/km^2)	
				Max	Average
Gray whale (*Eschrichtius robustus*)	Western North Pacific (Western North Pacific)	Endangered	Depleted	0	0
Steller sea lion (*Eumetopias jubatus*)	Western (Western)	Endangered	Depleted	0	0

[1]Unless otherwise noted, all fish populations are DPSs (not stocks). Marine mammal populations are managed as stocks; however, some populations are also organized into DPSs.
DPS = Distinct Population Segment, ESU = Evolutionarily Significant Unit, n/a = Not Applicable, ESA = Endangered Species Act, CA = California, OR = Oregon, WA = Washington

The density estimates presented in Table 3-1 include both an average of all density values and the maximum density for each species in the Contingency Landing Area. The maximum density was used in the analysis as a conservative approach to estimating potential exposures, but the maximum density is not representative of species distributions throughout the landing area and likely overestimates potential effects from the action. For example, a maximum density estimate for humpback whale is from nearshore waters along the West Coast and over the continental shelf, while densities farther offshore, in deep waters that make up most of the action area, are orders of magnitude lower. To address higher than expected exposure estimates for specific species, a mean or average density estimate was also calculated for each species and used in the analysis to present a more representative assessment of potential effects. The data sources and methods used to derive average and maximum density estimates are described below.

Four species have designated critical habitat adjacent to but not within the action area: humpback whale (Central America Distinct Population Segment [DPS] and Mexico DPS), Steller sea lion (Western DPs), killer whale (Southern Resident DPS), and leatherback sea turtle. All critical habitat is located outside of the Contingency Landing Area would not be affected by the action; therefore, critical habitat is not discussed further in this document.

Steller sea lions from the Western DPS and gray whales from the Western North Pacific DPS prefer nearshore habitat and are not expected to occur offshore in the proposed Contingency Landing Area. Critical habitat for Steller sea lions extends only to 20 nm from shore off the coast of Alaska and is indicative of their habitat preferences. Gray whales in the Western North Pacific DPS are mainly distributed in the western North Pacific off the coast of Russia. While they do occur off the coast of North America, their abundance is very low, and they follow the same nearshore migratory routes as gray whales in the larger eastern North Pacific DPS and are expected to remain shoreward of the proposed Contingency Landing Area. Neither of these species are described further in this document.

There are three pods of killer whales in the Southern Resident DPS, identified as J, K, and L pods. They reside for part of the year in the inland waterways of Washington State and British Columbia known as the "Salish Sea" principally during the late spring, summer, and fall (Ford et al., 2000; Krahn et al., 2004). These killer whales also occur in outer coastal waters, primarily in winter, off Washington and Vancouver Island (Ford et al., 2000; Hanson et al., 2017), but they have been documented as far south as central California and as far north as Southeast Alaska. Although less is known about the whales' movements in outer coastal waters, satellite tagging, opportunistic sighting, and acoustic recording data suggest that killer whales from the Southern Resident DPS spend nearly all of their time on the continental shelf, within 34 km of shore in water less than 200 m deep (Hanson et al., 2017), which is outside of the Contingency

Landing Area. Therefore, killer whales from the Southern Resident DPS are not discussed further in the document.

3.2 Species Descriptions

3.2.1 Fishes

3.2.1.1 Oceanic Whitetip Shark (*Carcharhinus longimanus*)

3.2.1.1.1 Status and Trends

The oceanic whitetip shark was listed as threatened on 30 January 2018 (83 Federal Register [FR] 4153). A comprehensive status review of the oceanic whitetip shark based on the best scientific and commercial information available was completed in 2016 (Young et al., 2016b). In 2023, NMFS published a draft recovery plan which provides detailed information on the oceanic whitetip shark's biology, ecology, status and threats, and conservation efforts, as well as a description of site-specific management actions necessary for the conservation and survival of the species and objective, measurable criteria that, when met, will allow the species to be removed from the endangered and threatened species list (National Marine Fisheries Service, 2023b).

While the current population size is unknown, the best available information indicates the oceanic whitetip shark has experienced significant declines in abundance throughout its range over at least the last several decades due to overutilization in commercial fisheries resulting in excessive fishing mortality (National Marine Fisheries Service, 2023b).

3.2.1.1.2 Distribution

Oceanic whitetip sharks are found worldwide and occur throughout the central Pacific Ocean mainly in warm tropical and subtropical waters between 30° North (N) and 35° South (S) latitude near the surface of the water column (Young et al., 2016a). This species has a clear preference for open ocean waters, with abundances decreasing with greater proximity to continental shelves. Preferring warm waters near or over 20 degrees Celsius (°C) (68 degrees Fahrenheit [°F]), and offshore areas, the oceanic whitetip shark is known to undertake seasonal movements to higher latitudes in the summer (National Oceanic and Atmospheric Administration, 2016d) and may regularly survey extreme marine environments (deep depths, low temperatures) as a foraging strategy (Young et al., 2016a). Oceanic whitetip sharks are more likely to occur in the Contingency Landing Area in summer and early fall when water temperatures are warmer.

3.2.1.2 Scalloped Hammerhead Shark (*Sphyrna lewini*)

3.2.1.2.1 Status and Trends

On 3 July 2014, four of six identified DPS of scalloped hammerhead sharks were listed as endangered or threatened (79 FR 38214). The Eastern Pacific DPS of the scalloped hammerhead population, which includes the west coast of the U.S., is listed as endangered under the ESA. The central Pacific DPS, which includes the Hawaiian archipelago, was not warranted for listing. The scalloped hammerhead shark has undergone substantial declines throughout its range (Baum et al., 2003a). There is some evidence of population increases in some areas of the southeast U.S., such as the Gulf of Mexico (Ward-Paige et al., 2012), but because many catch records do not differentiate between the hammerhead species, or shark species in general, population estimates and commercial or recreational fishing landing data are unavailable in the action area. Most abundance data are from the Gulf of California, where it is estimated that the scalloped hammerhead population has been decreasing by 6 percent per year (INP, 2006).

In its 2014 status review, NMFS used two models to estimate the overall population of scalloped hammerhead sharks to range from approximately 142,000 to 169,000 individuals in 1981 and between 24,000 and 28,000 individuals in 2005 (Miller, 2014). However, lower abundance estimates have been reported (Nance, 2011).

3.2.1.2.2 Distribution

The scalloped hammerhead shark is distributed worldwide, occurring in all temperate to tropical waters (Duncan & Holland, 2006) from the surface to depths of 1,600 feet and possibly deeper (Miller et al., 2014). It typically inhabits nearshore waters of bays and estuaries where water temperatures are at least 22 °C (72°F). The scalloped hammerhead shark remains close to shore during the day and moves to deeper waters at night to feed (Daly-Engel et al., 2012). A genetic marker study suggests that females typically remain close to coastal habitats, while males are more likely to disperse across larger open ocean areas (Daly-Engel et al., 2012). Scalloped hammerhead sharks are more likely to occur in the Contingency Landing Area in summer and early fall when water temperatures are warmer.

3.2.1.3 Giant Manta Ray (*Mobula birostris*)

3.2.1.3.1 Status and Trends

On 22 January 2018, NMFS published the Final Rule listing this species as threatened (83 FR 2916) based on the scientific and commercial data and information available, including the status review report (Miller & Klimovich, 2016), and after taking into account efforts to protect these species.

No stock assessments exist for the giant manta ray. Most estimates of subpopulations are based on anecdotal observations by divers and fishermen, with current populations throughout its range estimated between 100 and 1,500 individuals (Miller, 2016). In general, giant manta ray populations have declined, except in areas where they are specifically protected, such as the Hawaiian Islands (National Oceanic and Atmospheric Administration, 2016).

3.2.1.3.2 Distribution

Giant manta rays are visitors to productive coastlines with regular upwelling, including oceanic island shores, and offshore pinnacles and seamounts. They utilize sandy bottom habitat and seagrass beds, as well as shallow reefs, and the ocean surface both inshore and offshore. The species ranges globally and is distributed in tropical, subtropical, and temperate waters. Typically they seasonally migrate more than 1,000 km, however not likely across ocean basins (National Oceanic and Atmospheric Administration, 2016c).

NMFS (2025) states that this species can exhibit a high degree of plasticity or variation in terms of their use of depths within their habitat. During feeding, giant manta rays may be found aggregating in shallow waters at depths less than 10 m. However, tagging studies have also shown that the species conducts dives of up to 200–450 m and is capable of diving to depths exceeding 1,000 m (National Marine Fisheries Service, 2025a). This diving behavior may be influenced by season and shifts in prey location associated with the thermocline.

3.2.1.4 Chum Salmon (*Oncorhynchus keta*) – Hood Canal Summer-run ESU

3.2.1.4.1 Status and Trends

On 25 March 1999, NMFS published a final rule listing the Hood Canal Summer-run Chum Salmon Evolutionary Significant Unit (ESU) as threatened under the ESA (64 FR 14508); that status was reaffirmed

(70 FR 37160) and subsequently updated on 14 April 2014 (79 FR 20802). This ESU includes naturally spawned summer-run chum salmon originating from Hood Canal and its tributaries as well as from Olympic Peninsula rivers between Hood Canal and Dungeness Bay (inclusive) (79 FR 20802). This ESU also includes summer-run chum salmon from two artificial propagation programs: the Lilliwaup Creek Fish Hatchery Program and the Tahuya River Program.

3.2.1.4.2 Distribution

Juvenile Hood Canal summer-run chum enter the Pacific Ocean as young-of-the-year fish in late-winter or early-spring months. For those fish that reside in Puget Sound waters for an extended period, they may enter the Pacific Ocean as age-1 fish in spring months. These juveniles quickly move beyond the offshore as they migrate north and west towards Gulf of Alaska waters to rear. Returning adults from this ESU return to the region then move towards natal systems in Hood Canal in the Salish Sea from August to October on their return migration towards Hood Canal estuaries (Sands et al., 2009).

3.2.1.5 Chum Salmon (*Oncorhynchus keta*) – Columbia River ESU

3.2.1.5.1 Status and Trends

On 25 March 1999, NMFS published a final rule listing the Columbia River Chum Salmon ESU as threatened under the ESA (64 FR 14508); that status was reaffirmed on 25 June 2005 (70 FR 37160) and subsequently updated on 14 April 2014 (79 FR 20802). This ESU includes naturally spawned chum salmon originating from the Columbia River and its tributaries in Washington and Oregon, and chum salmon from three artificial propagation programs (81 FR 72759): the Grays River Program, the Washougal River Hatchery/Duncan Creek Program, and the Big Creek Hatchery Program.

3.2.1.5.2 Distribution

Juvenile Columbia River chum salmon would be expected to occur in the proposed Contingency Landing Area typically as young-of-the-year (YOY) fish in spring months as they exit the Columbia River estuary and enter the coastal Columbia River plume. Upon entering the plume, these fish move north towards the Gulf of Alaska and beyond. The majority of adult chum from this ESU are fall fish, generally returning to the Columbia River estuary in late fall to begin their upstream migration to spawning habitats. However, a much smaller number of summer-run fish remain in this ESU, with upstream migration occurring in mid-summer.

3.2.1.6 Sockeye Salmon (*Oncorhynchus nerka*) – Ozette Lake ESU

3.2.1.6.1 Status and Trends

On 25 March 1999, NMFS published a final rule listing the Ozette Lake Sockeye Salmon ESU as threatened under the ESA (64 FR 14528); that status was reaffirmed on 28 June 2005 (70 FR 37160) and subsequently updated on 14 April 2014 (79 FR 20802). This ESU includes naturally spawned sockeye salmon originating from the Ozette River and Ozette Lake and its tributaries as well as sockeye salmon the Umbrella Creek/Big River Hatchery Program.

3.2.1.6.2 Distribution

Juvenile Ozette Lake sockeye salmon would be expected to briefly occur off northern Washington, north of Ozette Lake, from March to June, as age-1+ smolts. Once entering the ocean, these fish rapidly move north towards the Gulf of Alaska. Adult sockeye salmon from this ESU, after spending typically 2 to 2.25

years at sea, return to northern Washington coastal waters between April and mid-August, then move into the freshwater systems of the Lake Ozette watershed to spawn.

3.2.1.7 Sockeye Salmon (*Oncorhynchus nerka*) – Snake River ESU

3.2.1.7.1 Status and Trends

On 20 November 1991, NMFS published a final rule listing the Snake River Sockeye Salmon ESU as endangered under the ESA (56 FR 58619); that status was reaffirmed on June 28, 2005 (70 FR 37160) and subsequently updated on 14 April 2014 (79 FR 20802). This ESU includes naturally spawned anadromous and residual sockeye salmon originating from the Snake River basin and also sockeye salmon from the Redfish Lake Captive Broodstock Program and the Snake River Sockeye Salmon Hatchery Program.

3.2.1.7.2 Distribution

Juvenile Snake River sockeye salmon enter the Columbia River plume during the spring high flows (freshets). They occur briefly in the plume and waters offshore of Washington (May–mid June), before rapidly move north towards southeast Alaskan coastal waters, then the Gulf of Alaska. Adult sockeye salmon from this ESU, after spending typically two years at sea, return to northern Washington coastal waters from mid-June to mid-July, before migrating up the Columbia River towards Snake River natal systems.

3.2.1.8 Steelhead (*Oncorhynchus mykiss*) – Puget Sound DPS

3.2.1.8.1 Status and Trends

On 11 May 2007, NMFS published a final rule listing the Puget Sound Steelhead DPS as threatened under ESA (72 FR 26722); with this status updated on 14 April 2014 (79 FR 20802). This DPS includes naturally spawned steelhead originating below natural and manmade impassable barriers from rivers flowing into Puget Sound from the Elwha River (inclusive) eastward, including rivers in Hood Canal, South Sound, North Sound and the Strait of Georgia. This DPS also includes steelhead from five artificial propagation programs: the Green River Natural Program, the White River Winter Steelhead Supplementation Program, the Hood Canal Supplementation Program, the Lower Elwha Fish Hatchery Wild Steelhead Recovery Program, and the Fish Restoration Facility Program.

3.2.1.8.2 Distribution

Juvenile steelhead from this DPS, typically ranging from age-1 to age-3 fish, typically migrate to coastal Pacific waters, via the Strait of Juan de Fuca, from March through June (Bell, 1990; Moore & Berejikian, 2022; Moore, Berejikian, et al., 2010; Moore, Goetz, et al., 2010). Staying in surface waters (Light et al., 1989), juvenile steelhead, once entering Pacific coast waters, quickly migrate westward 20–34 mi. (32–55 km) after entering marine water and reaching oceanic waters off the continental shelf in as short a time as 1–3 days and averaging about 10 days (Daly et al., 2014). While there is variation between the various river systems within Puget Sound, in general, winter-run steelhead from this DPS return to these waters from November to mid-June and summer-run fish from April to November (Myers et al., 2015). There is likely very little overlap with the proposed Contingency Landing Area south of Cape Flattery.

3.2.1.9 Steelhead (*Oncorhynchus mykiss*) – Upper Columbia River DPS

3.2.1.9.1 Status and Trends

18 August 1997, NMFS published a final rule listing the Upper Columbia River Steelhead DPS as endangered under the ESA (62 FR 43937). This status was reclassified to threatened on 5 January 2006 (71 FR 833) and 24 August 2009 (74 FR 42605); updated 14 April 2014 (79 FR 20802). This DPS includes naturally spawned steelhead originating below natural and manmade impassable barriers from the Columbia River and its tributaries upstream of the Yakima River to the U.S.-Canada border as well as steelhead from five artificial propagation programs: the Wenatchee River Program, the Wells Complex Hatchery Program (in the Methow River), the Winthrop National Fish Hatchery Program, the Ringold Hatchery Program, and the Okanogan River Program.

3.2.1.9.2 Distribution

Juvenile steelhead from the Upper Columbia River DPS, typically ranging from age-2 or age-3 fish, enter the Columbia River plume in April and June, before quickly moving to offshore north Pacific Ocean waters. As with most or all steelhead DPSs, ocean-rearing steelhead are expected to stay in the top 10 m of the water column. Winter-run steelhead from this DPS return to the Columbia system from November to May and summer-run fish from June to August.

3.2.1.10 Steelhead (*Oncorhynchus mykiss*) – Middle Columbia River DPS

3.2.1.10.1 Status and Trends

On 25 March 1999, NMFS published a final rule listing the Middle Columbia River Steelhead DPS as threatened under the ESA (64 FR 14517); with this status updated on 5 January 2006 (71 FR 834) and 14 April 2014 (79 FR 20802). This DPS includes naturally spawned anadromous steelhead originating below natural and manmade impassable barriers from the Columbia River and its tributaries upstream of the Wind and Hood Rivers (exclusive) to and including the Yakima River, while excluding fish originating from the Snake River basin. This DPS also includes steelhead from four artificial propagation programs: the Touchet River Endemic Program, the Yakima River Kelt Reconditioning Program (in Satus Creek, Toppenish Creek, Naches River, and Upper Yakima River), the Umatilla River Program, and the Deschutes River Program.

3.2.1.10.2 Distribution

Juvenile steelhead from the Middle Columbia River DPS, typically age-2+ fish, enter the Columbia River plume in the spring, before quickly moving to offshore north Pacific Ocean waters. As with most or all steelhead DPSs, ocean-rearing steelhead are expected to stay in the top 10 m of the water column. Due to variable life histories within this DPS, adult steelhead enter the Columbia River estuary in nearly every month of the year.

3.2.1.11 Steelhead (*Oncorhynchus mykiss*) – Lower Columbia River DPS

3.2.1.11.1 Status and Trends

On 19 March 1998, NMFS published a final rule listing the Lower Columbia River Steelhead DPS as threatened under the ESA (63 FR 13347) and their status was updated on 5 January 2006 (71 FR 834) and 14 April 2014 (79 FR 20802). This DPS includes naturally spawned steelhead originating below natural and manmade impassable barriers from rivers between the Cowlitz and Wind Rivers (inclusive) and the Willamette and Hood Rivers (inclusive), while excluding such fish originating from the upper Willamette

River basin above Willamette Falls. This DPS also includes steelhead from eight artificial propagation programs.

3.2.1.11.2 Distribution

Juvenile steelhead from the Lower Columbia River DPS typically enter the Columbia River plume at younger ages than other Columbia River DPSs, but like other DPSs, quickly moving to offshore north Pacific Ocean waters. As with most or all steelhead DPSs, ocean-rearing steelhead are expected to stay in the top 10 m of the water column. Winter-run steelhead from this DPS return to the Columbia system from December to April and summer-run fish from April to November.

3.2.1.12 Steelhead (*Oncorhynchus mykiss*) – Upper Willamette River DPS

3.2.1.12.1 Status and Trends

On 25 March 1999, NMFS published a final rule listing the Upper Willamette River Steelhead DPS as threatened under the ESA (64 FR 14517); their status was updated on 5 January 2006 (71 FR 834) and14 April 2014 (79 FR 20802). This DPS includes naturally spawned winter-run steelhead originating below natural and manmade impassable barriers from the Willamette River and its tributaries upstream of Willamette Falls to and including the Calapooia River (79 FR 20802). No hatchery programs are currently included as part of this DPS.

3.2.1.12.2 Distribution

Juvenile steelhead from the Upper Willamette River DPS typically enter the Columbia River plume as age 2+ fish from late spring through winter. Like other DPSs, these fish quickly move to offshore waters of the north Pacific Ocean. As with most or all steelhead DPSs, ocean-rearing steelhead are expected to stay in the top 10 m of the water column. Winter-run steelhead from this DPS return to the Columbia system from November to May and summer-run fish from April to August.

3.2.1.13 Steelhead (*Oncorhynchus mykiss*) – Snake River Basin DPS

3.2.1.13.1 Status and Trends

On 18 August 1997, NMFS published a final rule listing the Snake River Basin Steelhead DPS as threatened under the ESA (62 FR 43937); this status affirmed on 5 January 2006 (71 FR 833) and updated on 14 April 2014 (79 FR 20802). This DPS includes all naturally spawned anadromous steelhead originating below natural and manmade impassable barriers from the Snake River basin, and steelhead from six artificial propagation programs.

3.2.1.13.2 Distribution

Juvenile steelhead from the Snake River Basin DPS typically enter the Columbia River plume as age-2 to age-4 fish in spring months. Like other DPSs, these fish quickly move to offshore waters of the north Pacific Ocean. As with most or all steelhead DPSs, ocean-rearing steelhead are expected to stay in the 10 m of the water column. Adult Snake River Basin steelhead begin entering the Columbia River estuary in late summer, with peak upstream migration occurring from August to October.

3.2.1.14 Steelhead (*Oncorhynchus mykiss*) – Northern California DPS

3.2.1.14.1 Status and Trends

On 7 June 2000, NMFS published a final rule listing the Northern California Steelhead DPS as threatened under the ESA (65 FR 36074), with their status updated on 5 January 2006 (71 FR 834) and 14 April 2014 (79 FR 20802). This DPS includes naturally spawned steelhead originating below natural and manmade impassable barriers in California coastal river basins from Redwood Creek to and including the Gualala River (79 FR 20802). No hatchery programs are currently included as part of this DPS.

3.2.1.14.2 Distribution

Juvenile steelhead from the Northern California DPS typically enter the Pacific Ocean waters from northern California estuaries between March and June, though if conditions are poor, they may wait until late fall. Like other DPSs, these fish quickly move to offshore waters of the North Pacific Ocean. As with most or all steelhead DPSs, ocean-rearing steelhead are expected to stay in the top 10 m of the water column. Due to the variety of life histories adapted to these smaller systems, adult steelhead from this DPS return to these systems in all months of the year.

3.2.1.15 Steelhead (*Oncorhynchus mykiss*) – California Central Valley DPS

3.2.1.15.1 Status and Trends

On 19 March 1998, NMFS published a final rule listing the California Central Valley Steelhead DPS as threatened under the ESA (63 FR 13347). Their status was updated on 5 January 2006 (71 FR 834) and 14 April 2014 (79 FR 20802). This DPS includes naturally spawned steelhead originating below natural and manmade impassable barriers from the Sacramento and San Joaquin Rivers and their tributaries; excludes such fish originating from San Francisco and San Pablo Bays and their tributaries. This DPS includes steelhead from the following artificial propagation programs: the Coleman National Fish Hatchery Program, the Feather River Fish Hatchery Program, and the Mokelumne River Hatchery Program.

3.2.1.15.2 Distribution

California Central Valley DPS steelhead are all winter-run fish, typically out-migrating from the San Francisco Bay-Delta region to the Pacific Ocean waters as age-2+ fish between December to May, though a small portion of this DPS out-migrates in fall. Like other steelhead DPSs, these fish quickly move to offshore waters, but unlike more northerly DPSs some of these fish may not make the long migrations to the north Pacific Ocean. At-sea rearing for this DPS is not well understood. As with most or all steelhead DPSs, ocean-rearing steelhead are expected to stay in the top 10 m of the water column. Adult California Central Valley steelhead return through the San Francisco estuary from August through April.

3.2.1.16 Steelhead (*Oncorhynchus mykiss*) – Central California Coast DPS

3.2.1.16.1 Status and Trends

On 18 August 1997, NMFS published a final rule listing the Central California Coast Steelhead DPS as threatened under the ESA (62 FR 43937). Their status was reaffirmed on 5 January 2006 (71 FR 834) and updated on 14 April 2014 (79 FR 20802). This DPS includes naturally spawned steelhead originating below natural and manmade impassable barriers from the Russian River to and including Aptos Creek, and all drainages of San Francisco and San Pablo Bays eastward to Chipps Island at the confluence of the Sacramento and San Joaquin Rivers. This DPS also includes steelhead from two artificial propagation programs: the Don Clausen Fish Hatchery Program and the Kingfisher Flat Hatchery Program (Monterey Bay Salmon and Trout Project).

3.2.1.16.2 Distribution

Central California Coast steelhead have numerous life history patterns, typically out-migrating to the Pacific Ocean as age-2+ fish. Due to the diversity within this DPS, outmigration could occur year-round, depending on conditions. Like other DPSs, these fish quickly move to offshore waters, but unlike more northerly DPSs some of these fish may not make the long migrations to the north Pacific Ocean. At-sea rearing for this DPS is not well understood. As with most or all steelhead DPSs, ocean-rearing steelhead are expected to stay in the top 10 m of the water column. Adult steelhead from this DPS typically return to coastal estuaries from October to May, with peak entry occurring between November and February.

3.2.2 Sea Turtles

3.2.2.1 Leatherback Sea Turtle (*Dermochelys coriacea*)

3.2.2.1.1 Status and Trends

The leatherback sea turtle is listed as a single population and classified as endangered under the ESA throughout its range. Leatherbacks within the proposed Contingency Landing Area are within the Western Pacific population but are not listed as a separate DPS under the ESA.

In some areas there have been sustained long-term declines in nesting abundance of leatherback turtles, while in other areas upward or stable trends have reversed to downward trends (Hays et al., 2024). Leatherbacks within the Contingency Landing Area, however, are declining (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2020). The declining trends in leatherback abundance may be linked to the broadscale movements of individuals, sometimes across many thousands of kilometers spanning ocean basins, where they are exposed to a number of threats including coastal modifications (Nelson Sella & Fuentes, 2019; U.S. Army Corps of Engineers, 2022) or bycatch in oceanic longline fisheries as well as coastal pot fisheries (Wallace, 2025). Some information on leatherback occurrences is available off Oregon and Washington. An abundance of approximately 55 leatherbacks was estimated by Benson et al. (2020) off Central California with probably fewer than 150 along the West Coast. No leatherbacks were sighted during a 2024 survey of off the coast of Washington even though suitable habitat was found (Forney, 2024). A conservative density of 0.002 leatherbacks/km2 was proved by Benson (2025) for the Pacific Northwest, which is used in this analysis.

It is possible that leatherback turtles could travel farther north into Alaskan waters during foraging expeditions and migration to the West Coast; however, only 19 sightings of leatherbacks were recorded in Alaska waters between 1960 and 1998 (Hodge & Wing, 2000), all within the Gulf of Alaska. While leatherback sea turtles are physically capable of foraging in Alaska water are rare in the region and prefer warmer waters farther south.

3.2.2.1.2 Distribution

The leatherback sea turtle is distributed worldwide in tropical and temperate waters of the Atlantic, Pacific, and Indian Oceans. The movements of adult leatherback sea turtles appear to be linked to the seasonal availability of their prey, primarily brown sea nettle and other soft-bodied salps, and the requirements of their reproductive cycles (Collard, 1990; Davenport & Balazs, 1991). Leatherbacks prefer convergence zones and upwelling areas in the open ocean, along continental margins, or near large archipelagos. Telemetry studies have shown migration through the North Pacific and areas of concentration along the Central California coast and in the waters of Oregon and Washington (Benson et al., 2011; Benson et al., 2007). Aerial surveys off Washington, Oregon, and California, indicate that most leatherbacks occur in waters over the continental slope, with a few beyond the continental shelf (Eckert, 1993).

3.2.3 Marine Mammals

3.2.3.1 Blue Whale (*Balaenoptera musculus*)

3.2.3.1.1 Status and Trends

The world's population of blue whales can be separated into five subspecies, based on geographic location and some morphological differences (National Marine Fisheries Service, 2020). In the proposed Contingency Landing Area, the subspecies *Balaenoptera musculus musculus* is present. In the North Pacific, NMFS divided *B. musculus* into two stocks, the Eastern North Pacific and Central North Pacific stocks (Carretta et al., 2023). Blue whales are listed as endangered under the ESA and both stocks of blue whales are designated as depleted/strategic under the MMPA.

Widespread whaling over the last century is believed to have decreased the global blue whale population and (Monnahan et al., 2014) estimated that 3,411 blue whales (95 percent CI = 2,593–4,114) were removed via commercial whaling from the Eastern North Pacific (ENP) between 1905 and 1971. Abundance calculations for blue whales in the ENP, based on photo identifications of individual whales from 2015 to 2018, resulted in an estimated 1,898 animals (Calambokidis & Barlow, 2020).

3.2.3.1.2 Distribution

Blue whales spend their summers feeding in productive waters near the higher latitudes and winters in the warmer waters at lower latitudes returning to the same feeding areas each year either due to the persistence of foraging hotspots or due to learned behavior (Abrahms et al., 2019; Becker et al., 2018; Fahlbusch et al., 2022). Sighting typically occurs in nearshore and continental shelf waters (Barlow, 2016; Hamilton et al., 2009). The structure of blue whale populations can be determined based on acoustic data (McDonald et al., 2006).

Blue whales satellite-tagged off California in summer have traveled to the eastern tropical Pacific and the Costa Rica Dome in winter (Bailey et al., 2009; Mate et al., 1999). Blue whales photographed off California have been matched to individuals photographed off the Queen Charlotte Islands in northern British Columbia and to one individual photographed in the northern Gulf of Alaska (Calambokidis et al., 2009). Barlow (2016) and Barlow (2010) noted evidence of a northward shift in blue whale distribution with increasing numbers of blue whales found in Oregon and Washington waters, based on a series of vessel-based line-transect surveys between 1991 and 2014 as well as satellite tracks of blue whales in Gulf of Alaska and Canadian waters between 1994 and 2007 (Bailey et al., 2009). Passive acoustic monitoring within the Gulf of Alaska indicates that blue whales from both the Northeast Pacific and Central/Western Pacific populations inhabit this region for at least a portion of the year (Rice et al., 2022; Rone et al., 2017).

Though prey aggregations may be a driving factor for migration timing, Blevins et al. (2022) used stable isotope analysis of baleen plates of thirteen individuals and found sex specific inter-individual variation in seasonal migratory patterns. Adult female blue whales exhibit relatively stable seasonal migrations between temperate foraging grounds and subtropical breeding areas, with some skipping migration due to reproductive needs. Adult males show varied strategies, with some remaining in temperate regions for years, while others migrate to subtropical areas. Juveniles display erratic movement patterns, likely due to inexperience in locating prey (Blevins et al., 2022).

3.2.3.2 Fin Whale (*Balaenoptera physalus*)

3.2.3.2.1 Status and Trends

The fin whale is listed as endangered under the ESA and depleted under the MMPA. In the North Pacific, NMFS recognizes three fin whale stocks: (1) a Northeast Pacific stock that ranges from Western Canada through the Gulf of Alaska and into the Bering Sea; (2) a California, Oregon, and Washington stock; and (3) a Hawaiʻi stock (Carretta et al., 2023; Young, 2023). Genetic evidence suggests that North Pacific fin whales should be recognized as a separate subspecies, *Balaenoptera physalus velifera* (Archer et al., 2019).

Abundance estimates of fin whales off the U.S. West Coast show increasing numbers since the early 1990s (Moore & Barlow, 2011) and now are estimated at 11,065 (Becker et al., 2020; Carretta et al., 2022). Estimates of population size from line-transect surveys and species distribution models have steadily increased from 1991 to 2018, (Becker et al., 2020; Moore & Barlow, 2011; Nadeem et al., 2016). In their northern range extent in Alaska, annual increases were estimated to be 4.8 percent between 1987 to 2003 (Nadeem et al., 2016).

3.2.3.2.2 Distribution

The fin whale is found in all the world's oceans and is the second largest species of whale (Jefferson et al., 2015). Fin whales prefer temperate and polar waters and are scarcely seen in warm, tropical waters (Reeves et al., 2002).

The movements of six fin whales tagged off the West Coast were shown to be highly variable, ranging from less than 1 to over 200 km from the California coast and as far north as the Oregon border and as far south as the central Baja California Peninsula, Mexico (Mate et al., 2015). Fin whales frequently congregate in areas with high primary productivity, often in upwelling zones, which may indicate high concentrations of prey. Fin whales are known to be highly adaptable to varying habitat and tend to follow prey, which frequently aggregates off the continental shelf (Azzellino et al., 2008; Panigada et al., 2008).

Based on predictive habitat-based density models derived from line-transect survey data collected between 1991 and 2018 off the West Coast, relatively high densities of fin whales are predicted to occur in offshore waters during the summer and fall, with fewer occurring in winter and spring (Barlow et al., 2009; Becker et al., 2020; Becker, Forney, Ferguson, et al., 2012; E. A. Becker et al., 2022; Becker et al., 2025; Calambokidis et al., 2024; Forney et al., 2012).

When seasonally present in northern British Columbia waters of Hecate Strait, Queen Charlotte Sound, and Greater Caamaño Sound, satellite tag data and photographic identifications indicated little movement of fin whales between the inshore areas and the offshore regions of the Canadian Pacific (Nichol et al., 2018). Burnham et al. (2021), used acoustic data from glider deployments that confirmed the presence of fin whales in the deep-coastal and offshore waters of the west coast of Vancouver Island. Their analysis also supported previous models that suggest a proclivity of fin whales for shelf break and offshore waters, as well as more coastal areas.

3.2.3.3 Humpback Whale (*Megaptera novaeangliae*; Mexico and Central America Distinct Population Segments)

3.2.3.3.1 Status and Trends

In 2016 NMFS divided the global population of humpback whales into 14 DPSs. Four DPSs were designated for the North Pacific based on the location of distinct breeding areas: Western North Pacific, Hawaiʻi, Mexico, and Central America. Humpback whales that occur seasonally in the proposed Contingency

Landing Area are from three of the four DPSs: Hawaiʻi DPS, Mexico DPS, and Central America DPS (Bettridge et al., 2015; Carretta et al., 2023; National Marine Fisheries Service, 2016b; Young, 2023). Humpback whales from the Mexico DPS are listed as threatened and those from the Central America DPS are listed as endangered under the ESA (National Marine Fisheries Service, 2016a).

The three previously defined stocks of North Pacific humpback whales did not align with the DPS structure, so NMFS reevaluated the stock structure to incorporate both the locations of foraging and overwintering areas and population demographics. As a result, NMFS defined five stocks in the North Pacific:

1. Central America/Southern Mexico-California-Oregon-Washington stock
2. Mainland Mexico-California-Oregon-Washington stock
3. Mexico-North Pacific stock
4. Hawaiʻi stock
5. Western North Pacific stock

Humpback whales from the first four stocks listed above occur seasonally in the proposed Contingency Landing Areas; humpbacks from the Western North Pacific stock do not occur in the proposed Contingency Landing Areas. Humpback whales wintering in Hawaiʻi are identified as the Hawaiʻi DPS and comprise the Hawaiʻi stock. Humpback whales from the Hawaiʻi DPS/stock forage across the North Pacific (Figure 3-1). Humpback whales from the Mexico DPS migrate to summer foraging habitat from California northward along the U.S. West Coast, Canada, Alaska, into the Bering Sea, and off the coast of Russia and are divided into the Mexico-North Pacific stock and the Mainland Mexico-California-Oregon-Washington stock. Humpback whales from the Central America DPS forage in waters off California and the Pacific Northwest and make up the Central America/Southern Mexico-California-Oregon-Washington stock (Carretta et al., 2023). For additional information on the revised stock and DPS structure and population dynamics refer to Martien et al. (2023), Wade (2021), Martien et al. (2021) and Martien et al. (2019).

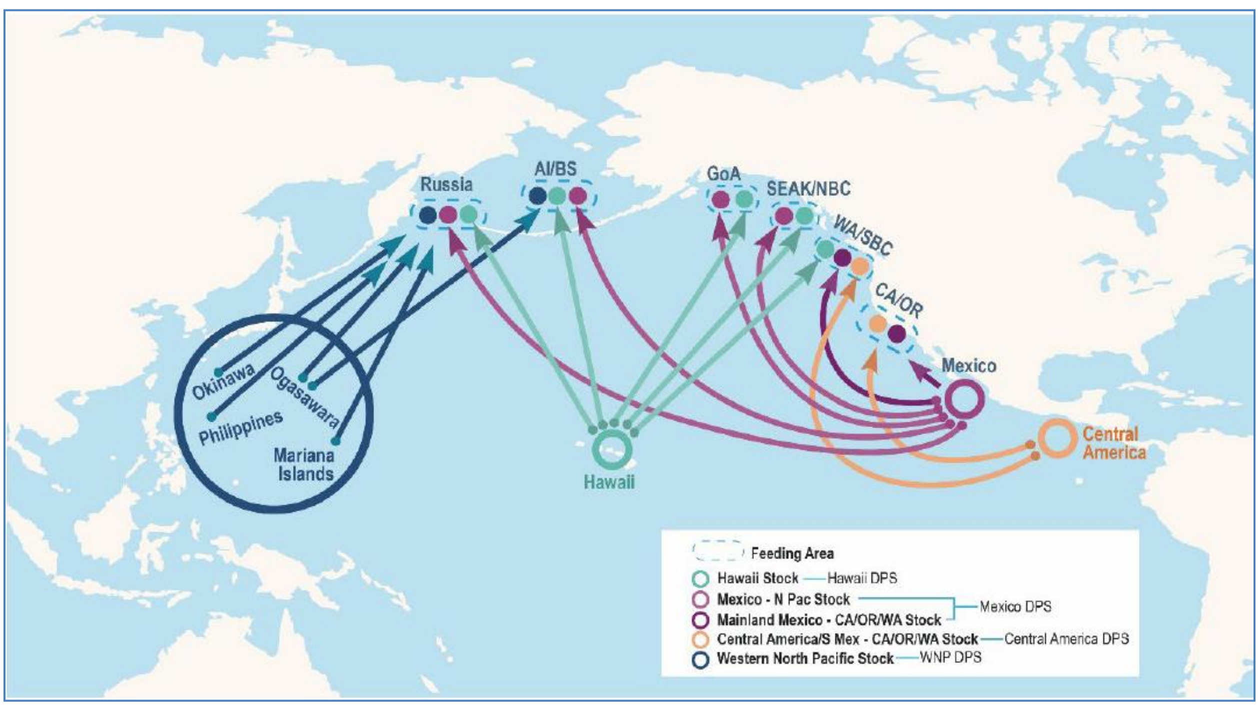

Figure 3-1: Humpback Whale Stocks and DPSs Defined in the North Pacific. Whales From the Hawaiʻi, Mexico, and Central America DPSs Occur Seasonally in the proposed Contingency Landing Areas

Based on data collected through 2018, humpback whale abundance in the California Current increased at a rate of 8.2 percent annually since 1989 (Calambokidis & Barlow, 2020). Using mark-recapture techniques, (Cheeseman et al., 2024) estimated a total abundance of 26,662 humpback whales in the North Pacific as of 2021, growing from 2002 to 2021 at an average rate of 3 percent per year. They surmised that across the North Pacific Ocean, humpback whale population dynamics may now be more constrained by environmental factors such as variability in resources induced by climate change. Since multiple humpback whale stocks occur in these waters, overall trend estimates cannot be assumed for each of the individual stocks.

Based on capture-recapture analyses of photographic identification data collected between 2019 and 2021, there appears to be an annual growth rate of 1.6 percent for the Central America/Southern Mexico – CA/OR/WA stock of humpback whales (Curtis et al., 2022). Stock-specific trend data are not available for the Mainland Mexico – CA/OR/WA stock of humpback whales (Carretta et al., 2023). Since some of the individuals from the Mexico-North Pacific stock of humpback whales feed in Alaska, and there have been recent declines in the numbers of humpback whale in these feeding grounds, it is unknown if there is an increasing or decreasing population trend for this stock (Young, 2023).

3.2.3.3.2 Distribution

In the eastern North Pacific, humpback whales are typically found during the summer in high latitude feeding grounds, including Alaska and British Columbia, and during the winter migrate to breeding areas off Hawaiʻi, Mexico, and Central America, where breeding and calving occurs. As a result, humpback migrations are complex and cover great distances (Bettridge et al., 2015; Calambokidis et al., 2009; Calambokidis et al., 2008). Off the West Coast, humpback whales are more abundant in shelf and slope waters (<2,000 m deep), and are often associated with areas of high productivity (Becker et al., 2020; Becker et al., 2010; Becker, Forney, Foley, et al., 2012; Becker et al., 2014; Forney et al., 2012; Redfern et al., 2013).

Three DPSs, Hawaiʻi, Mexico, and Central America, are primarily found along the western coast of North America during the summer-fall feeding season. During this season these populations occur in somewhat distinct feeding aggregations, with Hawaiʻi animals being found in southeastern Alaska and northern British Colombia; Mexico animals being found off Washington and southern British Colombia; and Central America animals being found off California and Oregon (Bettridge et al., 2015).

3.2.3.4 North Pacific Right Whale (*Eubalaena japonica*)

3.2.3.4.1 Status and Trends

In 2008, NMFS reclassified the Northern right whale as two separate endangered species, North Pacific right whale (*E. japonica*) and North Atlantic right whale (*E. glacialis*) (National Marine Fisheries Service, 2008b). North Pacific right whales are today among the world's rarest marine mammals (National Marine Fisheries Service, 2013; Wade et al., 2011). Recent genetic analysis has led to the generally accepted belief that the species comprises eastern and western populations that are largely or wholly discrete (Pastene et al., 2022). The eastern population is the one that could be present off the Washington and to a lesser extent off the Oregon coasts.

There are currently 68 identified individuals in the Eastern North Pacific right whale catalog, yet only 31 are considered reliably unique due to a lack of adequate imagery (e.g. coverage of only one side or poor image composure). Between 2006 and 2023, there were 99 sightings of right whales in the eastern North Pacific; 58 of these sightings occurred during dedicated shipboard and aerial surveys (2008–2009), 17 during other marine mammal surveys in Alaska and the North Pacific, and 25 during opportunistic effort.

All sightings were adults, subadults, or juveniles; no calves have been sighted since 2004 (Crance & Kennedy, 2024). There are key uncertainties in the assessment of the Eastern North Pacific right whale stock. The abundance of this stock is critically low and migration patterns, calving grounds, and breeding grounds are not well known. There appears to be three times more males than females in the population and calf production is very low (Pastene et al., 2022). The only recent estimate of abundance comes from mark-recapture analyses of photo-identification in 2008 and genetic data in 2004. Photographic (18 identified individuals) and genotype (21 identified individuals) data through 2008 were used to calculate the first mark-recapture estimates of abundance for right whales in the Bering Sea and Aleutian Islands, resulting in separate estimates of 31 (95 percent Confidence Level [CL]: 23-54; Coefficient of Variation [CV] = 0.226) and 28 (95 percent CL: 24-42), respectively (Wade et al., 2011). Given the extreme paucity of sightings in the Gulf of Alaska, it seems unlikely that the overall abundance is significantly larger. Due to a low resighting rate and the extremely low population size, no estimate of trends in abundance is available for this stock (Young, 2024).

3.2.3.4.2 Distribution

The summer range of the Eastern North Pacific right whale stock includes the Gulf of Alaska and the Bering Sea, while the Western stock is believed to feed in the Okhotsk Sea and in pelagic waters of the northwestern North Pacific. The winter calving grounds of both stocks remain unknown (Young, 2024). The small Eastern population is primarily concentrated in the southeastern Bering Sea (specifically the middle shelf) and the Gulf of Alaska south of Kodiak Island (Crance et al., 2022). Acoustic detections in the Bering Sea strongly suggest a consistent presence from May through December, with peak calling from July to October, mainly over the continental shelf (Munger et al., 2008; Simon et al., 2010). Sightings in the Gulf of Alaska, including recent ones in 2021 and 2023, and acoustic detections occur in the northern Gulf of Alaska, particularly in the Barnabas Trough area off Kodiak Island, which is considered important habitat (Crance et al., 2022; Wright et al., 2025). The eastern Aleutian Islands passes are also used as a likely migratory corridor (Wright et al., 2025). Occasional sightings of North Pacific right whales have been made off California and off Baja California, Mexico; this includes two recent records from California in 2017 (off La Jolla and in the Channel Islands, both of which were single whales) as well as a sighting of a single skim-feeding right whale off Año Nuevo, CA in April 2022 and an animal in Monterey Bay in March 2023. It remains possible that California and Mexico, and possibly offshore waters of Hawaiʻi, were once the principal calving grounds for North Pacific right whales from the Gulf of Alaska and Bering Sea prior to whaling (Young, 2024). In May 2024, there was a sighting of a single North Pacific right whale off the coast of California in the Cordell Bank National Marine Sanctuary, northwest of San Francisco (https://www.northpacificrightwhale.org/recent-sightings).

3.2.3.5 Sei Whale (***Balaenoptera borealis***)

3.2.3.5.1 Status and Trends

A single Eastern North Pacific sei whale stock is recognized in the U.S. EEZ and that stock is considered endangered under the ESA (Carretta et al., 2024). The stock is considered depleted/strategic under the MMPA.

Line transect surveys in 2010 and 2012 in the central and eastern North Pacific, Gulf of Alaska, and off Southeast Alaskan and British Columbia, Canada to 40° north latitude indicate that the abundance of sei whales in the North Pacific is 34,718 individuals (Hakamada et al., 2017). While the study area of Hakamada et al. (2017) included waters north of 40°N latitude and west of 135°W longitude, it excluded waters of the California Current. The most recent estimate of sei whale abundance of 864 (CV = 0.40) in the California Current is based on a 2014 survey. Although there was no formal assessment of an abundance trend for sei whales, design-based estimates from ship surveys off the West Coast showed an increasing trend from 1991-2014, with the 2014 estimate being the highest (Barlow, 2016). This may be partly due to recovery of the population from commercial whaling but may also involve distributional shifts in the population.

3.2.3.5.2 Distribution

Sei whales have a worldwide distribution and are found primarily in cold temperate to subpolar latitudes. During the winter, sei whales are found in warm tropical waters like Hawaiʻi. Sei whales are also encountered during the summer off the west coast of North America from the Mexican border to Vancouver Island, Canada (Horwood, 2009; Masaki, 1976; Smultea et al., 2010). Sei whales are typically found in the open ocean and are rarely observed near the coast (Horwood, 2009). Whaling data provide some evidence of differential migration patterns by reproductive class, with females arriving at and departing from feeding areas earlier than males (Horwood, 1987; Perry et al., 1999). Although there appears to be some seasonal movement between higher latitude summer feeding areas and lower latitude winter calving areas, these movements are not as extensive as those of many other baleen whale species (Jefferson et al., 2015).

3.2.3.6 Sperm Whale (*Physeter macrocephalus*)

3.2.3.6.1 Status and Trends

Sperm whales are divided into three stocks in the Pacific: Hawaiʻi, California/Oregon/Washington, and Alaska (North Pacific Stock). The sperm whale is listed as endangered under the ESA, and considered depleted/strategic under the MMPA (National Marine Fisheries Service, 2009).

Global population size before whaling has been estimated at 1.1 million individuals, with numbers declining to roughly 360,000 by 1999 (Whitehead, 2002, 2003). Kato and Miyashita (1998) reported 102,112 sperm whales (CV = 0.155) in the western North Pacific, with the caveat that their estimate is likely positively biased. Estimates are lacking of the historical size of the California/Oregon/Washington stock. Moore and Barlow (2014) used a Bayesian hierarchical approach to examine sperm whale population abundance and trends based on line-transect surveys conducted off the West Coast from 1991 to 2008. Although an estimate of trends was not conclusive, they found that the abundance of adult male sperm whales has increased (Moore & Barlow, 2014). Moore and Barlow (2017) updated their sperm whale assessment using new data from a NMFS 2014 West Coast survey. While they reported little evidence of increasing trends in overall sperm whale abundance, the new analysis supports prior evidence for an increasing number of sperm whales that occur in small groups (presumed to be adult or near-adult males). However, given high uncertainty associated with the estimated growth rates of this population, a definite trend could not be confirmed (Moore & Barlow, 2017). The most recent abundance estimate based on habitat-based density modeling (Becker et al., 2020) provides a mean estimate of 2,606 individuals in West Coast waters (CV = 0.135).

3.2.3.6.2 Distribution

Sperm whales are somewhat migratory. General shifts occur during summer months for feeding and breeding, while in some tropical areas, sperm whales appear to be largely resident (Rice, 1989; Whitehead, 2003, 2009; Whitehead et al., 2008). This species appears to prefer deep waters (Baird, 2013; Jefferson et al., 2015), typically correlating with areas of high productivity.

Related females and their offspring remain on breeding grounds throughout the year, between 40° N and 45° N (Rice, 1989; Whitehead, 2003), while males migrate between low-latitude breeding areas and higher-latitude feeding grounds (Pierce et al., 2007). In the northern hemisphere, “bachelor” groups (males typically 15–21 years old and bulls [males] not taking part in reproduction) generally leave warm waters at the beginning of summer and migrate to feeding grounds that may extend as far north as the perimeter of the arctic zone. In fall and winter, most return south, although some may remain in the colder northern waters during most of the year (Pierce et al., 2007). Female sperm whale social groups are not restricted to temperate and tropical latitudes. Posdaljian et al. (2023) found female groups to be consistently detected at all seven passive acoustic monitoring sites across the Gulf of Alaska and the Bering Sea/Aleutian Islands in a 2010 to 2019 study, suggesting these areas are an overlooked female habitat.

3.2.3.7 Guadalupe Fur Seal (*Arctocephalus townsendi*)

3.2.3.7.1 Status and Trends

The Guadalupe fur seal is listed as threatened under the ESA and depleted under the MMPA (National Marine Fisheries Service, 1985). The primary breeding rookery of Guadalupe fur seals is at Isla de Guadalupe, Mexico, and a second breeding population has been established at Islas San Benito, Baja California, Mexico (Norris, 2019). Since all individuals are descendants from a breeding colony at Isla Guadalupe, Mexico, the Guadalupe fur seal population is treated as a single stock by NMFS (Carretta et al., 2020).

An unpublished abundance estimate of over 90,000 Guadalupe fur seals was provided by Elorriaga-Verplancken and Norris (2025). Since most pups are born in summer on Guadalupe Island, Mexico and remain on land through March, few if any of those pups would occur in or shoreward of the proposed Contingency Landing Area from July through March. However, pups born the previous year and some juveniles remain in the region year round for about the first two years, before returning to Guadalupe Island in their third year.

3.2.3.7.2 Distribution

Off North America, Guadalupe fur seals are pelagic and rarely come to shore along the mainland coast (Norris & Elorriaga-Verplancken, 2020). The primary breeding colony is on Guadalupe Island, located off the Baja California Peninsula, Mexico. Breeding also occurs on a smaller scale on islands in the San Benito Archipelago, located approximately 170 miles east-southeast of Guadalupe Island and 45 miles from Point Eugenia on the Peninsula. San Benito was recolonized by a small number of fur seals and is now considered an established rookery (Aurioles-Gamboa et al., 2010; Carretta et al., 2024). Occasional sightings of Guadalupe fur seal pups have also been reported on the Channel Islands off Southern California, including San Miguel, San Nicolos, and the Farallon Islands (Gallo-Reynoso, 1994; Juárez-Ruiz et al., 2018; Melin & DeLong, 1999). With rare exceptions, Guadalupe fur seals are expected to remain at sea when in the Study Area and are not expected to haul out or occur in nearshore waters.

Tagging studies tracking Guadalupe fur seal movements from Guadalupe Island north along the West Coast show that adults and juveniles of both sexes (non-pups) occur in highest concentrations in waters off Central and Southern California near the Patten Escarpment at approximately the 2,000 m depth contour (Norris, 2019; Norris & Elorriaga-Verplancken, 2020). Pups, however, migrate farther north into waters off Oregon, Washington, and British Columbia and tend to remain closer to shore than non-pups. Based on the routes followed by tagged fur seals, including pups, a species distribution has been defined with a “core range” representing the area of highest use and a broader “geographic range” representing the full extent of their distribution (Elorriaga-Verplancken & Norris, 2025; McCue et al., 2021; Norris, 2022). The core range is located outside of the proposed Contingency Landing Aera; however, the geographic range overlaps with a portion of the Landing Area.

4 Effects of the Action

Calculating the potentially affected area within which ESA-listed species could be affected is one of the required inputs for conducting a quantitative analysis of potential impacts on marine species. Data on the abundance and distribution of species in the potentially affected area is also required to conduct a quantitative analysis of potential impacts. The 2025 consultation identified potential stressors to ESA-listed species due to Starship activities. The potential effects to the ESA-listed species identified above from the stressors are described below, focusing on those stressors that pertain to Starship reentry and landing.

4.1 Sonic booms and impulse noise generated during Starship landings

ESA-listed marine species in the proposed Contingency Landing Area could be exposed to the overpressures from sonic booms and impulse noise in the air when they are surfacing to breathe, in the case of marine mammals and leatherback sea turtles. However, the chance of both events happening at the same time (i.e., an animal surfacing and a sonic boom/impulse noise occurring) is extremely low, considering the duration of the sonic boom is less than 1 second (less than 300 milliseconds) and the duration of an ocean landing is less than 1 minute. Overpressures from Starship sonic booms range from 1–4 pounds per square foot (psf). An overpressure of 1 psf is similar to a thunderclap. Previous research conducted by the U.S. Air Force determined that a peak pressure of 12 pounds per square inch (psi) in the water would be needed to meet the acoustic threshold at which harassment of marine mammals and sea turtles may occur from impulsive sound. Rather than responding primarily to sound pressure, invertebrates mainly detect particle motion and can sense local water movements (Solé et al. 2023). This detection is limited, as particle motion diminishes rapidly with distance from the sound source, making the impact of noise on invertebrates likely less than the impact on marine mammals and sea turtles. ESA-listed fishes have a slightly lower acoustic threshold for harassment than marine mammals and sea turtles (FHWG 2008); however, to produce even 12 psi in water, a surface (in-air) pressure of approximately 900 psf is needed. Therefore, any effect from the sonic booms or impulse noise on ESA-listed marine species at the surface of the water would be discountable because exposure of these animals to the stressor is extremely unlikely to occur.

Impulse noise from vehicle landings may affect ESA-listed species' hearing underwater. Noise from a landing is unlikely to effectively cross the air-water boundary, as previously discussed. The likelihood that an animal occurs at the same time and place as a Starship landing and would be exposed to sound generated by the landing is expected to be extremely unlikely given relatively low species densities, large areas over which either vehicle may be expended, and the short duration (only a few seconds) of landings.

Therefore, sonic booms and impulse noise generated during launches and landings may affect, but are not likely to adversely affect, ESA-listed marine species.

4.2 Direct impact by fallen objects (Starship debris)

In the case of an in-flight breakup, pieces of Starship falling from the sky have the potential to affect ESA-listed species in the water. The primary concern is direct impact from these objects striking an ESA-listed species. Strikes may result in injury or mortality to the individuals struck. Because NMFS estimates that the probability a vehicle will land in a specific location within a portion of the action area is equal across that portion, the highest monthly mean species density across all portions of the action area are used as a proxy for all species considered in this consultation. The highest maximum species density is 0.19267 animals/kilometer squared (km^2) for the Mexico DPS of humpback whale in the summer months at the extreme eastern boundary of the proposed Contingency Landing Area along the Oregon coast. Multiplying the species density by the vehicle area, 0.00063 km^2, results in an extremely small number of individuals that may be exposed to a direct impact from a falling object (0.00012 animals). Thus, the likelihood that an ESA-listed species will be in the exact location at the surface at the exact same time when a piece of the Starship lands in the water is extremely unlikely, and thus, discountable.

Starship debris from 1) an in-flight breakup, 2) a breakup upon landing in the ocean (for which debris is expected to be contained within 1 km of the landing location), or 3) a mishap will be smaller than Starship itself. Falling objects may disturb the sea surface as they impact the ocean, disturb the seafloor as they settle, and affect physical and biological conditions including water and sediment quality. Falling objects may also temporarily displace prey species as objects sink through the water column and temporarily affect prey availability as prey disperse away from the object. However, the temporary sinking of debris or the vehicle itself through the water column is not expected to affect the overall density, abundance, availability, or accessibility of prey in a manner that would measurably affect any ESA-listed species. Debris resting on the seafloor in deep offshore waters below the euphotic zone would not affects ESA-listed fish, marine mammal, and sea turtle species which do not inhabit or forage in deepwater benthic habitat. In summary, the potential effects to ESA-listed species from a direct impact by falling objects are discountable.

Therefore, direct impact by fallen objects (i.e., Starship debris) may affect, but is not likely to adversely affect, ESA-listed marine species.

4.3 Impacts from unrecovered debris

Unrecovered debris from Starship could include stainless steel, thermal (heat) tiles and matting, composite overwrapped pressure vessels (COPVs), cork, plastic, and adhesive. Stainless steel fragments are expected to sink due to their density. While it is possible that a stainless-steel sheet may float under certain sea conditions, it is likely to eventually sink due to wave action. Thermal tiles and matting are made of silica and are expected to float. Unrecovered debris may be ingested by ESA-listed species foraging in the landing area. In a recent global review on ingested marine debris, a majority of 46 mortalities in marine mammals were caused by ingestion of film-like plastic (e.g., plastic bags), plastic fragments (hardness not specified), rope/nets, and fishing debris (Roman et al. 2021). Based on the aforementioned studies on debris ingestion, it appears unlikely that ESA-listed species would ingest the following debris types: stainless steel, thermal tiles, matting, and COPVs. Cork, plastic, and adhesive would likely float if not destroyed during the explosive event. Given that plastic is flammable, it is likely that any plastic on Starship would be incinerated and would not survive to the ocean. Cork is a well-known insulation material, especially for thermal insulation, and studies show that cork and composite cork have relatively low flammability and may be useful in fire retardants and thermal protection, but during an explosive event, it is unlikely that cork would survive due to the breakdown of the cork into dust, which becomes extremely flammable. Given the large expanse of ocean, distribution over which ESA-listed species may occur and be foraging in those areas, and relatively small addition of Starship debris to the overall debris in the ocean, it is unlikely that ESA-listed species would encounter a piece of Starship debris and ingest it. In summary, the potential effects to ESA-listed species from unrecovered debris are discountable.

Therefore, effects from unrecovered debris may affect, but are not likely to adversely affect, ESA-listed marine species.

4.4 Impacts from pollution (vessel and vehicle emissions, propellant)

Pollutants emitted by vessels used during Starship-Super Heavy surveillance or recovery operations can include exhaust (carbon dioxide, nitrogen oxides, and sulfur oxides), and fuel or oil spills or leaks. These pollutants may affect air-breathing ESA-listed species such as marine mammals. It is unlikely that pollutants in the air would have a measurable impact on ESA-listed marine mammals given the relatively short duration of vessel operations (approximately five days for each launch with a recovery), dispersion of pollutants in the air, and the brief amount of time that marine mammals spend at the water's surface to breathe. Thus, the effects of pollutants in the water on ESA-listed species will be so small as to be immeasurable (insignificant). In the event that Starship residual propellant ends up in the ocean, residual propellant is expected to evaporate or be diluted relatively quickly due to surface currents and ocean mixing. It is unlikely that residual propellant measurably contributes to the overall pollutant levels in the contingency landing area given the limited number of times Starship will be expended (and residual propellant would reach the ocean), and the large action area. The effects of residual propellant in the ocean on ESA-listed species are immeasurable and, thus, insignificant.

Therefore, effects from pollution (vessel and vehicle emissions, propellant) may affect, but are not likely to adversely affect, ESA-listed marine species.

4.5 Vessel presence, strike, and noise

Vessel presence may disturb animals, vessel strike may result in injury or mortality, and vessel noise may cause disturbance because of elevated noise levels. The duration of vessel operations lasts approximately five days for recovery. The proposed action has a limited amount of vessel activity, especially compared to the amount of recreational and commercial vessel traffic in the action area. Given the relatively small contribution of the vessels associated with the proposed action to the overall vessel activity, effects from vessel presence are expected to be so minor that they cannot be meaningfully evaluated and are thus insignificant. The potential for a vessel striking an ESA-listed species is unlikely because the proposed action consists of relatively little vessel use. Furthermore, ESA-listed marine mammals may spend time at or near the ocean surface but generally spend most of their time underwater where they would not be exposed to vessel strikes. SpaceX would comply with the "Vessel Operations" conservation measures listed in the 2025 BCO to avoid or minimize the potential for effects. Noise from vessels may produce an acoustic disturbance or otherwise affect ESA-listed species that spend time near the surface which may generally disrupt their behavior. Studies have shown that vessel operation can result in changes in the behavior of marine mammals; however, vessel noise will not exceed that of larger commercial shipping vessels and will only be temporary. The potential effects to ESA-listed species from vessel presence, strike, and noise are discountable or insignificant.

Therefore, vessel presence, strike, and noise may affect, but are not likely to adversely affect, ESA-listed marine species.

4.6 Aircraft overflight

Noise from aircraft overflight may enter the water, but as stated in relation to sonic booms and impulse noise, very little of that sound is transmitted into water. Sound intensity produced at high altitudes is reduced when it reaches the water's surface. At lower altitudes, the perceived noise will be louder, but it will decrease rapidly as the aircraft moves away. ESA-listed species that occur at or very near the surface at the time of an overflight could be exposed to some level of elevated sound from aircraft overflights. There could also be a visual stimulus from the overflight that could potentially lead to behavioral response. Both noise and visual stimulus impacts would be temporary and only occur if an individual is surfacing or very close to the surface at the same time an aircraft is flying over. Studies have shown minor behavioral effects (e.g., longer time to first vocalization, abrupt dives, shorter surfacing periods, breaching, tail slaps) in marine mammals exposed to repeated fixed wing aircraft overflights (Patenaude et al., 2002; Richter et al., 2003; Smultea et al., 2008; Würsig et al., 1998). However, most of these responses occurred when the aircraft was below altitudes of approximately 250 m, which is lower than the altitude to be flown by aircraft during surveillance for the activities considered. In accordance with the "Aircraft Procedures" conservation measures listed in the 2025 BCO, SpaceX would avoid flying in circles if marine mammals or sea turtles are spotted and avoid any type of harassing behavior. Given the limited and temporary behavioral responses documented in available research, the potential effects to ESA-listed species from aircraft overflight are insignificant.

Therefore, aircraft overflights may affect, but are not likely to adversely affect, ESA-listed marine species.

4.7 In-air acoustic effects from Starship landings and explosive events

ESA-listed species that surface to breathe may be exposed to the in-air acoustic effects from a Starship contingency landing or explosive event. To be exposed to this stressor, ESA-listed marine mammals would have to be in the exact same place at the exact same time that Starship lands, or an explosive event subsequently occurs. ESA-listed marine mammals spend very little time at the surface, and generally only spend a few seconds to breathe before diving back underwater. Landings, whether they result in an explosive event or not, of Starship will occur 25 times in the contingency landing area. Therefore, given the limited number of landings and explosive events, and the large areas over which ESA-listed species can be distributed, it is extremely unlikely that ESA-listed species will be exposed to in-air acoustic effects from vehicle landings and explosive events and, thus, the effects are discountable.

Therefore, in-air acoustic effects from vehicle landings and explosive events may affect, but are not likely to adversely affect, ESA-listed marine species.

4.8 Heat from vehicle landings and explosive events

Heat from a vehicle landing (produced by engines during the landing burn) or explosive event may affect ESA-listed marine mammals. An explosive event would result in a temporary but significant increase in temperatures at the surface of the ocean because of the burning of propellant. To be exposed to this stressor, ESA-listed species would have to be in the exact same place at the exact same time that Starship lands or an explosive event subsequently occurs. ESA-listed species spend a vast majority of time underwater, and it is unlikely species will occur at the surface at the same time. Therefore, given the limited number of landings and explosive events and limited time ESA-listed marine mammals spend at the surface, it is extremely unlikely that ESA-listed species will be exposed to heat from vehicle landings and explosive events.

Therefore, heat from vehicle landings and explosive events may affect, but is not likely to adversely affect, ESA-listed marine species.

4.9 Underwater acoustic effects from explosive events

Overpressure events from explosions generated during certain expended landings of Starship may affect marine species within the action area. Individuals, if in close proximity to the landing location and subsequent explosion, could be at risk of mortality, physical injury, auditory injury (AUD INJ) (formerly referred to as permanent threshold shift), temporary threshold shift (TTS), or behavioral changes that would be considered *take*. NMFS developed criteria thresholds defining the onset of TTS and AUD INJ in marine mammals and sea turtles based on species' hearing sensitivities over a range of frequencies (Table 4-1; National Marine Fisheries Service, 2024).

Table 4-1: AUD INJ onset and TTS onset thresholds (unweighted peak sound pressure level) for underwater impulsive noise

Hearing Group	AUD INJ (dB re 1 μPa)	TTS (dB re 1 μPa)
Low-Frequency Cetaceans	222	216
High-Frequency Cetaceans	230	224
Very High-Frequency Cetaceans	202	196
Otariid Pinnipeds (underwater)	230	224
Sea Turtles	230	224

Source: National Marine Fisheries Service, 2024

The FAA independently evaluated and approved an analysis methodology developed by SpaceX that relies on the robust application of scientific principles; an estimation of the necessary coefficients based on available, existing reference data; and the application of appropriate species harassment thresholds taken directly from NMFS. This analysis was used to estimate the affected area from the explosive event over which NMFS thresholds could be exceeded for ESA-listed species, if present.

Calculating the potentially affected area within which ESA-listed species could be affected is one of the required inputs for conducting a quantitative analysis of potential impacts to marine species. Data on the abundance and distribution (i.e., density) of marine mammals in the potentially affected area is also required to conduct a quantitative analysis of potential impacts. These data are presented in Table 3-1.

Upon impact with the ocean surface, Starship would have approximately 31 metric tons of propellant remaining in the header tanks and 70 metric tons remaining in the main tanks.

For the header tanks, an explosive weight of 3,647 kilograms (kg) was used based on an 11.9 percent explosive yield, which is highly conservative value based on a simulation of uncontained mixing between two close coupled masses of propellant and no barriers impeding their mixing, comparable to the conditions of the intact impact at terminal velocity of the Starship header tanks against the ocean surface. For the main tanks, an explosive weight of 6,300 kg was used based on a 9 percent explosive yield. The analysis for 9 percent yield was used in the 2025 consultation, and due to the small variation in propellant mass and small change to the propellant mass fill geometry, the assumption that the manner of propellant mixing will remain consistent is still appropriate. For Starship, the peak sound pressure level would remain the same as in the 2025 consultation (267.7 decibels [dB]).

Two sets of predicted auditory effects on ESA-listed marine mammals were estimated using 1) the maximum species density in the action area and 2) the average species density across the action area. The maximum species densities were used in the calculation to predict a conservative estimate of the number of exposures potentially affecting each species. The average density for each species was calculated by averaging all available density values within the action area. The average density was used to predict the number of exposures that are more likely to result from a landing than the number based on the maximum density. Results using the average density can provide context to results based on the maximum density, particularly in cases where the maximum density predicts a substantially higher number of exposures than the average density. For example, the maximum density for humpback whales occurs off Oregon in an isolated location on the eastern boundary of the action area and is not representative of the vast majority of the action area. Humpback whales prefer shallower water over the continental shelf, and the density data reflect that preference. A landing would need to occur within a 10 km^2 area at the eastern boundary of the action area to result in the number of exposures predicted using the maximum species density. Reporting predicted exposure using the average density, which is an order of magnitude lower than the maximum, provides context.

The results of the calculations are shown in Table 4-1 for 1 landing event involving an explosion. No exposures exceeding either the maximum AUD INJ or TTS thresholds are predicted for any ESA-listed species. SpaceX is proposing up to 20 landing events with an explosion in the Northern Contingency Landing Area. The events would be dispersed within the action area and separated in space and time such that effects on any one animal due to an explosion would not accumulate. Therefore, the predicted number of exposures shown in Table 4-1 are applicable to all 20 events, and no AUD INJ or TTS exposures to any ESA-listed species would occur from the 20 explosive events over the 4-year authorization period.

While the proposed action is to conduct 20 landings with an explosive event, multiplying the predicted exposures from a single event by 20 does not represent the potential effects from 20 discrete events occurring in different locations in the action area (Figure 4-2).

(1) In the current approach to analysis, the exposures from a single event are multiplied 20-fold to represent the potential impacts from 20 events. This approach overpredicts the number of exposures from 20 independent explosive events.

(2) The analysis assumes the same animal would be affected during all 20 explosive events. The probability of this happening is so small that it is essentially impossible.

   a. Assuming the surface area of a blue whale (the largest species) is approximately 325 meters squared (m^2), Starship has an area of approximately 630 m^2, and the action area is approximately 11,653,432 m^2, the probability of Starship exploding near a blue whale is estimated as

      i. $P = (A_{BW} + A_S)/A_{AA} = 8.2 \times 10^{-5}$ for a single event.

      (note: AA = action area; BW = blue whale; S = Starship)

   b. The probability that the same whale is near the explosive event 20 times is statistically impossible (see supplemental calculations below)

      i. $P = 10^{-3000}$.

Using the blue whale gives us the highest probability of occurrence due to its size. The probability that a smaller species would be affected by all 20 events is even lower. Each of the 20 proposed landing events would be separated in space and time within the 11,653 km^2 contingency landing area over a period of four years and result in the number of effects predicted for a single event (Table 4-1). Based on the calculation estimating the TTS harassment area (Table 4-1) for LF cetaceans, the range to TTS effects would be approximately 384 m from the landing site, and the corresponding area of TTS effect (0.46 km^2) is just 0.0040% of the Contingency Landing Area, indicating the probability that the same habitat and animals would be affected more than once is remote.

While 20 events would have a greater effect than a single event, the effects would be distributed across time and space and would be very unlikely to accumulate for individual animals or species' populations..

No exposures to ESA-listed species exceeding the AUD INJ or TTS thresholds based on maximum species densities are predicted for a single landing event; therefore, underwater acoustic effects from explosive events may affect, but are not likely to adversely affect, ESA-listed marine species.

Blast Inputs	
TNT Yield (kg)	4973.68
Surface Pressure in air (kPa)	12111.15
Surface Pressure in Water (kPa)	24210
Peak SPLwater dB (re 1 uPa)	267.7
# of Flights	1.0

Enter 4.5m Incident Pressure from https://unsaferguard.org/un-saferguard/kingery-bulmash

INPUTS	CALCS	RESULTS

ESA Species — **ESA SPL**

Species Data (NE and Tropical Pacific)			NMFS Thresholds (dB re 1 uPa)		Harassment Area		Species		Species Harassment Results Average Densities		
Species	Type	Max. Density(per km^2)	AUD INJ	TTS	AUD INJ (km2)	TTS (km2)	AUD INJmax	TTSmax	Ave. Density(per km2)	AUD INJave (per km2)	TTSave (per km2)
Blue Whale	LF cetacean	0.000821	222	216	0.12	0.46	0.000095	0.000380	0.00041	0.000048	0.000190
Fin Whale	LF cetacean	0.019306	222	216	0.12	0.46	0.002243	0.008930	0.010606	0.001232	0.004906
Humpback Whale (Summer)	LF cetacean	0.19267	222	216	0.12	0.46	0.022385	0.089117	0.024802	0.002882	0.011472
North Pacific Right Whale	LF cetacean	0.00003	222	216	0.12	0.46	0.000003	0.000014	0.000019	0.000002	0.000009
Sei Whale	LF cetacean	0.0004	222	216	0.12	0.46	0.000046	0.000185	0.00038	0.000044	0.000176
Sperm Whale	HF cetacean	0.004076	230	224	0.02	0.07	0.000075	0.000299	0.00148	0.000027	0.000108
Guadalupe fur seal	OCW	0.22007	230	224	0.02	0.07	0.004052	0.016133	0.08764	0.001614	0.006425

Turtle Species Data (NE and Tropical Pacific)			NMFS Thresholds (dB re 1 uPa)		Harassment Area		Species	
Species	Type	Uniform Density(per km^2)	AUD INJ	TTS	AUD INJ (km2)	TTS (km2)	AUD INJuni	TTSuni
Leatherback Sea Turtle	Turtle	0.00200	230	224	0.02	0.07	0.000037	0.000147

Figure 4-1: Proposed Northern Pacific Contingency Landing Area ESA-Listed Species Effects From One Explosive Event

Blast Inputs	
TNT Yield (kg)	4973.68
Surface Pressure in air (kPa)	12111.15
Surface Pressure in Water (kPa)	24210
Peak SPLwater dB (re 1 uPa)	267.7
# of Flights	20.0

Enter 4.5m Incident Pressure from https://unsaferguard.org/un-saferguard/kingery-bulmash

INPUTS	CALCS	RESULTS

ESA Species

ESA SPL

Species Data (NE and Tropical Pacific)			NMFS Thresholds (dB re 1 uPa)		Harassment Area		Species		Species Harassment Results Average Densities		
Species	**Type**	**Max. Density(per km^2)**	**AUD INJ**	**TTS**	**AUD INJ (km2)**	**TTS (km2)**	**AUD INJmax**	**TTSmax**	**Ave. Density(per km2)**	**AUD INJave (per km2)**	**TTSave (per km2)**
Blue Whale	LF cetacean	0.000821	222	216	0.12	0.46	0.001908	0.007595	0.00041	0.000953	0.003793
Fin Whale	LF cetacean	0.019306	222	216	0.12	0.46	0.044861	0.178595	0.010606	0.024645	0.098113
Humpback Whale (Summer)	LF cetacean	0.19267	222	216	0.12	0.46	0.447703	1.782338	0.024802	0.057632	0.229437
North Pacific Right Whale	LF cetacean	0.00003	222	216	0.12	0.46	0.000070	0.000278	0.000019	0.000044	0.000176
Sei Whale	LF cetacean	0.0004	222	216	0.12	0.46	0.000929	0.003700	0.00038	0.000883	0.003515
Sperm Whale	HF cetacean	0.004076	230	224	0.02	0.07	0.001501	0.005976	0.00148	0.000545	0.002170
Guadalupe fur seal	OCW	0.22007	230	224	0.02	0.07	0.081047	0.322654	0.08764	0.032276	0.128493

Turtle Species Data (NE and Tropical Pacific)			NMFS Thresholds (dB re 1 uPa)		Harassment Area		Species	
Species	**Type**	**Uniform Density(per km^2)**	**AUD INJ**	**TTS**	**AUD INJ (km2)**	**TTS (km2)**	**AUD INJuni**	**TTSuni**
Leatherback Sea Turtle	Turtle	0.00200	230	224	0.02	0.07	0.000737	0.002932

Figure 4-2: Proposed Northern Pacific Contingency Landing Area ESA-Listed Species Effects From Twenty Explosive Events

The supplemental analysis referenced above is provided below, where the probability *P* is estimated as:

$$P \approx \frac{A_o + A_a}{A_t} = \frac{718}{11{,}653{,}432} \approx 6.16 \times 10^{-5}$$

And the duration of the 4 year timeframe for the Proposed Action in seconds is calculated as:

$$n = 4 \times 365.25 \times 24 \times 3600 = 126230400$$

The number of times (λ) the animal is next to the object (Starship) is:

$$\lambda = np \approx 126230400 \times \frac{718}{11653432} \approx 7777.$$

The probability that the same whale and Starship will be in proximity 20 times is estimated using the following equation:

$$P(X = 20) = \binom{n}{20} p^{20}(1-p)^{n-20} \approx \frac{e^{-\lambda}\lambda^{20}}{20!}$$

$$P(X = 20) \approx \frac{e^{-7777.4} \times (7777.4)^{20}}{20!}$$

The standard deviation (*z*) is estimated as:

$$z = \frac{20 - 7777.4}{88.2} \approx -88$$

Using Stirling's approximation for the factorial term shows 20! is large but utterly negligible compared to the exponential decay of $e^{-\lambda}$, and λ^{20} is very small relative to the peak of $\lambda^{7,777}$.

The Poisson probability mass is overwhelmingly concentrated in a narrow band around 7,777 ± a few hundred. At 20 (which is ~88 standard deviations), the probability density has dropped by many orders of magnitude beyond what any physical system could ever realize $10^{-3,000}$. Therefore, it is statistically impossible for 20 events to result in 20 times the number of exposures from a single event.

5 Determination of Effect

Based on the analysis of potential effects to ESA-listed species from the action's stressors presented in Section 4, the following table summarizes the effects determination for each species potentially occurring in the action area.

Table 5-1: Species Effects Determinations

Species	Stock (DPS)[1]	ESA-Status	Species Effects Determination
Fishes			
Giant manta ray (*Manta birostris*)	n/a	Threatened	NLAA
Oceanic whitetip shark (*Carcharhinus longimanus*)	n/a	Threatened	NLAA
Scalloped hammerhead shark (*Sphyrna lewini*)	Eastern Pacific	Endangered	NLAA
Chum Salmon (*Oncorhynchus keta*)	Hood Canal Summer-Run ESU	Threatened	NLAA
	Columbia River ESU	Threatened	NLAA
Sockeye Salmon (*Oncorhynchus nerka*)	Ozette Lake ESU	Threatened	NLAA
	Snake River ESU	Endangered	NLAA
Steelhead (*Oncorhynchus mykiss*)	Puget Sound	Threatened	NLAA
	Upper Columbia River	Endangered	NLAA
	Middle Columbia River	Threatened	NLAA
	Lower Columbia River	Threatened	NLAA
	Upper Willamette River	Threatened	NLAA
	Snake River Basin	Threatened	NLAA
	Northern California	Threatened	NLAA
	California Central Valley	Threatened	NLAA
	Central California Coast	Threatened	NLAA
Sea Turtles			
Leatherback sea turtle (*Dermochelys coriacea*)	n/a	Endangered	NLAA
Marine Mammals			
Sei whale (*Balaenoptera borealis)*	Eastern North Pacific	Endangered	NLAA
Blue whale (*Balaenoptera musculus*)	Eastern North Pacific	Endangered	NLAA
Fin whale (*Balaenoptera physalus)*	CA/OR/WA	Endangered	NLAA
	Northeast Pacific	Endangered	NLAA

Species	Stock (DPS)[1]	ESA-Status	Species Effects Determination
North Pacific right whale (*Eubalaena japonica*)	Eastern North Pacific	Endangered	NLAA
Humpback whale (*Megaptera novaeangliae*)	Mexico- North Pacific (Mexico)	Threatened	NLAA
	Mainland Mexico-CA-OR-WA (Mexico)	Threatened	NLAA
	Central America-Southern Mexico-CA-OR-WA (Central America)	Endangered	NLAA
	Western North Pacific (Western North Pacific)	Endangered	NLAA
Sperm whale (*Physeter macrocephalus*)	CA/OR/WA	Endangered	NLAA
	North Pacific	Endangered	NLAA
Guadalupe fur seal (*Arctocephalus townsendi*)	Mexico	Threatened	NLAA

[1]Unless otherwise noted, all fish populations are DPSs (not stocks). Marine mammal populations are managed as stocks; however, some populations are also organized into DPSs.
DPS = Distinct Population Segment, ESU = Evolutionarily Significant Unit, n/a = Not Applicable, ESA = Endangered Species Act, NLAA = May Affect, but Not Likely to Adversely Affect, CA = California, OR = Oregon, WA = Washington

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APPENDIX B

USFWS REINITIATED BIOLOGICAL OPINION

Biological Assessment of SpaceX Starship Reentry Operations in Support of

Endangered Species Act Section 7 Consultation with the United States Fish and Wildlife Service

22 June 2026

Prepared for

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ACRONYMS AND ABBREVIATIONS

BA	Biological Assessment
BCO	Biological Conference Opinion
DPS	Distinct Population Segment
EEZ	Exclusive Economic Zone
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FR	Federal Register
Hz	hertz
kg	kilogram(s)
kHz	kilohertz
km	kilometer(s)
m	meter(s)
mi	mile(s)
MMPA	Marine Mammal Protection Act
NLAA	not likely to adversely affect
nm	nautical mile(s)
nm^2	square nautical mile(s)
NLAA	not likely to adversely affect
NMFS	National Marine Fisheries Service
SpaceX	Space Exploration Technologies Corporation
U.S.	United States
USFWS	United States Fish and Wildlife Service

1 Introduction

1.1 Background & Purpose of Current Consultation

The purpose of this Biological Assessment (BA) is to evaluate potential impacts on species listed under the Endangered Species Act (ESA) under the authority of the United States Fish and Wildlife Service (USFWS) resulting from the Federal Aviation Administration (FAA) Office of Commercial Space Transportation's Proposed Action. Issuing a reentry license is considered a major federal action under the National Environmental Policy Act of 1969, as amended, and FAA Order 1050.1G, FAA National Environmental Policy Act Implementing Procedures (issued 30 June 2025), and requires an environmental review. The Proposed Action is Space Exploration Technologies Corporation's (SpaceX) proposal to obtain a license modification from FAA to land the Starship vehicle in the Northern Pacific Basin (south of the Aleutian Islands SpaceX also intends to expend Starship in the previously evaluated landing areas in the Hawaii and Central Pacific Basin (southwest of the Hawaiian Islands) as an additional contingency landing location for Starship. SpaceX seeks to perform reentries of vehicles to transport and deliver material through space.

This consultation builds upon previous regulatory reviews. FAA previously consulted with the USFWS under the comprehensive formal ESA Section 7 Consultation conducted for *SpaceX Starship-Super Heavy Launch and Landing Operations at Launch Complex-39A*, which included a Final Biological and Conference Assessment submitted in May 2025 , and the subsequent USFWS Biological Conference Opinion (BCO) issued on 20 October 2025, for the same potential impacts during Starship reentry and recovery activities on the band-rumped storm-petrel (*Oceanodroma castro*), Hawaiian petrel (*Pterodroma sandwichensis*), Newell's shearwater (*Puffinus auricularis newelli*) and short-tailed albatross (*Phoebastria albatrus*) and determined that noise, light, activity, sonic booms, vibration, heat and vapor plume exposure may effect, but was not likely to adversely affect each of these species (Consultation Number 02ETCC00- 2012-F-0186-R001; 2023-0087412). FAA is reinitiating consultation with USFWS on this Proposed Action due to the addition of new proposed contingency landing areas in the Pacific Ocean. No additional ESA-listed species under USFWS jurisdiction are present within the proposed landing areas.

2 Description of the Action and the Action Area

2.1 Proposed Action

FAA's Federal Action is to modify SpaceX's existing vehicle operator license to authorize SpaceX's proposed action to expand Starship in contingency landing locations, including the previously approved Hawaii and Central Pacific Region. SpaceX will also expand Starship in additional contingency landing areas, not previously analyzed, in the Northern Pacific.

The baseline pre-flight operations, pad commodities, and land-bound production or manufacturing parameter constraints remain unchanged from prior consultations and are considered part of the environmental baseline.

2.1.1 Action Area

2.1.1.1 Hawaii and Central Pacific Contingency Landing Area (southwest of the Hawaiian Islands)

The prior USFWS section 7 consultation analyzed no more than 25 in-flight breakups, 25 soft water landings, and 20 explosive events of Starship in each portion of the action area analyzed within that document (**Figure 2-1**, Hawaii and Central Pacific Approved Landing Area, purple region). The new Proposed Hawaii and Central Pacific Contingency Landing Area (**Figure 2-1**, green region) would be absorbed into the greater Approved Landing Area (**Figure 2-1**, purple region) and include the already approved 25 in-flight breakups, 25 soft water landings, and 20 explosive events.

The Previously Approved Landing Area has been previously analyzed and contains the same species as the prior consultations and will therefore not be reanalyzed. The Proposed Hawaii and Central Pacific Contingency Landing Area is 200 nautical miles (nm) from the Hawaiian Islands and outside of the Economic Exclusion Zone (EEZ) and the Papahānaumokuākea Marine National Monument, which contains a 50nm buffer around Marine National Monument in addition to the 200 nm EEZ (**Figure 2-1**).

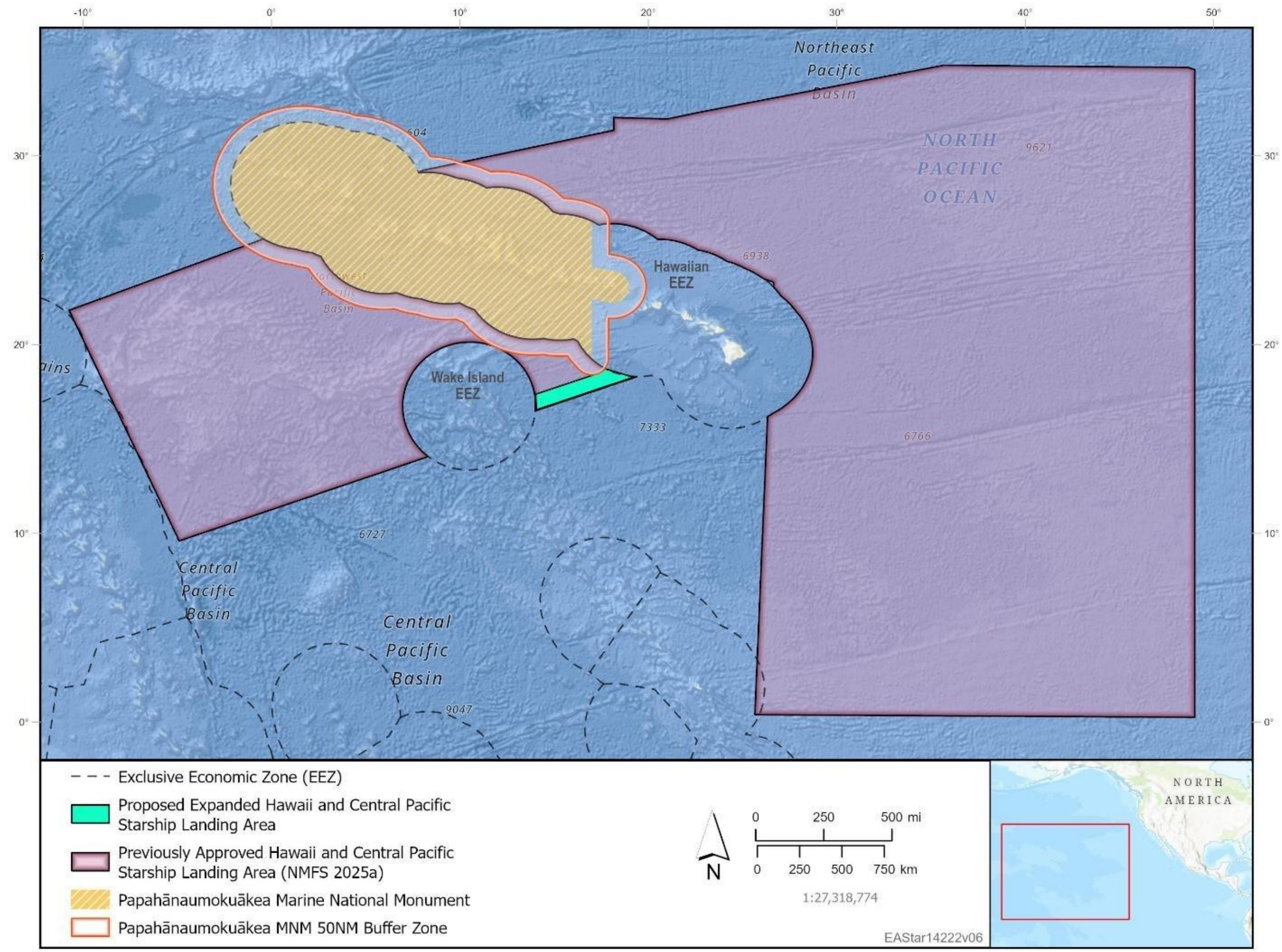

Figure 2-1. Hawaii and Central Pacific Proposed Contingency Landing Area and Previously Approved Contingency Landing Area

2.1.1.2 Northern Pacific Contingency Landing Area (south of the Aleutian Islands and west of Oregon and Hawaii)

This BA analyzes up to 25 in-flight breakups, 25 soft water landings, and 20 explosive Starship events in the new Proposed Northern Pacific Contingency Landing Area (Figure 2-2). Nominal reentry and recovery operations would be performed within the Proposed Northern Pacific Contingency Landing Area would and occur no closer than 70 nm south of the Aleutian Islands and 70 nm west of Oregon and California in the designated yellow area in Figure 2-2 within the Northern Pacific Basin. and include Starship nominal reentry and recovery operations. The Proposed Northern Contingency Landing Area is within the U.S. EEZ south of Alaska and east of the contiguous U.S. (Figure 2-2).

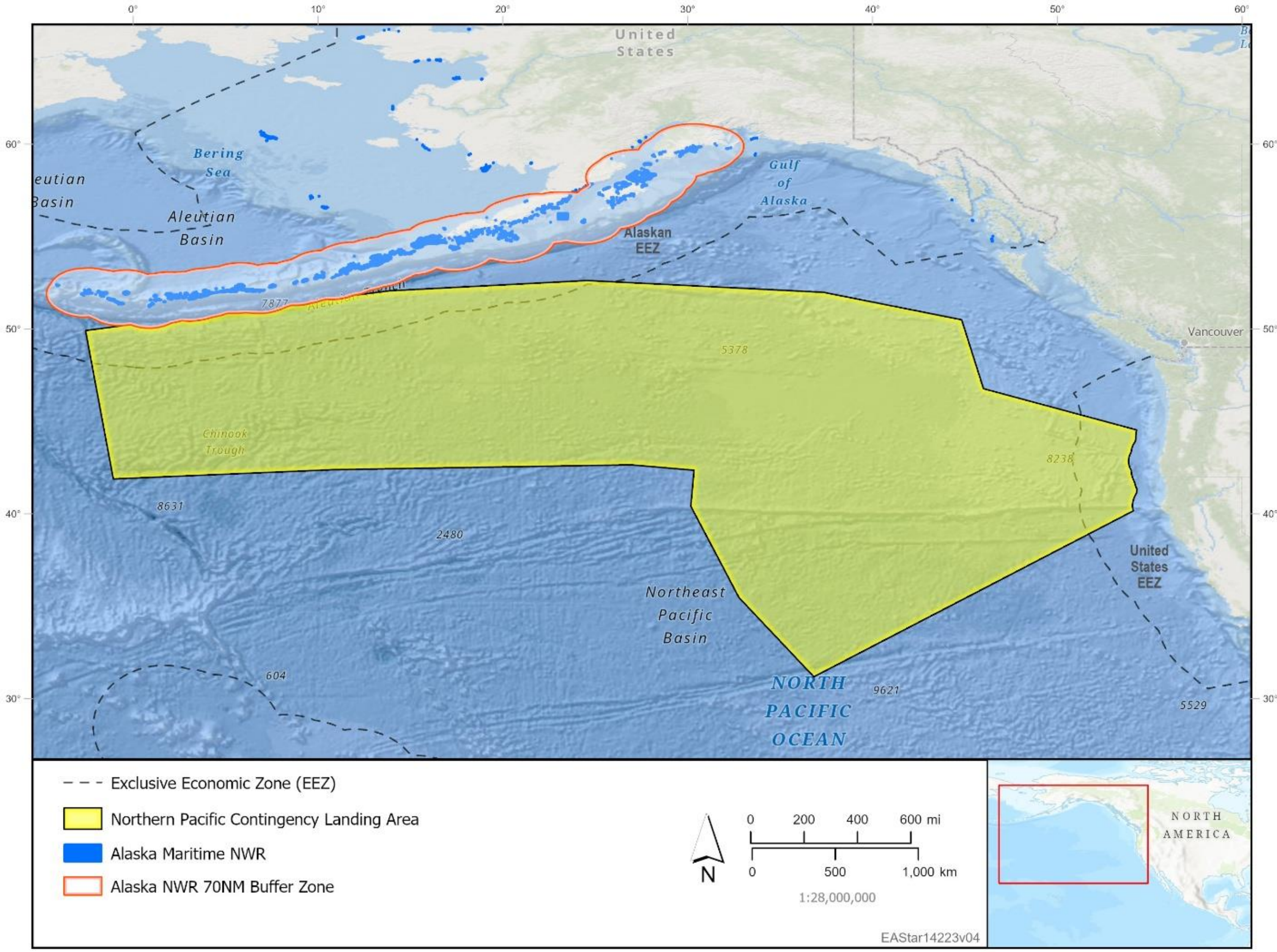

Figure 2-2 Northern Pacific Contingency Landing and Starship Landing at Starbase TX

2.1.2 Starship Reentry Operations

SpaceX anticipates recovery operations to be an infrequent occurrence given the goals of the reusable concept. SpaceX recovery personnel would follow standard salvage procedures in compliance with applicable state and Federal requirements for the salvage activity. Although unlikely, to prevent debris from a Starship explosive event or in-flight breakup from entering the Papahānaumokuākea National Marine Sanctuary, SpaceX will have a vessel in the area of highest likelihood of debris that will identify large debris for salvage. SpaceX will use the vessel to survey for debris for approximately 24–48 hours (using visual survey in the daytime and onboard vessel radar at night) depending on the outcome of the breakup. If there is floating debris detected by the vessel during the debris survey, SpaceX will sink or recover any debris before it can drift into the Papahānaumokuākea National Marine Sanctuary by removing the item using a net or boat hook, or puncturing the item using a firearm to cause it to sink. If debris is still identified after the 24–48 hour survey, SpaceX will use an aerial asset, additional vessel, or satellite imaging, to confirm and characterize any debris to verify that debris sinks within 10 days.

Starship is designed to be fully reusable, but while working towards reliability for Starship, landing site potential issues could necessitate Starship be expended in the contingency landing area up until October 2030.

2.2 Conservation Measures

SpaceX and FAA implement numerous protocols and procedures to assess, avoid, mitigate, and minimize potential risks to ESA-listed species during reentry operations. The conservation measures outlined for the Hawaii and Central Pacific region remain the same as outlined in the USFWS BCO. The proposed conservation measures for the Northern Pacific Region are described below:

2.2.1 Measures Applicable to Reentry

- Reentry activities (e.g. vehicle atmospheric reentry and landing) will occur in the proposed action area at least 70 nm offshore the coast of the U.S. or islands. The only operations component that will occur near shore will be watercraft transiting to and from a port when recovering reentry vehicle components, or possibly for surveillance.

2.2.2. Measures Applicable to Operations of Support Vessels

- SpaceX will ensure that all personnel associated with vessel support operations are instructed about seabird species and any critical habitat protected under the ESA that could be present in the proposed landing area. Personnel will be advised of the civil and criminal penalties for harming, harassing, or killing ESA-listed species.
- SpaceX will immediately report any injuries or mortalities to ESA-listed species to the appropriate USFWS contact.

3 Description of the Species

The ESA-listed endangered and threatened species that may be affected by the Action were developed by reviewing USFWS endangered species web sites, scientific literature, available reports, IPaC, and consulting with species experts.

Table **3-1** lists the ESA-listed species and designated critical habitat under USFWS jurisdiction that may occur within the Action Area.

Table 3-1. ESA-listed Species Occurring or Potentially Occurring in the Action Area.

Common Name	Scientific Name	DPS	ESA Status	Location of Critical Habitat
Band-rumped Storm Petrel	*Hydrobates castro*	Hawaii	Endangered	N/A
Hawaiian Petrel	*Pterodroma sandwichensis*	-	Endangered	N/A
Newell’s Shearwater	*Puffinus newelli*	-	Threatened	N/A
Short-tailed Albatross	*Phoebastria albatrus*	-	Endangered	N/A

Notes: DPS=Distinct Population Segment, ESA=Endangered Species Act

3.1 Designated Critical Habitat

Critical habitat has not been designated for the Band-rumped storm petrel, Hawaiian petrel, Newell’s shearwater, or the short-tailed albatross.

3.2 Band-rumped Storm Petrel

The USFWS listed the Hawaii Distinct Population Segment (DPS) of the band-rumped storm-petrel as federally endangered on 30 September 2016 (81 Federal Register [FR] 67786). Band-rumped storm-petrels primarily nest in remote, high-elevation locations in the Hawaiian Islands, including the islands of Kauaʻi, Hawaiʻi, Lehua, and potentially Maui and Lānaʻi (USFWS 2015, 2021). The species is highly philopatric to its nesting areas, utilizing natural cavities in barren lava fields or crevices on steep, vegetated cliffs (Wood et al. 2002, USFWS 2015). In the Hawaiian archipelago, the breeding cycle typically occurs from May through October, with egg-laying in mid-June and fledging in October (Raine et al. 2017a). During this period, adults often forage in coastal waters and may form "rafts" offshore while awaiting nightfall to return to their colonies (Harrison et al. 1990).

The total population size of the Hawaii DPS is currently unknown due to the cryptic nature of the species and the inaccessibility of its nesting sites, though it is estimated to be in the low hundreds of breeding pairs (KESRP 2021). Global population estimates vary widely from 20,000 to 200,000 individuals across the Atlantic and Pacific basins (BirdLife International 2018). In the North Pacific, band-rumped storm-petrels are broadly distributed while foraging, with sightings recorded over

600 mi (966 km) north and 1,000 mi (1,609 km) south of the Hawaiian Islands (KESRP 2021). Outside of the breeding season (November through April), the species is largely absent from its known nesting areas and is thought to disperse across the tropical and subtropical Pacific Ocean (Pyle et al. 2016, USFWS 2021). Given their low population density and vast foraging range, they are likely to occur in the Action Area only in very low densities.

3.3 Hawaiian Petrel

The USFWS listed the Hawaiian petrel as federally endangered on 11 March 1967, pursuant to the ESA. After fledging, Hawaiian petrels spend the first several years of their lives at sea and do not typically begin breeding until they are six years old. Individuals may not breed each year, but live greater than 30 years. This species primarily preys on squid but also feeds on fish, crustaceans, and plankton. Hawaiian petrel ranges in the central Pacific Ocean and breeds only in the main Hawaiian Islands, though there are specimen records from Japan, Philippines, and Moluccas at the western edge of the distribution. Most of the Hawaiian petrel global population breeds on the island of Maui within Haleakala National Park. The Hawaiian petrel typically feeds far offshore but tends to feed closer to shore during spring than in the fall. This species favors open ocean water conditions. It occurs largely in equatorial waters of the eastern tropical Pacific, generally from 10 degrees South to 20 degrees North. The Hawaiian petrel may occur in open ocean waters in the Action Area, but given the vast expanse of the ocean that these birds inhabit, their at-sea density is relatively low.

3.4 Newell's Shearwater

The USFWS listed the Newell's shearwater as federally threatened on 28 October 1975 (40 FR 44149). Newell's shearwaters are endemic to the Hawaiian Islands, with the largest remaining breeding colonies located on the island of Kauaʻi, particularly within the mountainous interior (USFWS 2017). This species is colonial and exhibits high site fidelity, nesting in burrows typically situated on steep, heavily vegetated slopes dominated by uluhe fern (Ainley et al. 1997). The breeding season spans from April to November, with adults returning to colonies in April and chicks fledging in October and November (Raine et al. 2017b). During the incubation and chick-rearing phases, adults forage over deep pelagic waters, often traveling hundreds of kilometers from the nesting site (Day and Cooper 1995).

The total population is estimated at approximately 21,000 to 25,000 individuals, though the species has experienced a precipitous decline—estimated at 94% between 1993 and 2013—primarily due to predation by invasive species and fallout caused by light attraction (Raine et al. 2017b, USFWS 2020). While concentrated around Kauaʻi during the breeding season, Newell's shearwaters forage extensively across the tropical and subtropical North Pacific Ocean (Suryan et al. 2007, USFWS 2017). Outside of the breeding season, they migrate to the equatorial Pacific, specifically the Intertropical Convergence Zone (Adams and Takekawa 2012). Consequently, the species may be encountered throughout the Action Area, though they are likely found in low densities outside of their primary foraging corridors.

3.5 Short-tailed Albatross

The USFWS listed the short-tailed albatross as federally endangered on 31 July 2000 (65 FR 46643). Short-tailed albatross primarily nest on Torishima Island in the Izu Islands of Japan (USFWS 2008). This species is monogamous and philopatric to nesting areas and breeds at 5 or 6 years of age. During the incubation and brooding cycle (October through June) adults forage in the coastal waters of Honshu Island, Japan (Suryan et al. 2008). Adults leave the nesting colony in Late May and early June, chicks fledge soon after, dispersing across the North Pacific Ocean (Austin 1949). There are approximately 7,365 individuals, primarily concentrated around the breeding islands of Torishima and the Senkaku Islands, making their density relatively high in those areas, but very low across the vast expanse of the Pacific Ocean. In the summer, short-tailed albatross forage found throughout the North Pacific Ocean (Sanger 1972, Suryan et al. 2007) and therefore may be found in the Action Area in very low densities.

4 Effects of the Action

As stated in the previous USFWS BCO, effects from the Proposed Action on the four listed seabird species were analyzed. Band-rumped storm-petrels, Hawaiian petrels, Newell' shearwaters, and short-tailed albatrosses foraging in the Pacific landing areas could be exposed and subsequently startled by landings and other activities associated with Starship expenditures. The duration of vessel operations lasts approximately five days for recovery.

4.1 Lighting

As with seabirds in the Atlantic (2025 USFWS BCO), the number of birds attracted to the boat lighting is expected to be low, given the distance that the ship is to be stationed from the Hawaiian Islands, Oregon or Pacific coast and the fact that most observed fallout from light occurs on land, near populated areas (Troy et al., 2013). During the day, it is not expected that the lights would have any effect on seabirds; however, birds may still forage or rest on or around ship. Nighttime lighting would be kept to a minimum, and red lights would be preferred at night to mitigate possible effects.

4.2 Scattered Debris

Expended vehicles may involve explosions that scatter debris or release hazardous materials (hydraulic oil). Debris from Starship could include stainless steel, thermal (heat) tiles and matting, Composite Overwrapped Pressure Vessels (COPVs), cork, plastic, and adhesive. Stainless steel fragments are expected to sink due to their density. While it is possible that a stainless steel sheet may float under certain sea conditions, it is likely to eventually sink due to wave action. Thermal tiles and matting are made of silica and are expected to float. Cork, plastic, and adhesives would likely float if not destroyed during the explosive event. Given that plastic is flammable, it is likely that any plastic on Starship would be incinerated and would not survive to the ocean. Cork is a well-known insulation material, especially for thermal insulation, and studies show that cork and composite cork have relatively low flammability and may be useful in fire retardants and thermal protection, but during an explosive event, it is unlikely that cork would survive due to the breakdown of the cork into dust, which becomes extremely flammable. Given the large expanse of ocean, distribution over which ESA-listed seabird species may occur and be foraging in those areas, and relatively small addition of Starship debris (debris is expected to be contained within 1 km of the landing location) to the overall debris in the ocean, it is unlikely that ESA-listed seabird species would encounter a piece of Starship debris and ingest it, thus, the potential for impacts from hazardous materials or debris to seabirds is discountable.

4.3 Noise

The band-rumped storm-petrel, Hawaiian petrel, Newell's shearwater, and short-tailed albatross have been documented in the Pacific Landings Area. Although individuals present at the time of landings could be disturbed by noise, lighting, and sonic booms depending on their proximity to these activities, any temporary alterations in feeding and sheltering would not significantly disrupt normal behavioral patterns.

ESA-listed seabird species within the vicinity of the recovery area may be exposed to sonic booms during a landing event. While diving, birds would not be exposed to these noises. The hearing capabilities of these species have not been measured; therefore, their hearing capabilities are inferred from other species. The majority of the published literature on bird hearing focuses on terrestrial birds and their ability to hear in air. A review of 32 terrestrial and marine species indicates that birds generally have greatest hearing sensitivity between 1 and 4 kHz (Beason 2004; Dooling 2002). Very few seabird species can hear below 20 Hz, most have an upper frequency hearing limit of 10 kHz, and none exhibit hearing at frequencies higher than 15 kHz (Dooling 2002). Hearing capabilities have been studied for only a few seabirds (Beason 2004; Beuter et al. 1986; Crowell et al. 2015; Johansen et al. 2016; Maxwell et al. 2017; Mooney et al. 2019; Thiessen 1958; Wever et al. 1969); these studies show that seabird hearing ranges and sensitivity in air are consistent with what is known about bird hearing in general.

Due to the temporary and intermittent nature of the landing noise source, seabirds would be expected to resume normal behavior shortly after reentry operation are complete.

4.4 Overall Effects

The USFWS 2025 BCO determined a finding of may affect, not likely to adversely affect with respect to the band-rumped storm-petrel, Hawaiian petrel, Newell's shearwater, and short-tailed albatross. The primary change for the Proposed Action considered herein is the addition of contingency landing areas discussed in Section 2.1.1 and Starship reentry operations are similar to those considered in the prior consultation. The effects to seabirds from the Proposed Action remain discountable.

SpaceX has determined that the Proposed Action for this BA would not occur within any designated or proposed critical habitat and therefore would not result in the destruction or adverse modification of designated or proposed critical habitat in or adjacent to the Action Area.

5 Determination of Effects

Table 5-1 presents FAA's overall effects determinations for ESA-listed species and critical habitat designations analyzed in this BA. Stressors analyzed in this BA may affect, but not adversely affect, ESA-listed seabird species occurring in the Action Area. The FAA has determined that the Proposed Action would not occur within proposed or designated critical habitat located in the

Action Area, and, therefore, would not destroy or adversely modify critical habitat for species analyzed as part of this consultation.

Table 5-1. Effects Determinations Under the Action

Species Name	DPS	ESA Status	Species Effects Determination	Critical Habitat Effects Determination[1]
Band-rumped Storm Petrel	Hawaii	Endangered	NLAA	-
Hawaiian Petrel	-	Endangered	NLAA	-
Newell's Shearwater	-	Threatened	NLAA	-
Short-tailed Albatross	-	Endangered	NLAA	-

Notes: DPS=Distinct Population Segment, ESA=Endangered Species Act, NLAA=Not Likely to Adversely Affect

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APPENDIX C

NMFS MMPA LOC

APPENDIX D

ESSENTIAL FISH HABITAT ASSESSMENT FOR SPACEX STARSHIP REENTRY OPERATIONS

Essential Fish Habitat Assessment

SpaceX Starship Reentry Operations

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ACRONYMS AND ABBREVIATIONS

BSAI	Bering Sea and Aleutian Islands
CFR	Code of Federal Regulations
COPVs	Composite Overwrapped Pressure Vessels
CPS	Coastal Pelagic Species
EEZ	Exclusive Economic Zone
FAA	Federal Aviation Administration
EFH	Essential Fish Habitat
FMC	Fishery Management Council
FMP	Fishery Management Plan
GOA	Gulf of Alaska
HAPC	Habitat Areas of Particular Concern
HMS	Highly Migratory Species
LOX	liquid oxygen
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NE	northeastern
NM	nautical mile
NMFS	National Marine Fisheries Service
NPFMC	North Pacific Fishery Management Council
PFMC	Pacific Fishery Management Council
SFA	Sustainable Fisheries Act
SpaceX	Space Exploration Technologies Corporation
U.S.	United States
WPFMC	Western Pacific Fishery Management Council

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1 INTRODUCTION

As required by the Magnuson-Stevens Fishery Conservation and Management Act of 1976 (MSA; Public Law 104-267) and the MSA's regulatory provisions (50 Code of Federal Regulations [CFR] part 600), the Federal Aviation Administration (FAA) is requesting consultation with the National Marine Fisheries Service (NMFS) due to potential adverse effects to Essential Fish Habitat (EFH) associated with Space Exploration Technologies Corporation's (SpaceX) proposed Starship reentry and landing operations in the Pacific Ocean. This EFH Assessment evaluates how the Proposed Action (described below in Section 2) might impact the waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity, as well as identify whether this action will result in the physical, chemical, or biological alteration of the water or substrate.

1.1 Regulatory Background

The MSA established jurisdiction over marine fishery resources in the United States (U.S.) and was reauthorized and amended by the Sustainable Fisheries Act (SFA) of 1996 (Public Law 104-297) to include the Essential Fish Habitat (EFH) mandate. The SFA set forth a number of new directives for the National Marine Fisheries Service (NMFS), regional Fishery Management Councils (FMCs), and other federal agencies to identify and protect important marine, estuarine, and anadromous fish habitat. To that end, the SFA requires that regional FMCs prepare Fishery Management Plans (FMPs) and Fishery Ecosystem Plans for the identification, protection, and enhancement of EFH for federally "managed species." The MSA requires that all federal agencies consult with NMFS on all proposed actions permitted, funded, or undertaken by the agency that may adversely affect EFH.

Congress defined EFH to mean those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. In 2002, NMFS further clarified EFH with the following definitions:

- "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate.
- "Substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities.
- "Necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 Code of Federal Regulations [CFR] 600.10).

An "adverse effect" means any impact that reduces quality and/or quantity of EFH. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions. [50 CFR § 600.810]

1.2 Document Structure

A complete description of the Proposed Action is presented in Chapter 2 (Description of the Proposed Action and the Study Area). Chapter 3 (Description of Essential Fish Habitat and Habitat Areas of Particular Concern) describes the managed species and applicable EFH as set forth in the FMPs along with the life history information of the managed species and the occurrence of species in the study area based on the best available information. Chapter 4 (Assessment of Impacts) and Chapter 5 (Conclusions) provides an effects analysis and conclusions. Chapter 6 is Literature Cited.

2 DESCRIPTION OF THE PROPOSED ACTION AND THE STUDY AREA

2.1 PROPOSED ACTION

The FAA is currently evaluating SpaceX's proposal to expand its Starship contingency landing area in the Pacific Ocean. SpaceX plans to land its Starship vehicle at its launch site in Boca Chica, Texas (referred to as Starbase). In situations where SpaceX is unable to land Starship at Starbase, SpaceX would use the Pacific Ocean as a contingency landing area. The FAA previously analyzed Starship landings in portions of the Pacific Ocean (National Marine Fisheries Service, 2025.

The FAA's federal action is to modify SpaceX's existing vehicle operator license (VOL 23-129) to authorize SpaceX's proposal to expand the Starship landing area in the Pacific Ocean and expend Starship in the Northeastern (NE) Pacific Basin. This Proposed Action is necessary if something impedes use of the catch tower at Starbase, there are issues with Starship operating parameters, or other extenuating safety circumstances prevent Starship landing operations at Starbase. The Proposed Action being analyzed in this document is for up to 25 in-flight breakups, 25 soft water landings, and 20 explosive events of Starship in the NE Pacific Basin (Figure 2-1).

2.1.1 STUDY AREA

The Proposed Action would occur approximately 70 nautical miles (NM) south of the Aleutian Islands within the NE Pacific Basin and extending out approximately 70 NM from the Oregon coast, including nominal reentry and recovery operations (Figure 2-1). Potential impacts on EFH are analyzed for the areas where the study area (i.e., contingency landing area for Starship) overlaps EFH, as shown in Figure 3-1 and Figure 3-2.

Although there is an additional proposed landing contingency location off the southwest Hawaiian coast (Figure 2-1), it is located more than 200 NM off the coast of Hawaii (i.e., outside the U.S. Economic Exclusion Zone [EEZ]) and therefore is not included in this EFH assessment. To prevent debris from a Starship explosive event or in-flight breakup from entering the Papahānaumokuākea Marine National Sanctuary, SpaceX would have a vessel in the area of highest likelihood of debris that would identify large debris for salvage. SpaceX would use the vessel to survey for debris for approximately 24 to 48 hours (using visual survey in the daytime and onboard vessel radar at night) depending on the outcome of the breakup. If there is floating debris detected by the vessel during the debris survey, SpaceX would sink or recover any debris before it can drift into the Papahānaumokuākea Marine National Sanctuary by removing the item using a net or boat hook, or puncturing the item using a firearm to cause it to sink. If debris is still identified after the 24–48-hour survey, SpaceX would use an aerial asset, additional vessel, or satellite imaging, to confirm and characterize any debris to verify that debris sinks within 10 days.

2.1.2 STARSHIP REENTRY OPERATIONS

SpaceX and the FAA implement numerous protocols and procedures to assess, avoid, mitigate, and minimize potential risks to EFH during reentry operations, which are discussed in the 2022 FAA Final Programmatic Environmental Assessment for the SpaceX Starship/Super Heavy Launch Vehicle Program at the SpaceX Boca Chica Launch Site in Cameron County, Texas (Federal Aviation Administration, 2022), 2026 Final Environmental Impact Statement for the SpaceX Starship-Super Heavy Launch Vehicle at Launch Complex 39A (Federal Aviation Administration, 2026), and NMFS 2025 Conference and Biological Opinion on SpaceX Starship-Super Heavy Increased Launch Cadence and Operations in the North

Atlantic Ocean, Gulf of Mexico (non-U.S. waters), Gulf of America, North Pacific Ocean, South Pacific Ocean, and Indian Ocean (National Marine Fisheries Service, 2025).

During flight, Starship's engines would start and the booster would separate from Starship. Starship would continue to the desired orbit and perform a controlled descent using atmospheric resistance to slow the vehicle down and guide it to its landing location. Guidance systems are used to maneuver the vehicle along flight paths. Starship is designed to be fully reusable, but while working towards reliability, it is expected that 20 explosive events could occur up to 2030. Starship may expend within the contingency landing location under the following conditions:

1. In-flight breakup/disposal: Starship breaking up during reentry, resulting in debris falling into the study area.

2. Explosive event: Starship lands in the ocean either at terminal velocity, breaking up upon impact with debris contained within approximately 0.6 mile (1 kilometer) of the landing point, or conducts a soft water landing and tips over in the ocean. Both scenarios are expected to result in an explosive event at the surface of the water.

3. Soft water landing: Starship conducts a soft water landing, tips over, and sinks to the bottom of the ocean (no explosive event).

2.1.3 Minimization Measures

The use of firearms to puncture and sink floating debris near the Papahānaumokuākea Marine National Monument would be restricted to open-ocean basins and will avoid designated seamount HAPCs and verified deep-sea coral and sponge fields.

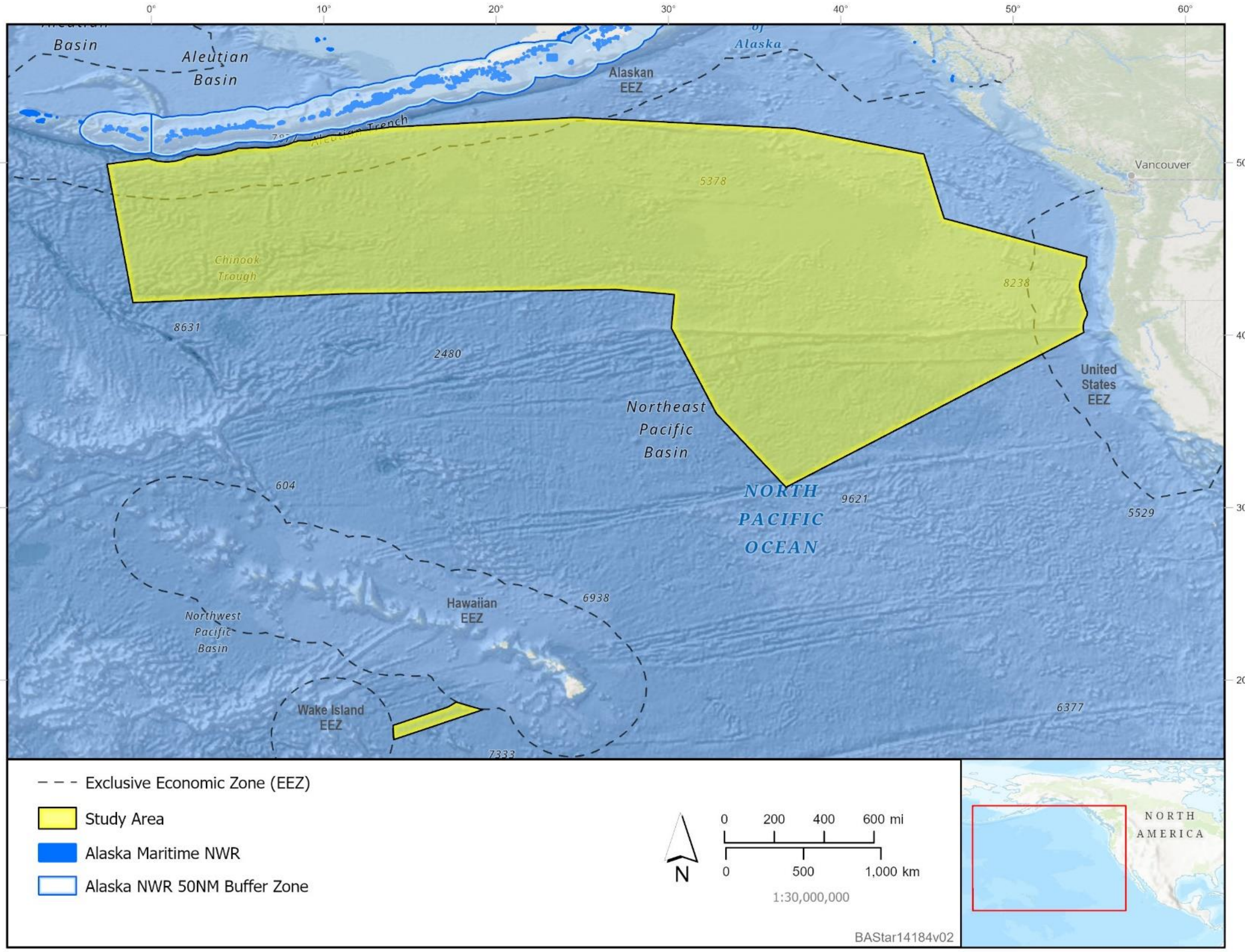


Figure 2-1. **Proposed Starship Contingency Landing Areas**

3 DESCRIPTION OF ESSENTIAL FISH HABITAT AND HABITAT AREAS OF PARTICULAR CONCERN

EFH is defined as the waters and substrate necessary for life history processes including spawning, breeding, feeding, and growth to maturity. 50 CFR 600.05 through 600.930 further interpreted this definition to mean, “waters including aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species contribution to a healthy ecosystem; and spawning, breeding, feeding, or growth to maturity covers a species’ full life cycle.” FMCs manage fisheries in terms of five basic life stages:

- Eggs – individuals that are formed into an egg. For fishes, this is typically outside of the organism but in some cases may be held within the body of an individual. These individuals are completely dependent upon the egg’s yolk sac for nutrition.
- Larvae – individuals that have hatched from the egg but have some type of mouth and alimentary canal that has formed for use in capturing and digesting prey items.
- Juveniles – individuals that are not sexually mature but possess fully formed organ systems that are similar in look to adults but may have some morphometric differences (e.g., coloration) from the adult form.
- Spawning Adults – individuals that are sexually mature and reproductively primed. They are capable of spawning.
- Adults – sexually mature individuals that are not necessarily in spawning condition. In some species, reproduction is cyclical occurring over certain periods of time. In other cases, reproduction can occur multiple times a day. It depends on the species and the area a species lives. Note that tropical species tend to reproduce multiple times a day but further away from the tropics, the more limited and cyclical reproduction tends to be.

The basic categories of EFH descriptors include (1) water column habitats; (2) abiotic substrates/topography; (3) biotic features; and (4) spatially complex areas, which could include both abiotic and biotic features. The water column habitats (e.g., bays/estuaries, ocean currents) include horizontal and vertical characteristics of the overlying water. Abiotic substrates refer to the natural bottom types (e.g., soft, intermediate, and hard substrate) and artificial structures (e.g., shipwrecks, military towers, oil/gas platforms, artificial reefs) that may or may not feature living organisms. High relief topography is generally reflected in the location of hard substrate but not specifically referenced in the mapping of habitats. Biotic features refer to living components of the water column (e.g., floating *Macrocystis*) and bottom (e.g., seagrass, oysters, shallow-water corals) that typically create a habitat for use by marine life. Spatially complex features are characterized by multiple habitat types near one another. For example, a spatially complex area could be sandy flats next to rocky bottoms or geographic features of the bottom with complex topography, including both high and low relief patches (e.g., shelf break/canyons, seamounts). Whereas high relief features are predominately hard substrate, they may also feature small patches of softer substrate not captured by available mapping efforts. There can also be small patches of hard substrate surrounded by vast expanses of soft or intermediate substrate on the continental shelf. Such small features require very high-resolution mapping to delineate and are not yet available for most locations.

The study area is within a region managed by three separate FMCs, the North Pacific Fishery Management Council (NPFMC; Alaskan fisheries), Pacific Fishery Management Council (PFMC; Washington, Oregon, and California), and the Western Pacific Fishery Management Council (WPFMC; Hawaii, American Samoa, and Mariana Archipelagos, and Pacific Remote Island Areas). Federally managed species in the FMPs that most likely occur in the study area are summarized below in Section 3.2. As noted above in Section 2.1.1, the additional proposed landing contingency location off the southwest Hawaiian coast is located more than 200 NM off Hawaii (i.e., outside the U.S. EEZ) and in the jurisdiction of the WPFMC is not included in this EFH assessment. EFH within the study area is shown in Figure 3-1Figure 2-1.

Habitat Areas of Particular Concern (HAPCs) are a special category of EFH designated to encompass areas providing extremely important ecological functions or that are especially vulnerable to degradation. EFH that is considered particularly important to the long-term productivity of populations of one or more managed species, or to be particularly vulnerable to degradation, also may be identified by NMFS as a HAPC. HAPCs within the study area are shown in Figure 3-2.

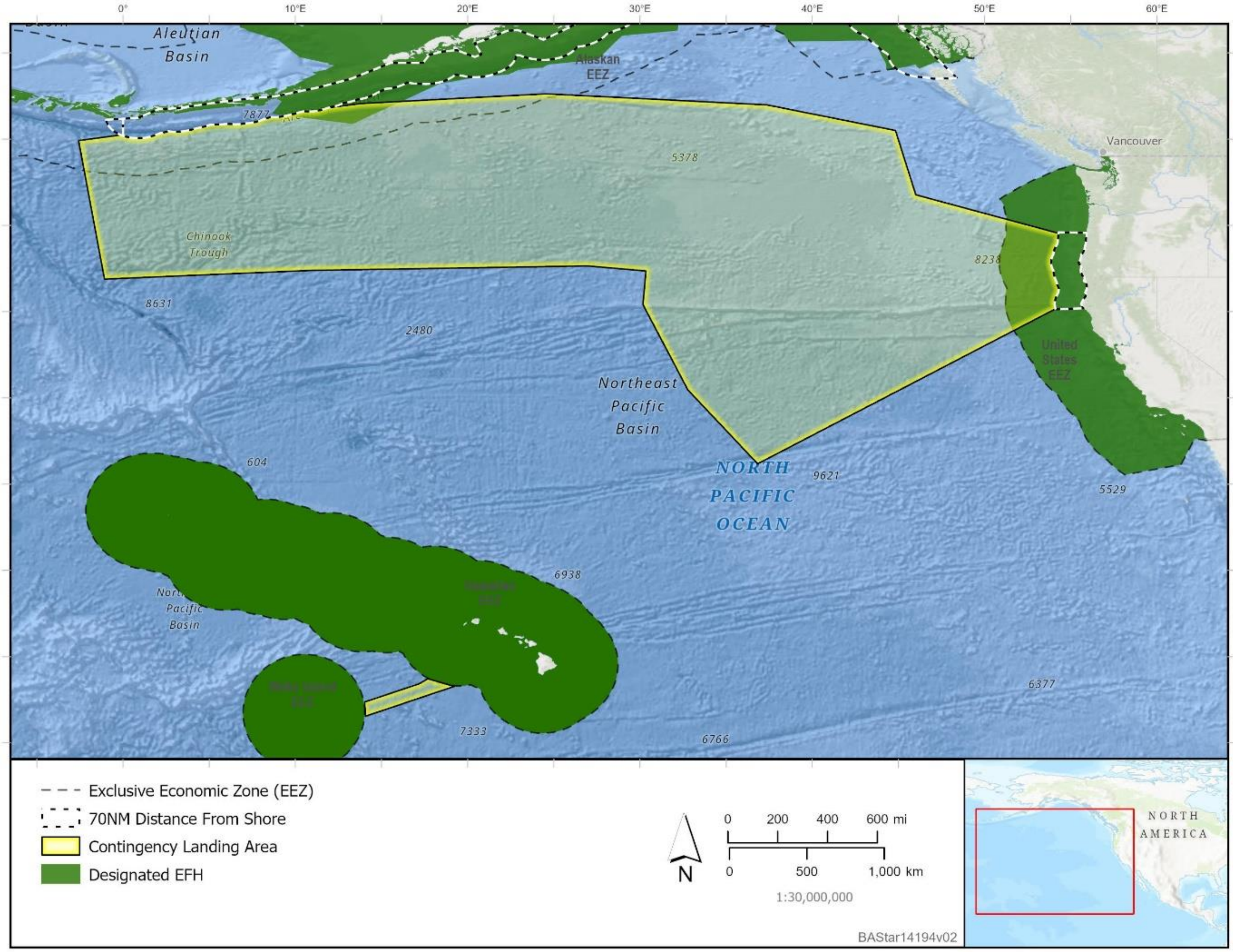


Figure 3-1. Essential Fish Habitat within the Study Area

3.1 Essential Fish Habitat

3.1.1 Water Column Habitat

Water column properties that may affect fisheries resources include both measurable parameters (e.g., temperature, salinity, dissolved oxygen, total suspended solids, nutrients, and chlorophyll *a*) and anthropogenic stressors (e.g., noise, electromagnetic fields, marine debris). Other measurable parameters include depth, pH, water velocity and movement, and water clarity. The presence of marine debris displaces water column habitat and may present the risks of entanglement or ingestion. Water column parameters referenced in EFH and HAPC descriptions include water types (e.g., offshore, nearshore, estuarine), vertical layers (e.g., epipelagic, mesopelagic, bathypelagic, and abyssopelagic), ocean currents, and salinity zones. Any reference to ”waters” or a specific type of ”water” (e.g., all estuaries) implies the inclusion of all vertical and bottom habitats, unless selected layers are implied (e.g., demersal species occupy the bottom layer of the water column). Measurable and biologically relevant properties of those waters are inferred as essential when there is scientific literature supporting an impact on managed species in terms of their biological functions (e.g., contaminants that reduce fecundity of spawning adults, suspended sediments that disrupt feeding activity).

Water column habitats can be characterized along the continuum of coastal rivers to offshore ocean waters. Ocean waters include the water column seaward of estuarine salinities (less than 30 practical salinity units). The offshore ocean waters are defined as the water column seaward of nearshore areas. Nearshore areas are not defined consistently among fishery management councils but generally include some portion of the continental shelf adjoining the U.S. coastline seaward of estuarine waters. Nearshore ocean waters are further defined by the typical interaction of waves and seafloor along ocean shorelines. For the purposes of this assessment, nearshore and “coastal zone” is considered basically equivalent to connect the proposed activity locations to the nearshore EFH. Offshore, nearshore, and estuarine waters occur within all fishery management council regions.

The features of the water column that are likely to be of importance include biological, physical, and chemical oceanographic processes that are hard to map. Frontal boundaries, temperature regimes and biological productivity all vary on seasonal and inter-annual scales that make identification of a static two-dimensional designation of a boundary, as is required for EFH, problematic (Pacific Fishery Management Council, 2005).

3.1.2 Abiotic Bottom Habitats

Marine habitats vary according to geographic location, underlying geology, hydrodynamics, atmospheric conditions, and suspended particles and associated biogenic features. Sediments may be derived from material eroded from land sources associated with coastal bluff erosion and sediment flows from creeks and rivers, which may create channels, tidal deltas, intertidal and subtidal flats, and shoals of unconsolidated material along the shorelines and estuaries.

The influence of land-based nutrients on habitat type and sediment increases with proximity to streams, bays and harbors, and nearshore waters. In the open ocean, gyres, eddies, and oceanic currents influence the distribution of organisms. Major bottom features in the offshore areas of the study area include shelves, banks, breaks, slopes, canyons, plains, and seamounts. Geologic features such as these affect the hydrodynamics of the ocean water column (e.g., currents, gyres, upwellings) as well as living resources present. The distribution of abiotic marine habitats in the study area is described in their respective sections.

3.1.2.1 Soft Bottom Habitat

Soft bottoms include all aquatic habitats with the following three characteristics: (1) more than 25 percent cover of particles smaller than stones, (2) unconsolidated sediment is predominantly mud or sand, and (3) primarily subtidal water regimes (Cowardin et al., 1979). Soft bottom forms the substrate of channels, shoals, subtidal flats, and other features of the bottom. Sandy channels emerge where strong currents connect estuarine and ocean water columns. Shoals or capes form where sand is deposited by interacting, sediment-laden currents. Subtidal flats occur between soft shores and channels or shoals. The continental shelf extends seaward of the shoals and inlet channels and includes relatively coarse-grained, soft bottom habitats. Relatively finer-grained sediments collect off the shelf break, continental slope, and abyssal plain.

3.1.2.2 Hard Bottom Habitat

Hard bottom occurs as extensions of intertidal rocky shores and as offshore outcrops of geologic features (e.g., shelf breaks, seamounts, relic ridgelines). The shapes and textures of the larger rock assemblages and the fine details of cracks and crevices are determined by the type of rock, the wave energy, and other local variables (Davis, 2009). Maintenance of mostly low-relief hard bottom (e.g., bedrock) requires wave energy and/or currents sufficient to sweep sediment away (Lalli & Parsons, 1997) or offshore areas lacking a significant sediment supply; therefore, rocky reefs are rare on broad coastal plains near sediment-laden rivers and are more common on high-energy shores and beneath strong bottom currents, where sediments cannot accumulate.

3.1.2.3 Biogenic Habitat

Living structures on the substrate are termed biogenic habitats, and include wetland shores, attached macroalgae beds, submerged rooted vegetation beds, and biogenic hard bottom. The differences between biogenic habitat reflect a basic continuum of resilience and recovery from disturbance; attached macroalgae recover quickly from the least disturbance (Mach et al., 2007), whereas reef structures take a very long time to recover from a relatively high level of disturbance (Fox & Caldwell, 2006).

Deep-sea coral and sponge communities are part of biogenic habitat that serve as EFH by providing shelter and nursery habitat, increasing diversity, and increasing prey availability (Baillon et al., 2012; Bright, 2007; Freese & Wing, 2003; Henderson et al., 2020). These vulnerable marine ecosystems (VMEs) also provide critical spawning and rearing grounds for globally managed species, including grouper, snapper, sea bass, and rockfish. Updated biennial reports to Congress highlight that collaborative underwater surveys have now documented widespread, direct associations between managed fish stocks and deep-sea coral/sponge structures across every coastal region, shifting the management focus from "exploratory" to "active protection" (National Marine Fisheries National Marine Fisheries Service, 2022a). These ecosystems remain highly vulnerable to physical disturbances, particularly bottom-contact fisheries, which can cause irreversible damage to species that grow only a few millimeters per year (Salgado et al., 2018; Sigwart, 2025). Emerging data indicates that the combined pressures of fishing and climate change—specifically ocean acidification, warming, and deoxygenation—are projected to cause a 30%–60% reduction in taxonomic richness on upper continental slopes as suitable habitats are pushed into deeper, more stable bathyal zones (Boch et al., 2019). Furthermore, maintaining community connectivity and sufficient patch size is vital for long-term persistence. Recent 3-dimensional Lagrangian modeling by (Wang et al., 2024) demonstrates that deep-sea dispersal networks are highly sensitive to fragmentation; the removal of key "source" patches can lead to a major decline in the connectedness of gorgonian coral, sea pen, and sponge communities, potentially compromising the resilience of the entire regional network.

3.2 Federally Managed Species

The species presented below and in Appendix A includes EFH for species that may not be specific to the study area but are still found within the jurisdiction of the NPFMC and PFMC. This comprehensive regional list is provided for informational and background purposes only. They do not represent species expected to be impacted by the proposed activities within the immediate Study Area.

3.2.1 North Pacific Fishery Management Council

Alaska Salmon

The FMP for Salmon in Alaska includes all five northeast Pacific salmon species: Chinook (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), pink salmon (*O. gorbuscha*), sockeye salmon (*O. nerka*), and chum salmon (*O. keta*) that occur in the EEZ off of Alaska. See North Pacific Fishery Management Council et al. (2024) for specific life history details of these managed species. Salmon identified in the FMP spend most of their lives within the water column and are not only important to recreational, commercial, and subsistence fisheries, but are also an important part of the food chain for other species, including other fishes, invertebrates, birds, and marine mammals.

Bering Sea and Aleutian Islands (BSAI) and Gulf of Alaska (GOA) Groundfish

Groundfish stocks described in this FMP are diverse, including groundfish species from the families: Anoplopomatidae (e.g. sablefish), Merlucciidae (e.g. hakes), Pleuronectidae (e.g. halibut and flounder), Scorpaenidae (e.g. rockfish, scorpionfish), Hexagrammidae (e.g. Atka mackerel), Rajidae (e.g. skates) and others, and more than eight species within the forage fish complex. See North Pacific Fishery Management Council (2024b) for specific life history details of these managed species.

Scallops off Alaska

Scallops are managed jointly by the NPFMC and the Alaska Department of Fish and Game through the Alaska Scallop FMP (North Pacific Fishery Management Council, 2024c). This FMP covers all scallop stocks off the coast of Alaska including the weathervane (*Patinopecten caurinus*), pink or reddish scallops (*Chlamys rubida*), spiny scallops (*Chlamys hastata*), and giant rock scallops (*Crassadoma gigantea*) representing the family Pectinidae (North Pacific Fishery Management Council, 2024c). Of the four scallop species, the weathervane scallop is the only commercially exploited scallop in Alaskan waters for which sufficient life history data was available for use in designating EFH (North Pacific Fishery Management Council, 2024c).

BSAI King & Tanner Crabs

This FMP is for commercial king and tanner crab fisheries in the Bering Sea/Aleutian Islands, including blue king crab (*Paralithodes platypus*), golden king crab (*Lithodes aequispina*), red king crab (*P. camtschaticus*), snow crab (*Chionoecetes opilio*), and tanner crab (*C. bairdi*) (North Pacific Fishery Management Council, 2024a). King and tanner crabs cross boundaries during seasonal and spawning migrations from one domain to another. Shelf dwellers, during the winter period king crabs move shoreward during the late winter and early spring and congregate on molting and spawning shoals (North Pacific Fishery Management Council, 2024a). Crabs may occupy shoals from 50 to less than 20 fathoms at this time of year. Snow and tanner crabs also may make off-on shelf migrations for spawning and molting (North Pacific Fishery Management Council, 2024a).

3.2.2 Pacific Fishery Management Council

Coastal Pelagic Species FMP

The FMP for Coastal Pelagic Species (CPS) includes four fish species: northern anchovy (*Engraulis mordax*), Pacific sardine (*Sardinops sagax*), Pacific (chub) mackerel (*Scomber japonicus*), jack mackerel (*Trachurus symmetricus*), and two invertebrates: market squid (*Doryteuthis opalescens*) and all species of euphausiids (krill) that occur in the West Coast EEZ (Pacific Fishery Management Council, 2024a). EFH for these CPS is defined both through geographic boundaries and by sea surface temperature ranges and includes all marine and estuarine waters from the shoreline offshore to the limits of the EEZ and above the thermocline where sea surface temperatures range between 10°C and 26°C. Species identified in the CPS FMP spend most of their lives within the water column and are an important part of the food chain for other species, including other fishes, invertebrates, birds, and marine mammals.

Pacific Coast Groundfish FMP

Over 90 species of groundfish off the west coast are managed under the Pacific Coast Groundfish FMP (Pacific Fishery Management Council, 2025), including 66 species of rockfishes, 12 flatfish species, 6 groundfish species, and 4 shark and skate species (see Appendix A). Habitats within EFH identified as important are based on ecological function provided by the habitat, the extent to which the habitat is sensitive to human-induced environmental degradation, the extent of development activities stressing the habitat type, and the rarity of the habitat type. Note that NMFS has also established closed areas to groundfish fisheries and fisheries that may take groundfish incidentally (National Marine Fisheries Service, 2024). These areas were established to minimize the bycatch of overfished groundfish species or to protect groundfish habitat. These areas include Rockfish Conservation Areas, Block Area Closures, EFH Conservation Areas, Cowcod Conservation Areas, Yelloweye Rockfish Conservation Areas, Cordell Banks Conservation Area, and a Deep-sea Ecosystem Conservation Area (National Marine Fisheries Service, 2024).

Pacific Coast Salmon FMP

The FMP for Pacific Coast salmon includes salmon fisheries (aggregate of natural and hatchery salmon) in the EEZ (three to 200 miles offshore) off Washington, Oregon, and California (Pacific Fishery Management Council, 2024c). While all species of salmon fall under the jurisdiction of this plan, fishery management objectives are only for Chinook or king salmon (*Oncorhynchus tshawytscha*), coho or silver salmon (*O. kisutch*), and pink salmon (*O. gorbuscha*) (Pacific Fishery Management Council, 2024c). The species managed under the Pacific Coast Salmon FMP are presented in Appendix A.

West Coast Highly Migratory Species FMP

The species managed under the Highly Migratory Species (HMS) FMP include migratory sharks, tunas, and billfishes. Species covered under this FMP are presented in Appendix A. EFH for HMS consists of all marine waters from the shoreline offshore to 200 NM offshore (Pacific Fishery Management Council, 2024b). HMS travel widely in the ocean, both in terms of area and depth. They are usually not associated with the features typically considered fish habitat (e.g., estuaries, seagrass beds, or rocky bottoms). Their habitat selection appears to be less related to physical features and more to temperature ranges, salinity levels, oxygen levels, and currents. Variations in the distribution and abundance of HMS are affected by ever-changing oceanic environmental conditions, including water temperature, current patterns, and the availability of food (Pacific Fishery Management Council, 2024b).

Sea surface temperatures and habitat boundaries vary seasonally and from year to year, which can affect the seasonal distribution of some HMS.

3.3 Habitat Areas of Particular Concern

For types or areas of EFH to be considered HAPC, at least one of the following must be demonstrated:

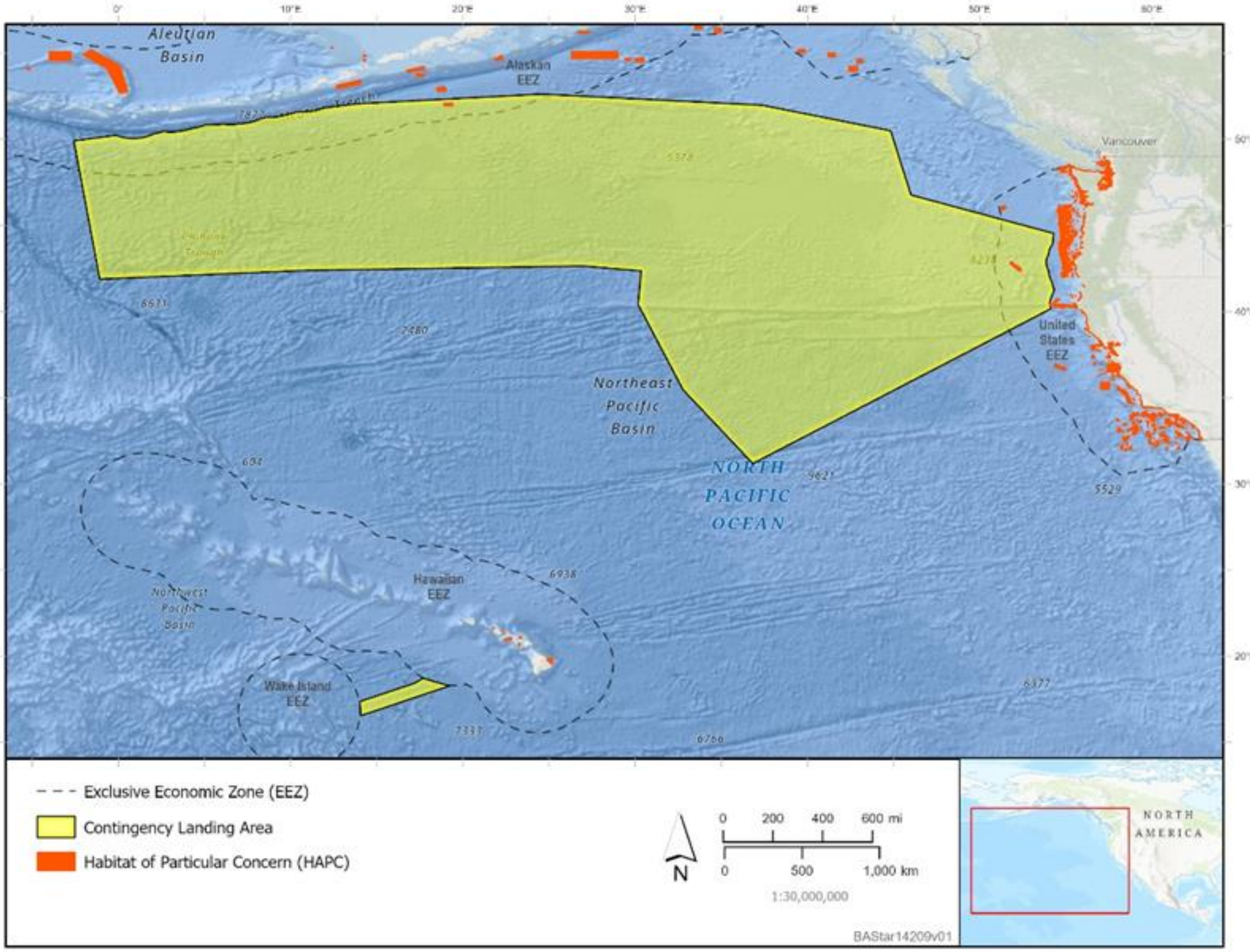
- The importance of the ecological function provided by the habitat
- The extent to which the habitat is sensitive to human-induced environmental degradation
- Whether, and to what extent, development activities are, or would be, negatively impacting the habitat type
- The rarity of the habitat

The following HAPCs are designated in the BSAI & GOA Groundfish FMP and occur within the study area:

- Alaska Seamount Habitat Protection Area: 16 named seamounts in the EEZ (15 in GOA, 1 in Aleutian Islands).

The following HAPCs are designated in the Pacific Coast Groundfish FMP and occur within the study area:

- Areas of Interest: Specific sites like the Cowcod Conservation Area and various seamounts/banks, including Mendocino Ridge, President Jackson Seamount EFH Conservation Area, and Thompson Seamount EFH Conservation Area.



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2 **Figure 3-2. Habitat Areas of Particular Concern within the Study Area**

4 ASSESSMENT OF IMPACTS

This section evaluates how and to what degree the Proposed Action could affect EFH (including HAPC) in the study area. Note that the ecological functions of EFH and HAPC descriptors for managed species and life stages are implied by their presence, extent, and quality within an area. As such, an impact on the habitat is considered an impact on the species and life stages for which the habitat was designated.

The term stressor is broadly used in this document to refer to an agent, condition, or other stimulus, resulting from reentry activities that may diminish the function, in terms of quantity or quality, of a designated EFH or HAPC for managed species. Impacts are evaluated by considering: 1) the individual stressors after applying standard operating procedures and mitigation measures and 2) the cumulative and synergistic effects of all stressors related to the Proposed Action.

Under the MSA, an adverse effect means "any impact which reduces quality and/or quantity of EFH. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions" (50 CFR 600.810[a]).

In accordance with EFH guidelines, the duration and intensity of effects must also be estimated. The duration of effects is based on either duration of stressor or recovery of the habitat (whichever is greater) (National Marine Fisheries Service, 2022b). The following durations were used to assess impacts on EFH:

- Temporary – stressor duration or recovery in hours, days, or weeks
- Short Term – stressor duration or recovery from weeks to in less than 3 years
- Long Term – stressor duration or recovery in more than 3 years but less than 20 years
- Permanent – stressor duration or recovery in more than 20 years

The intensity or magnitude of impacts may be characterized in terms of minimal, more than minimal but less than substantial, or substantial (National Marine Fisheries Service, 2022b). Minimal adverse effects result in only small measurable changes in the affected habitat and its ecological functions.[1] Substantial adverse effects may pose a relatively serious threat to EFH and typically could not be alleviated through minor modifications to a proposed action. For this assessment, minimal intensity stressors have at least one factor minimizing their effects, including infrequent and sparse occurrence, relatively benign nature of effects, typical avoidance of sensitive habitats, or unlikely coincidence with habitat. The impact of stressors exhibiting all these factors is considered negligible and therefore discountable as a meaningful threat to EFH.

In a controlled descent, Starship could vent residual main tank propellant during the in-space coast phase at or above approximately 74 miles above ground level. Following the in-space coast phase, Starship would conduct a deorbit burn to begin its controlled descent. Some residual liquid oxygen (LOX) and methane would remain in Starship. Starship could impact the ocean intact, horizontally, and at terminal velocity (i.e., the steady speed achieved by a freely falling object); the impact would disperse

[1] 67 FR 2343, EFH Final Rule: Comment 14 B.

remaining propellants and drive structural failure of the vehicle. The structural failure would allow the remaining LOX and methane to mix, resulting in an explosive event upon impact with the ocean's surface. Starship could also conduct a soft water landing where the vehicle's engines would fire prior to impact with the ocean's surface, causing the vehicle to land vertically and intact, then tip over and explode. In a rare occurrence, the vehicle could conduct a soft water landing, tip over, take on water, and sink or be scuttled (no explosive event). Residual propellant is anticipated to evaporate or be diluted quickly due to surface currents and ocean mixing. Starship would also have approximately 34 gallons of hydraulic fluid which would remain contained in the vehicle, ignite, or be released.

Expended materials from Starship could include stainless steel, thermal (heat) tiles and matting, Composite Overwrapped Pressure Vessels (COPVs), cork, plastic, and adhesive. Stainless steel fragments are expected to sink due to their density. While it is possible that a stainless steel sheet may float under certain sea conditions, it is likely to eventually sink due to wave action. Thermal tiles and matting are made of silica and are expected to float. A U.S. Environmental Protection Agency Hazardous Waste Test Method (SW846 Test Method 1311: Toxicity Characteristic Leaching Procedure) was conducted on the thermal tiles and matting. The test found no risk of toxic substances leaching into the marine environment. COPVs are cylindrical structures that consist of a composite material wrapped around a metallic liner. COPVs are filled with inert gas and will most likely float if they do not become waterlogged. Cork is used as an insulator and is buoyant. Thus, if not fully incinerated during a mishap or breakup, it will float. Plastic is likely to be incinerated by heat generated during a mishap or breakup, but it is possible for some plastic to survive to reach the ocean. The adhesive used throughout the vehicle is a silicone-based sealant which, when cured, has the texture and density of rubber. If the adhesive is not incinerated along with the component it is sealed to, it will likely float.

Explosions at or near the water's surface can introduce loud, impulsive, broadband sounds into the marine environment. However, unlike other acoustic stressors, explosives release energy at a high rate, producing a shock wave that can be injurious and even deadly. Propagation of explosive pressure waves in water is highly dependent on environmental characteristics such as water depth, temperature, and salinity, which affect how the pressure waves are reflected, refracted, or scattered. In addition, absorption greatly affects the distance over which higher-frequency components of explosive broadband noise can propagate.

Sound and energy from explosions could result in mortality and injury in fish for hundreds or even thousands of meters from an explosion depending on the explosive size. Generally, explosives that belong to larger bins (with large net explosive weights) and those calculated based on SPL sound exposure criteria (for single detonations) produce longer ranges within each effect category. However, some ranges vary depending upon several other factors (e.g., cluster size, depth of the water, depth of the charge, etc.). Fishes without a swim bladder, adult fishes, and larger species would generally be less susceptible to injury and mortality from sound and energy associated with explosive activities than small, juvenile, or larval fishes. The death of an animal would remove them from the population. Removal of individuals with high reproductive potential (e.g., adult females) would result in a larger effect on the overall population than potential loss of many larval or juvenile fishes, which tend to occur in high numbers (i.e., due to the nature of spawning) and have naturally high mortality rates. Non-auditory injuries such as barotrauma may lead to impaired swimming ability and could be accompanied by disorientation, reducing the overall fitness of an injured individual and potentially increasing risk of predation.

Explosive sound could result in a variety of behavioral and physiological responses in fish, with the likelihood of response lower at farther distances from the source (thousands of meters). These responses could include, alerting, startling, reduced feeding, altered communication, and avoidance. Any stress or behavioral reactions from single explosive detonations would be brief (seconds to minutes) during the onset of the explosive signal.

Expended materials (i.e., debris) from Starship could include stainless steel, thermal (heat) tiles and matting, Composite Overwrapped Pressure Vessels, cork, plastic, and adhesive. Stainless steel fragments are expected to sink due to their density. While it is possible that a stainless-steel sheet may float under certain sea conditions, it is likely to eventually sink due to wave action. Thermal tiles and matting are made of silica and are expected to float. Cork, plastic, and adhesives would likely float if not destroyed during the explosive event. Given that plastic is flammable, it is likely that any plastic on Starship would be incinerated and would not survive to the ocean. Cork is a well-known insulation material, especially for thermal insulation, and studies show that cork and composite cork have relatively low flammability and may be useful in fire retardants and thermal protection, but during an explosive event, it is unlikely that cork would survive due to the breakdown of the cork into dust, which becomes extremely flammable. Debris expended from the Starship following an explosion could cause a temporary (seconds), localized impact when they strike the surface of the water and cause bottom habitat disturbances as the expended material contacts the seafloor. Expended material may strike the water surface with sufficient force to cause injury or mortality. However, few federally managed species swim right at, or near, the surface of the water in the offshore portions of the study area, where the Proposed Action would occur.

Expended materials have the potential to physically disturb bottom habitat EFH to the extent that they impair the substrate's ability to function as a habitat. These disturbances can result from several sources, including the physical impact of the expended materials contacting the substrate, the covering of the substrate, or the alteration of the substrate from one type to another (e.g., converting soft bottom substrate into hard bottom resulting from solid expended materials overlying soft substrates).

The likelihood of expended materials adversely impacting substrates as they contact the seafloor depends on several factors, including the size, type, mass, and speed of the material; water depth; the amount of material expended; the frequency of training; and the type of substrate or biogenic community. Most of the kinetic energy of the expended material, however, is dissipated within the first few yards of the object entering the water, causing it to slow considerably by the time it reaches the seafloor. Because the damage caused by a strike is proportional to the force of the strike, slower speeds may result in lesser impacts.

Due to the depth of water in most of the study area, a direct strike on hard bottom is unlikely to occur with sufficient force to damage the substrate. The value of many of these substrates as habitat, however, is not entirely dependent on the precise shape of the structure. An alteration in shape or structure caused by expended materials would not necessarily reduce the habitat value of hard bottom. In softer substrates (e.g., sand, mud, silt, clay, and composites), the impact of the expended material coming into contact with the seafloor, if large enough and striking with sufficient momentum, may result in a depression and a localized redistribution of sediments as they are temporarily resuspended into the water column.

4.1 Potential Impacts on Water Column

Explosions from reentry operations at the water's surface would impact water column habitat designated as EFH and EFH species, including EFH species with pelagic life stages within the epipelagic water column. Overall, the number of EFH species at the water's surface or in the water column where explosions might occur is expected to be low compared to the total number in the study area. In addition, potential impacts in the water column would be temporary.

Physical disturbance and strike stressors from expended materials may have an adverse effect on water column habitat designated as EFH and EFH species, including EFH species with pelagic life stages within the epipelagic water column. Expended materials would either drift in the water column or pass quickly through the water column as they sink to the seafloor without altering the water in any measurable or lasting manner; there would be no adverse impact on the water column itself.

Therefore, explosions, physical disturbance, and strike stressors from the Proposed Action could adversely affect EFH species and designated water column EFH; any adverse effects are expected to be minimal and temporary.

4.2 Potential Impacts on Abiotic Bottom Habitat

The only effect on abiotic bottom habitat from the Proposed Action would be from expended materials that make contact with the seafloor. The size of materials that would remain after an explosion would be composed of small, fragmented debris, a majority of which will likely be thermal tiles and matting. Most debris is expected to be approximately one inch in diameter; some pieces might have a diameter of approximately 6 inches. The range depends on currents and wind direction but should be contained around a 0.6-mile radius. As stated above, most of the kinetic energy of the expended material is dissipated within the first few yards of the object entering the water, causing it to slow considerably by the time it reaches the seafloor. Due to the depth of water in most of the study area, a direct strike on abiotic bottom habitat is unlikely to occur with sufficient force to damage the substrate.

Another potential physical disturbance expended materials could have on substrates would be to cover them or to alter the type of substrate and, therefore, its function as habitat. The majority of expended materials that settle on hard bottoms, while covering the substrate, would still serve the same habitat function as the substrate it is covering by providing a hard surface on which organisms can settle and attach. Full colonization or fouling of the expended material would occur over a relatively short (e.g., 18-month) timeframe, depending on the area (Carter & Prekel, 2008).

Most expended materials that settle on soft bottom habitats, while not damaging the actual substrate, could inhibit the substrate's ability to function as a habitat by covering it with a hard surface. This could effectively alter the substrate from a soft surface to a hard structure and, therefore, could alter the ability of the substrate from one capable of supporting a soft bottom community to one that would be more appropriate as habitat for organisms more commonly found associated with hard bottom environments. Expended materials that settle in the shallower, more dynamic environments of the continental shelf would likely be eventually covered over by sediments due to currents and other coastal processes or encrusted by organisms. In the deeper waters off the continental slope and beyond where currents do not play as large of a role, expended materials may remain exposed on the surface of the substrate with minimal change for extended periods. Depending on the size of the expended material and seafloor conditions, it is likely that the material would permanently remain on the abiotic habitat.

Therefore, the Proposed Action may have an adverse effect on abiotic bottom habitat designated as EFH; any adverse effects are expected to be minimal and short-term to permanent.

4.3 Potential Impacts on Biogenic Habitat

Expended materials from reentry operations have the potential to adversely impact the benthic invertebrates and vegetation that compose the biogenic habitats (e.g., corals, sponges, macroalgae, hydroids, amphipod tubes, bryozoans) coinciding with areas where reentry operations occur. Due to their size and minimal weight, smaller items may result in little to no damage to biogenic habitats while larger, heavier items may break or crush the sessile invertebrates, which may occur where materials would be expended. Damage to these habitats would be primarily confined to the area of impact.

Most expended materials that settle on soft bottom habitats, while not damaging the actual substrate, could inhibit the substrate's ability to function as a habitat by covering it with a hard surface. This would effectively alter the substrate from a soft surface to a hard structure and, therefore, would alter the ability of the substrate from one capable of supporting a soft bottom community to one that would be more appropriate as habitat for organisms more commonly found associated with hard bottom environments. Expended materials may adversely affect live bottom organisms (e.g., areas with sponges, bryozoans, hydroids, amphipod tubes) and macroalgae designated as EFH in areas where the materials are deposited.

Expended materials that settle in the shallower, more dynamic environments of the continental shelf would likely be eventually covered over by sediments due to currents and other coastal processes or encrusted by organisms. In the deeper waters off the continental slope and beyond where currents do not play as large of a role, expended materials may remain exposed on the surface of the substrate with minimal change for extended periods. While this could take place over a very localized area, impacts to soft bottom habitats and communities would be inconsequential due to the large area of soft bottom available. The short duration and periodic nature of reentry operations in the study area and limited magnitude of effect to water column and substrate habitats from expended materials support the conclusion that the severity of physical disturbance and strike stressors on EFH is low.

Therefore, physical disturbance and strike stressors from the Proposed Action could adversely affect EFH species and designated biogenic habitat designated as EFH; any adverse effects are expected to be minimal and short term. However, some of the expended materials could have long-term to permanent effects on biogenic habitat, depending on the size of the material and the location where it is expended.

4.4 Potential Impacts on HAPCs

Even though most designated HAPCs in the study area are seamounts located in deep water, there is still overlap between the study area and designated HAPCs. An explosion at or near the surface would not affect seamounts. Likewise, contaminants would be expected to dissipate at the surface due to evaporation and ocean mixing and not affect seamounts. However, expended materials would fall through the water column where they could potentially land on a seamount. Therefore, expended materials associated with the Proposed Action is may result in in minimal and short term to permanent adverse effects on HAPCs.

4.5 Potential Impacts from Contaminants

It is possible that Starship residual propellant could end up in the ocean during reentry operations. If this occurs, residual propellant is expected to evaporate or be diluted relatively quickly due to surface currents and ocean mixing. It is unlikely that residual propellant measurably contributes to the overall pollutant levels in the contingency landing area given the limited number of times Starship will be expended (and residual propellant would reach the ocean), and the large study area. Therefore, the effects of residual propellant on EFH and EFH species is expected to be minimal and temporary.

5 CONCLUSIONS

As described in Section 4, all of the potential adverse effects to EFH from the Proposed Action are expected to be minimal. Table 5-1 presents the effects determinations for EFH in the study area.

Table 5-1. Effects Determinations for Starship Reentry Operations on Essential Fish Habitat in the Study Area

Stressors	*Water Column*	*Abiotic Bottom Habitat*	*Biogenic Habitat*	*HAPC*
Explosive Stressors				
Explosions at or near the surface	Adverse effect (Minimal and temporary)	Adverse effect (Minimal and temporary)	Adverse effect (Minimal and temporary)	No effect
Physical Disturbance and Strike Stressors				
Expended materials	Adverse effect (Minimal and temporary)	Adverse effect (Minimal and short term to permanent)	Adverse effect (Minimal and short term to permanent)	Adverse effect (Minimal and short term to permanent)
Contaminant Effects				
Rocket propellent and other chemical pollutants	Adverse effect (Minimal and temporary)	No effect	No effect	No effect

Note: HAPC = Habitat Areas of Particular Concern

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APPENDIX A

LIST OF SPECIES COVERED IN FISHERY MANAGEMENT PLANS

Table A-1: Species Listed in Fishery Management Plans within the Study Area

NORTH PACIFIC FISHERY MANAGEMENT COUNCIL	
Salmon FMP Species	
Common Name	**Species Name**
Chinook salmon	*Oncorhynchus tshawytscha*
Coho salmon	*O. kisutch*
Pink salmon	*O. gorbuscha*
Sockeye salmon	*O. nerka*
Chum salmon	*O. keta*
Bering Sea and Aleutian Islands and Gulf of Alaska Groundfish FMP Species	
Roundfish	
Atka mackerel	*Pleurogrammus monopterygius*
Bigmouth sculpin	*Hemitripterus bolini*
Black rockfish[2]	*Sebastes melanops*
Blackspotted rockfish	*Sebastes melanostictus*
Dark rockfish[2]	*Sebastes ciliatus*
Dusky rockfish	*Sebastes variabilis*
Great sculpin[1]	*Myoxocephalus polyacanthocephalus*
Greenstriped rockfish[2]	*Sebastes elongatus*
Harlequin rockfish	*Sebastes variegatus*
Longspine thornyhead rockfish	*Sebastolobus altivelis*
Northern rockfish	*Sebastes polyspinis*
Pacific cod	*Gadus macrocephalus*
Pacific Ocean perch	*Sebastes alutus*
Pygmy rockfish[2]	*Sebastes wilsoni*
Quillback rockfish[2]	*Sebastes maliger*
Redbanded rockfish[2]	*Sebastes babcocki*
Redstripe rockfish[2]	*Sebastes proriger*
Rosethorn rockfish[2]	*Sebastes helvomaculatus*
Rougheye rockfish	*Sebastes aleutianus*
Sablefish	*Anoplopoma fimbria*
Sharpchin rockfish	*Sebastes zacentrus*
Shortraker rockfish	*Sebastes borealis*
Shortspine thornyhead rockfish	*Sebastolobus alascanus*
Silvergrey rockfish[2]	*Sebastes brevispinis*
Walleye pollock	*Theragra calcogramma*
Yellow Irish lord[1]	*Hemilepidotus jordani*
Yelloweye rockfish	*Sebastes ruberrimus*
Flatfish	
Alaska plaice	*Pleuronectes quadrituberculatus*
Arrowtooth flounder	*Atheresthes stomias*
Dover sole	*Microstomus pacificus*
Flathead sole	*Hippoglossoides elassodon*
Kamchatka flounder[3]	*Atheresthes evermanni*
Northern rock sole	*Lepidopsetta polyxystra*
Pacific halibut[3]	*Hippoglossus stenolepis*
Rex sole	*Glyptocephalus zachirus*
Southern rock sole	*Lepidopsetta bilineata*

Yellowfin sole	*Limanda aspera*
Scallop FMP Species	
Weathervane scallop	*Patinopecten caurinus*
Bering Sea and Aleutian Islands King and Tanner Crab FMP Species	
Blue king crab	*Paralithodes platypus*
Golden king crab	*Lithodes aequispina*
Red king crab	*P. camtschaticus*
Snow crab	*Chionoecetes opilio*
Tanner crab	*C. bairdi*
PACIFIC FISHERY MANAGEMENT COUNCIL	
Coastal Pelagic Species FMP	
Northern anchovy	*Engraulis mordax* (Central and northern subpopulations)
Pacific sardine	*Sardinops sagax*
Jack mackerel	*Trachurus symmetricus*
Pacific (chub) mackerel	*Scomber japonicus*
Market squid	*Doryteuthis opalescens*
Krill or Euphausiids (all species in West Coast Exclusive Economic Zone, including these eight dominant species)	*Euphausia pacifica*
	Thysanoessa spinifera
	Euphausia recurva
	Euphausia gibboides
	Euphausia eximia
	Thysanoessa gregaria
	Nyctiphanes simplex
	Nematoscelis difficilis
Ecosystem Component Species	
Pacific herring	*Clupea pallasii*
Jacksmelt	*Atherinopsis californiensis*
GROUNDFISH FISHERY MANAGEMENT PLAN	
Elasmobranchs	
Big skate	*Raja binoculata*
Leopard shark	*Triakis semifasciata*
Longnose skate	*Raja rhina*
Spiny dogfish	*Squalus suckleyi*
Roundfishes	
Cabezon	*Scorpaenichthys marmoratus*
Kelp greenling	*Hexagrammos decagrammus*
Lingcod	*Ophiodon elongates*
Pacific cod	*Gadus microcephalus*
Pacific whiting (hake)	*Merluccius productus*
Sablefish	*Anoplopoma fimbria*
Rockfishes	
Aurora rockfish	*Sebastes aurora*
Bank rockfish	*Sebastes rufus*

Black rockfish	*Sebastes melanops*
Black and yellow rockfish	*Sebastes chrysomelas*
Blackgill rockfish	*Sebastes melanostomus*
Blackspotted rockfish*	*Sebastes melanostictus*
Blue rockfish	*Sebastes mystinus*
Bocaccio	*Sebastes paucispinis*
Bronzespotted rockfish	*Sebastes gilli*
Brown rockfish	*Sebastes auriculatus*
Calico rockfish	*Sebastes dallii*
California scorpionfish	*Scorpaena guttata*
Canary rockfish	*Sebastes pinniger*
Chameleon rockfish	*Sebastes phillipsi*
Chilipepper	*Sebastes goodie*
China rockfish	*Sebastes nebulosus*
Copper rockfish	*Sebastes caurinus*
Cowcod	*Sebastes levis*
Darkblotched rockfish	*Sebastes crameri*
Dusky rockfish	*Sebastes ciliates*
Dwarf-red rockfish	*Sebastes rufinanus*
Flag rockfish	*Sebastes rubrivinctus*
Freckled rockfish	*Sebastes lentiginosus*
Gopher rockfish	*Sebastes carnatus*
Grass rockfish	*Sebastes rastrelliger*
Greenblotched rockfish	*Sebastes rosenblatti*
Greenspotted rockfish	*Sebastes chlorostictus*
Greenstriped rockfish	*Sebastes elongates*
Halfbanded rockfish	*Sebastes semicinctus*
Harlequin rockfish	*Sebastes variegatus*
Honeycomb rockfish	*Sebastes umbrosus*
Kelp rockfish	*Sebastes atrovirens*
Longspine thornyhead	*Sebastolobus altivelis*
Mexican rockfish	*Sebastes macdonaldi*
Olive rockfish	*Sebastes serranoides*
Pacific ocean perch	*Sebastes alutus*
Pink rockfish	*Sebastes eos*
Pinkrose rockfish	*Sebastes simulator*
Puget Sound rockfish	*Sebastes emphaeus*
Pygmy rockfish	*Sebastes wilsoni*
Quillback rockfish	*Sebastes maliger*
Rainbow rockfish	*Scorpaenodes xyris*
Redbanded rockfish	*Sebastes babcocki*
Redstripe rockfish	*Sebastes proriger*
Rosethorn rockfish	*Sebastes helvomaculatus*

Rosy rockfish	*Sebastes rosaceus*
Rougheye rockfish	*Sebastes aleutianus*
Semaphore rockfish*	*Sebastes melanosema*
Sharpchin rockfish	*Sebastes zacentrus*
Shortbelly rockfish	*Sebastes jordani*
Shortraker rockfish	*Sebastes borealis*
Shortspine thornyhead	*Sebastolobus alascanus*
Silvergray rockfish	*Sebastes brevispinis*
Speckled rockfish	*Sebastes ovalis*
Splitnose rockfish	*Sebastes diploproa*
Squarespot rockfish	*Sebastes hopkinsi*
Starry rockfish	*Sebastes constellatus*
Stone scorpionfish*	*Scorpaena mystes*
Stripetail rockfish	*Sebastes saxicola*
Sunset rockfish*	*Sebastes crocotulus*
Swordspine rockfish	*Sebastes ensifer*
Tiger rockfish	*Sebastes nigrocinctus*
Treefish	*Sebastes serriceps*
Vermilion rockfish	*Sebastes miniatus*
Whitespotted rockfish*	*Sebastes moseri*
Widow rockfish	*Sebastes entomelas*
Yelloweye rockfish	*Sebastes ruberrimus*
Yellowmouth rockfish	*Sebastes reedi*
Yellowtail rockfish	*Sebastes flavidus*
Flatfishes	
Arrowtooth flounder (turbot)	*Atheresthes stomias*
Butter sole	*Isopsetta isolepis*
Curlfin sole	*Pleuronichthys decurrens*
Dover sole	*Microstomus pacificus*
English sole	*Parophrys vetulus*
Flathead sole	*Hippoglossoides elassodon*
Pacific sanddab	*Citharichthys sordidus*
Petrale sole	*Eopsetta jordani*
Rex sole	*Glyptocephalus zachirus*
Rock sole	*Lepidopsetta bilineata*
Sand sole	*Psettichthys melanostictus*
Starry flounder	*Platichthys stellatus*
Ecosystem Component Species	
Aleutian skate	*Bathyraja aleutica*
Bering/sandpaper skate	*Bathyraja interrupta*
California skate	*Raja inornata*
Roughtail/black skate	*Bathyraja trachura*
All other skates	*Endemic species in the family Arhynchobatidae*

Pacific grenadier	*Coryphaenoides acrolepis*
Giant grenadier	*Albatrossia pectoralis*
All other grenadiers	*Endemic species in the family Macrouridae*
Finescale codling (aka Pacific flatnose)	*Antimora microlepis*
Ratfish	*Hydrolagus colliei*
Soupfin shark	*Galeorhinus zyopterus*
PACIFIC COAST SALMON FISHERY MANAGEMENT PLAN	
Chinook or king salmon	*Oncorhynchus tshawytscha*
Coho or silver salmon	*Oncorhynchus kisutch*
Pink salmon	*Oncorhynchus gorbuscha*
HIGHLY MIGRATORY SPECIES FISHERY MANAGEMENT PLAN	
Common thresher shark	*Alopias vulpinus*
Shortfin mako shark	*Isurus oxyrinchus*
Blue shark	*Prionace glauca*
Albacore tuna	*Thunnus alalunga*
Bigeye tuna	*Thunnus obesus*
Pacific bluefin tuna	*Thunnus orientalis*
Skipjack tuna	*Katsuwonus pelamis*
Yellowfin tuna	*Thunnus albacares*
Striped marlin	*Kajikia audax*
Swordfish	*Xiphias spp.*
Dorado	*Mahi mahi*
Ecosystem Component Species (Prohibited)	
Bigeye thresher shark	*Alopias superciliosus*
Pelagic thresher shark	*Alopias pelagicus*
Common mola	*Mola mola*
Escolar	*Lepidocybium flavobrunneum*
Lancetfishes	*Alepisauridae*
Louvar	*Luvarus imperialis*
Pelagic sting ray	*Dasyatis violacea*
Wahoo	*Acanthocybium solandri*

Sources: North Pacific Fishery Management Council, 2024a, 2024b, 2024c; North Pacific Fishery Management Council et al., 2024; Pacific Fishery Management Council, 2024a, 2024b, 2024c, 2025

* The category "rockfish" includes all genera and species of the family Scorpaenidae, even if not listed, that occur in the Washington, Oregon, and California area. The Scorpaenidae genera are *Sebastes, Scorpaena, Sebastolobus*, and *Scorpaenodes*.

APPENDIX E

SE PACIFIC ADDENDUM TO 2025B NMFS CBO

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

7/9/26

Refer to NMFS No.: OPR-2025-02468

Memorandum For:
Ms. Stacey Zee
Manager, Operations Support Branch
U.S. Dept. Transportation, Federal Aviation Administration
Office of Commercial Space Transportation
800 Independence Ave SW, Suite 325
Washington, DC 20591

From:
DOBRZYNSKI.TANYA.JANINE.1365846517 Digitally signed by DOBRZYNSKI.TANYA.JANINE.1365846517 Date: 2026.07.09 09:32:39 -04'00'

Tanya Dobrzynski
Chief, Endangered Species Act Interagency Cooperation Division
U.S. Dept. Commerce, National Oceanic and Atmospheric Administration
Office of Protected Resources, National Marine Fisheries Service
1315 East-West Highway
Silver Spring, MD 20910

Subject: Amendment to the Conference and Biological Opinion OPR-2025-02468 to Modify the South Pacific Portion of the Action Area

The purpose of this amendment is to expand the South Pacific portion of the action area (one of the Starship landing areas) under the Conference and Biological Opinion on SpaceX Starship-Super Heavy Operations in the North Atlantic Ocean, Gulf of Mexico (non-U.S. waters), Gulf of America, North Pacific Ocean, South Pacific Ocean, and Indian Ocean Authorized by the Federal Aviation Administration (OPR-2025-02468; hereafter referred to as the opinion).

On May 28, 2026, the Federal Aviation Administration (FAA) formally notified us, the National Marine Fisheries Service (NMFS), that the Space Exploration Technologies Corp. (SpaceX) proposes to conduct an orbital mission which requires expanding Starship's landing area in the South Pacific Ocean. The updated South Pacific portion of the action area includes the original South Pacific portion of the action area (as previously delineated in the opinion, illustrated by the dark grey area in the figure below) and the expanded area (illustrated by the light grey area in the figure below). All applicable existing conservation measures for the South Pacific portion of the action area, including but not limited to dedicated observers on vessels, vessel strike avoidance measures, and vessel speed restrictions, will be implemented in the updated South Pacific portion of the action area. The updated South Pacific portion of the action area excludes all countries' Exclusive Economic Zones, thus, Starship landings will not occur within 200 nautical miles of the coast.

The updated Starship South Pacific landing area does not include any new or additional ESA-listed species or critical habitats that were not already analyzed in the opinion. To our knowledge, there have been no additional data available on ESA-listed species occurrence, distribution, or density in the South Pacific portion of the action area since the opinion was issued, in September 2025.

The updated Starship South Pacific landing area is located at least 200 nautical miles offshore where species are not expected to occur in high numbers or densities. In addition, the other components of the proposed action described in the opinion will not change (i.e., there will continue to be a limited number of 25 in-flight breakups, 25 soft water landings, and 20 explosive events in the updated South Pacific portion of the action area, as described in the opinion), and existing conservation measures implemented in the previously delineated South Pacific portion of the action area will be implemented in the updated Starship South Pacific landing area. Thus, NMFS concludes that this change will not alter the effects analysis in the opinion for the South Pacific portion of the action area (see Section 4.1 in the opinion, pages 40–71). We amend the opinion with the updated South Pacific portion of the action area.

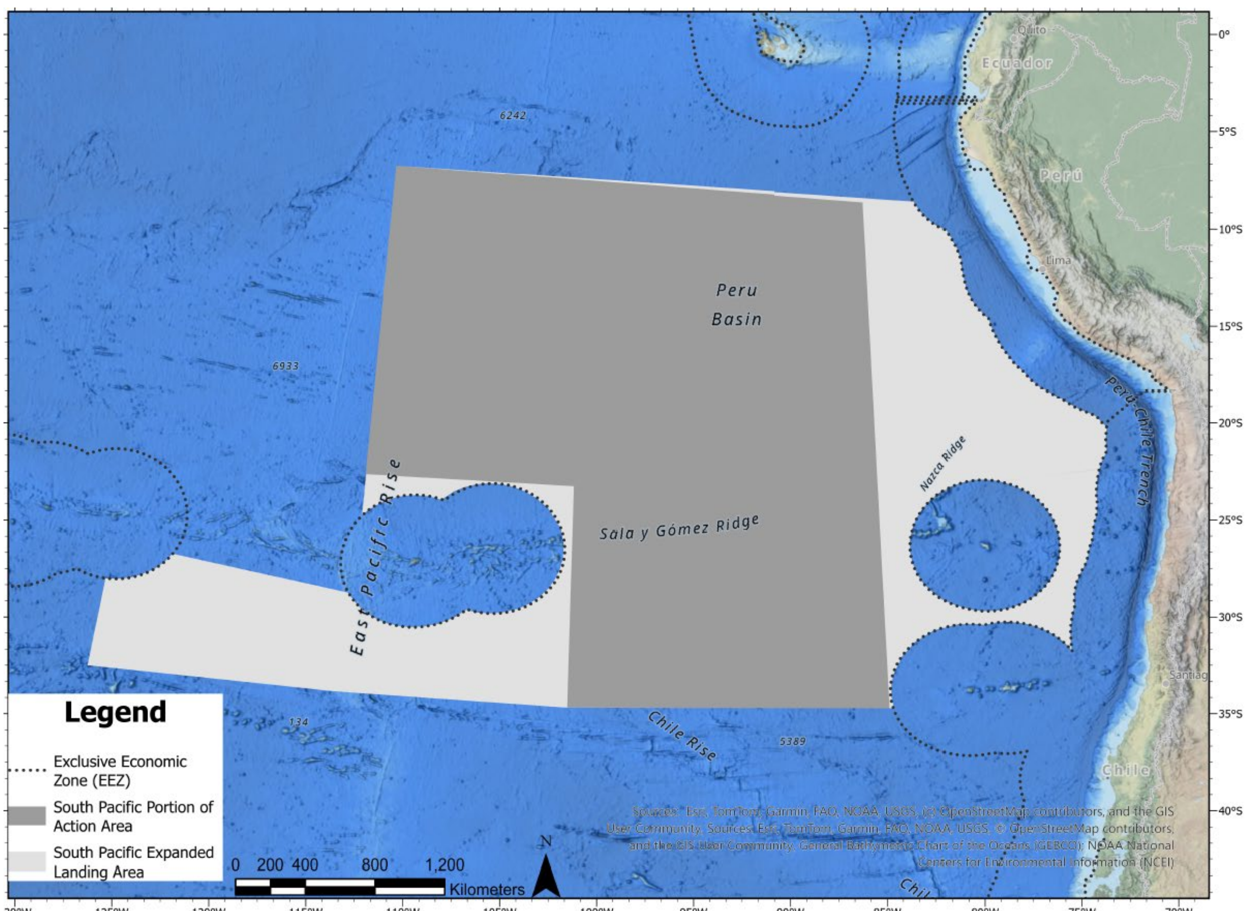

Figure of the updated South Pacific portion of the action area, which includes the South Pacific portion of the action area as described in the opinion (dark grey), and the expansion of that area (light grey).

If you have any questions regarding this amendment, please contact Emily Chou, Consultation Biologist, at (301) 427-8483 or Emily.Chou@noaa.gov, or Tanya Dobrzynski, Division Chief, at (240) 723-6321 or Tanya.Dobrzynski@noaa.gov.