ENVIRONMENTAL MANAGEMENT PLAN

SPACEX, EXUMA CAYS

Submitted to:
Department of Environmental Planning and Protection
Ministry of the Environment and Natural Resources
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Submitted by:
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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Table 1-1. Permitting Schedule DEPP= Department of Environmental Planning and Protection

Name / Type of Document	Date Received / Submitted
DEPP communication to SpaceX Reference DEPP/DEV/EXU/ISL/EIA/	1 March 2024
Environmental Baseline Statement (EBS) submitted to DEPP	25 March 2024
DEPP letter sent to BRON – Re: SpaceX, Starlink, Exuma Sound Booster Re-entry, EBS	4 April 2024
Environmental Management Plan (EMP) Terms of Reference (TOR) submitted to DEPP	1 May 2024
DEPP communication approving EMP TOR	15 May 2024
EMP submitted to DEPP	25 June 2024
Launch Coordination Meeting with Project Team	16 January 2025
Certificate of Environmental Clearance application submitted to DEPP	17 January 2025
EMP update submitted to DEPP	**17 February 2025**

1 EXECUTIVE SUMMARY

Space Exploration Technologies Corp. (SpaceX) is a space transportation and satellite communication company that offers the Starlink internet service. SpaceX first successfully launched in 2008 and has been transporting cargo to and from the International Space Station (ISS) since 2012 and astronauts since 2020.

SpaceX is collaborating with the Government of The Bahamas to launch Starlink satellites to low-earth orbit that will be used to provide 100Mbps+ internet service in The Bahamas. The Falcon 9 has flown over 300 missions with a success rate greater than 99% and is considered the world's most reliable rocket with more consecutive successful missions than any other launch vehicle in history. The Falcon 9 rocket will be launched in Florida, United States and land in the Exuma Sound, Bahamas. As a part of this collaboration SpaceX will establish Starlink terminals in some Bahamian schools, provide educational outreach, and space tourism opportunities for Bahamians.

The Falcon 9 is a reusable, two-stage rocket designed and manufactured by SpaceX for the reliable and safe transport of people and payloads into Earth orbit and beyond. Falcon 9 is the world's first orbital class reusable rocket. Falcon 9's first stage incorporates nine (9) Merlin engines and aluminum-lithium alloy tanks containing liquid oxygen and rocket-grade kerosene (RP-1) propellant. The Falcon 9 first stage is equipped with four (4) landing legs made of state-of-the-art carbon fiber with aluminum honeycomb. Placed symmetrically around the base of the rocket, they are stowed at the base of the vehicle and deploy just prior to landing. First-stage powered flight lasts approximately three minutes, with commanded shutdown of the nine first-stage engines based on remaining propellant levels.

The second stage, powered by a single Merlin Vacuum Engine, delivers Falcon 9's payload to the desired orbit. The second stage engine ignites a few seconds after stage separation and burns an additional five to six minutes to reach initial orbit, with deployment of the fairing typically taking place early in second-stage powered flight. Made of a carbon composite material, the fairing protects satellites on their way to orbit. The following table describes key safety features of Falcon launch vehicles.

Table 1-1. Key safety features of Falcon launch vehicles. (Table provided by SpaceX)

Design/Operations Feature	Safety Benefit
Designed to NASA human-rating margins and safety requirements	Improves reliability for payloads without crew through increased factors of safety, redundancy and fault mitigation
Horizontal manufacturing, processing and integration	Reduces work at height during numerous manufacturing, processing and integration procedures, and eliminates many overhead operations
All-liquid propulsion architecture; fuel and oxidizer are stored separately on the ground and in the vehicle. Propellant is not loaded into the vehicle until the vehicle is erected for launch	Significantly improves safety by eliminating hazardous ground handling operations required for systems that use solid propellant cores or boosters
Rocket-grade kerosene and liquid oxygen as primary propellants	Reduces health hazards to processing, integration, and recovery personnel compared to systems that use high toxicity primary propellants
Non-explosive, pneumatic release and separation systems for stage separation and standard payload fairing separation	Zero-debris separation systems significantly reduce orbital debris signature, can be repeatedly tested during the manufacturing process, and eliminate hazardous pyrotechnic devices
Regular hardware-in-the-loop (HITL) software testing	Complete verification of entire mission profile prior to flight

SpaceX met with several government agencies to help plan the proposed mission landing in the Exuma Sound, Bahamas (the Project). The agencies engaged to date include but are not limited to the Ministry of Tourism, Investments and Aviation, and the Department of Environmental Planning and Protection (DEPP). An Environmental Baseline Statement was submitted to the DEPP which outlined the expected environmental impacts on March 25, 2024. Based on subsequent meetings with the DEPP, and the approval of the Environmental Management Plan (EMP) Terms of Reference (TOR), the current EMP was prepared to capture additional environmental impacts, prescribe mitigation strategies, and describe environmental monitoring for the initial launch of the Falcon 9. As subsequent launches are proposed, the EMP will be amended to incorporate the results of the post-launch monitoring reports.

The EMP is an initial plan based on the Project design, and discussions with SpaceX and the DEPP. DEPP is the regulatory body managing EMPs and general environmental compliance in The Bahamas.

1.1 Summary of Impacts

Impacts were described in the Environmental Baseline Statement submitted to the DEPP in March 2024 and were based on readily available data from the landing site. The impacts were considered for both a worst-case scenario i.e. an anomaly, and a nominal-case scenario. In a worst-case scenario, the impacts included a moderate increase in noise, a moderate decrease in air and water quality, and a moderate impact on marine traffic. In the nominal case scenario, the impacts included minor impacts on marine traffic and noise quality and negligible impacts on the biological resources. In both instances, the impact on the socioeconomics was beneficial. Section 6.2 further summarizes these impacts and their associated mitigation measures and or best management practices. Section 10 describes studies designed to document conditions of the site before the launch and conditions post-launch to determine the impacts of the initial launch. Results from these studies will be used to develop a Post Launch Report. The Post Launch Report will help determine the requirements for additional launches.

1.2 Summary of Mitigation Strategies

A combination of mitigation strategies and best management practices will be followed. The temporary impact on mariners in the Exuma Sound will be mitigated through advanced communication with the mariners with the assistance of the Port Department. The landing area will be temporarily classified as a hazard area and as such will not be suitable for marine traffic. As this Project is meant to inform subsequent launches, ambient environmental conditions such as air and water quality will be measured near the landing site before and after the landing. Data will be compared in the Post Launch Report to determine whether the landing impacted these environmental conditions. In the event there is a negative impact on these conditions, the EMP will be modified with appropriate mitigation strategies for subsequent launches. Marine surveys will be conducted before and after the landing to document the marine species located within the minimum safe area from the landing site.

2 Introduction

2.1 Purpose

The Environmental Management Plan (EMP) for the Project serves as a critical framework designed to proactively address and mitigate potential environmental impacts associated with the Falcon 9 landing. Its primary purpose is to ensure safeguarding of the surrounding environment, including air, water, flora, fauna, and cultural heritage sites. The EMP outlines a comprehensive set of measures aimed at minimizing adverse environmental effects and promoting compliance with relevant legal and regulatory requirements. Additionally, the EMP facilitates stakeholder engagement and promotes transparency by providing a structured approach for consultation with local communities and regulatory authorities. Its scope encompasses all phases of the Project lifecycle, from the entry point of Falcon 9 to post-landing monitoring and reporting, emphasizing the Project's commitment to environmental stewardship and responsible resource management.

2.2 Scope and Content

The scope of this EMP includes a description of the Project’s potential environmental impacts, mitigation strategies to lessen environmental impacts, and plans to reduce health and safety risks.. The results of this EMP will provide SpaceX, DEPP and the Environmental Manager with details that help to avoid and/or mitigate detrimental environmental impacts and safety risks due to the Project, and therefore, assist with successful Project execution.

The Environmental Management Plan (EMP) also inlcudes a summary of the environmental baseline conditions, including assessments of air quality, water quality, flora, fauna, and noise levels.. Furthermore, the EMP aims to address environmental and social concerns raised by regulatory agencies and other stakeholders. This EMP proposes mitigation measures aimed at minimizing or eliminating adverse environmental impacts, along with strategies for their implementation and rigorous monitoring and reporting protocols to ensure compliance and continual improvement throughout all Project phases.

3 SITE LOCATION

The Bahamas, an archipelagic nation situated in the Atlantic Ocean, comprises 29 major islands, 661 cays and 2,387 rocks. The islands vary significantly in size and there are numerous uninhabited cays. There are extensive shallow sand banks, most notably, the Great Bahama Bank and the Little Bahama Bank. The Bahamas' prevailing trade winds, originate from the northeast during the winter months and the east-southeast during the summer months. These consistent winds, typically ranging from 10 to 20 knots, exert a significant influence on the region's tropical climate. The Falcon 9 mission will land in the Exuma Sound, east of the Exuma Cays.

3.1 GEOGRAPHIC LOCATION

The Exuma archipelago comprises approximately 365 islands and cays, forming a chain extending about 150 miles within the Bahamian archipelago. With a population recorded at 11,515 as of 2010, the Exuma Cays lie approximately 32 miles southeast of country’s capital city, Nassau. The two main islands within the Exuma district are Great Exuma and Little Exuma. George Town, the capital city of Exuma, is situated on Great Exuma, which spans an estimated landmass of 32 miles in length, while Little Exuma measures approximately 3 miles in length and is connected to Great Exuma via the Ferry Dock Bridge. The proposed landing site is in the Exuma Sound, located east of the Exuma Cays and west of South Eleuthera. The approximate coordinates of the landing site is 24.6615°N, and 76.5324 °W. These coordinates are within the northeast booster landing ellipse and SpaceX anticipates that the landing will remain inside the booster landing ellipse. In addition to the booster landing site, the parafoil landing is another site to consider. The coordinates are approximately 24.034°N and 75.848°W; and 24.020°N and 75.860°W. The retrieval area for the parafoil will remain within the green ellipse shown in the following figures. The following figures show the proposed flight plan and landing sites relative to islands in The Bahamas.

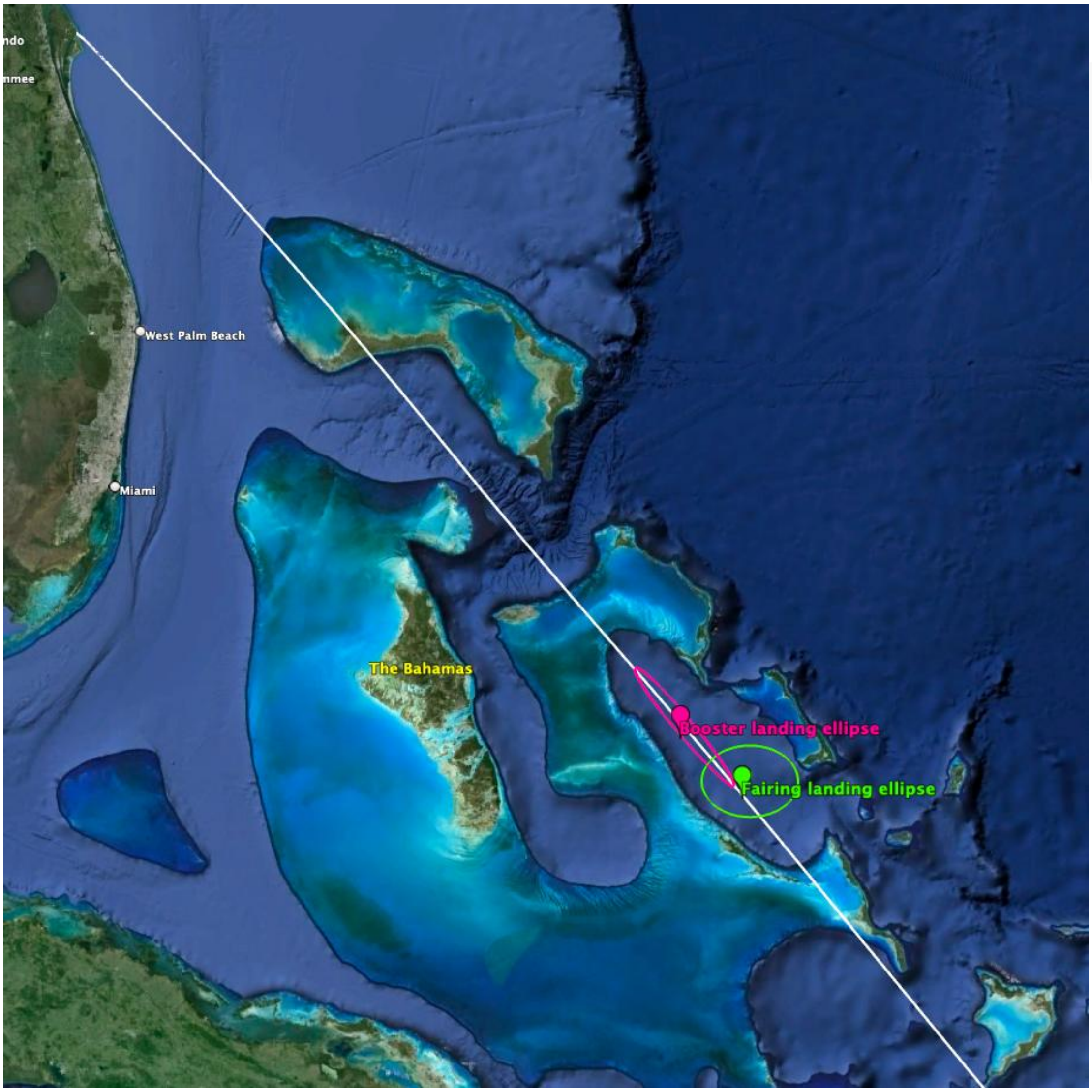

Figure 3-1. Flight Plan figure provided by SpaceX based on original landing location.

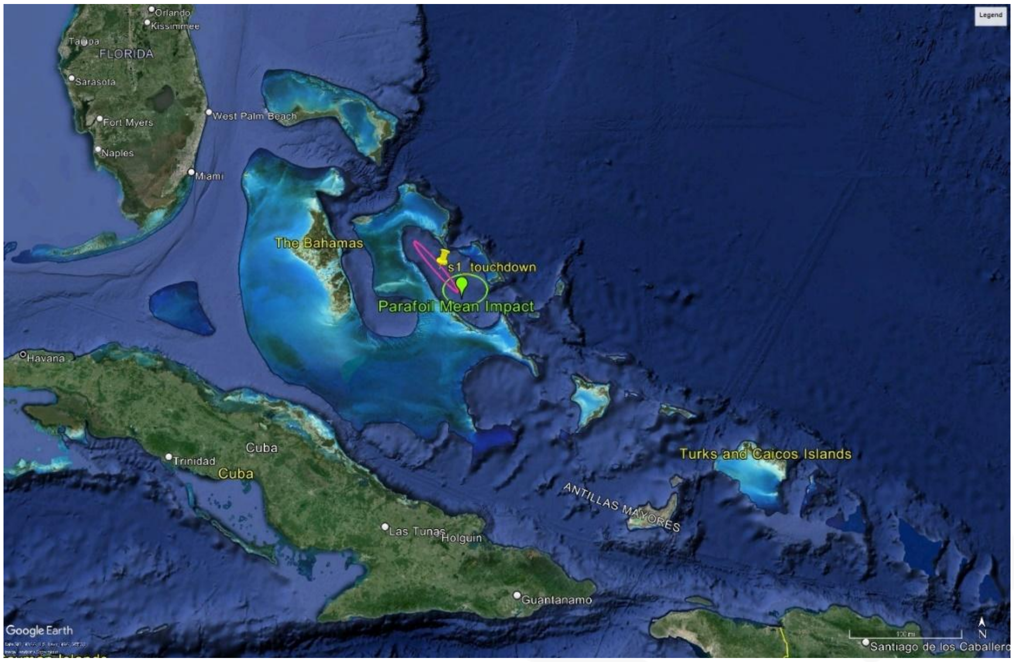

Figure 3-2. Original proposed landing is shown relative to The Bahamas, Florida, and Turks and Caicos (Basemap Google Earth, 2024)

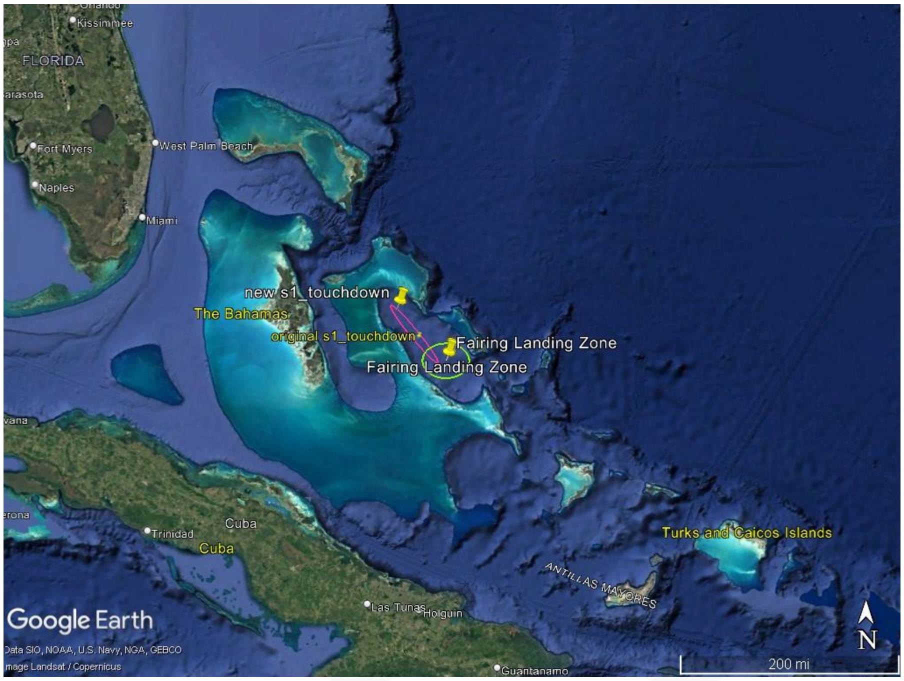

Figure 3-3. New landing site shown relative to the original landing site in The Bahamas. (Basemap Google Earth, 2025)

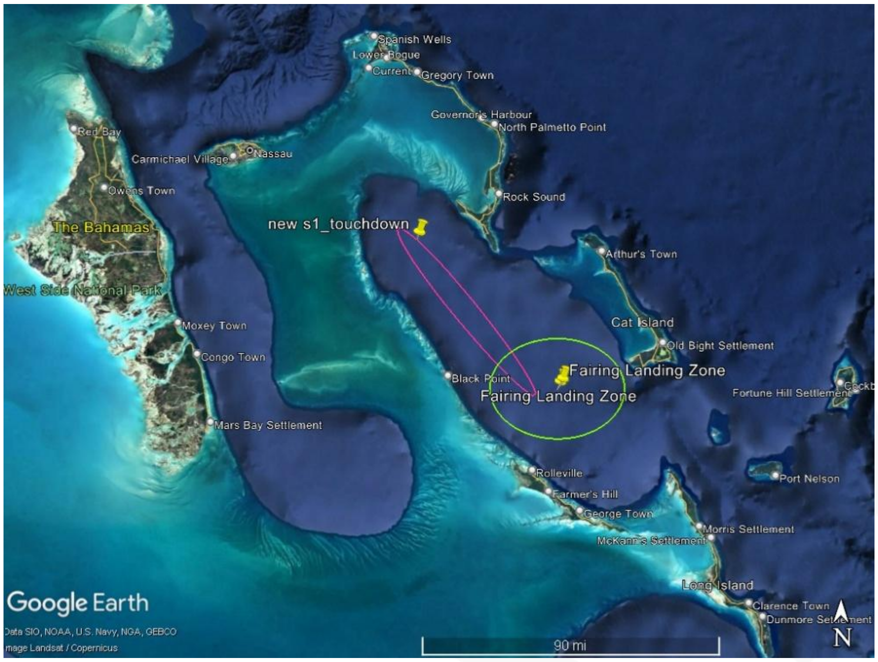

Figure 3-4. Proposed landing site relative to islands in the Central Bahamas. (Basemap Google Earth, 2024)

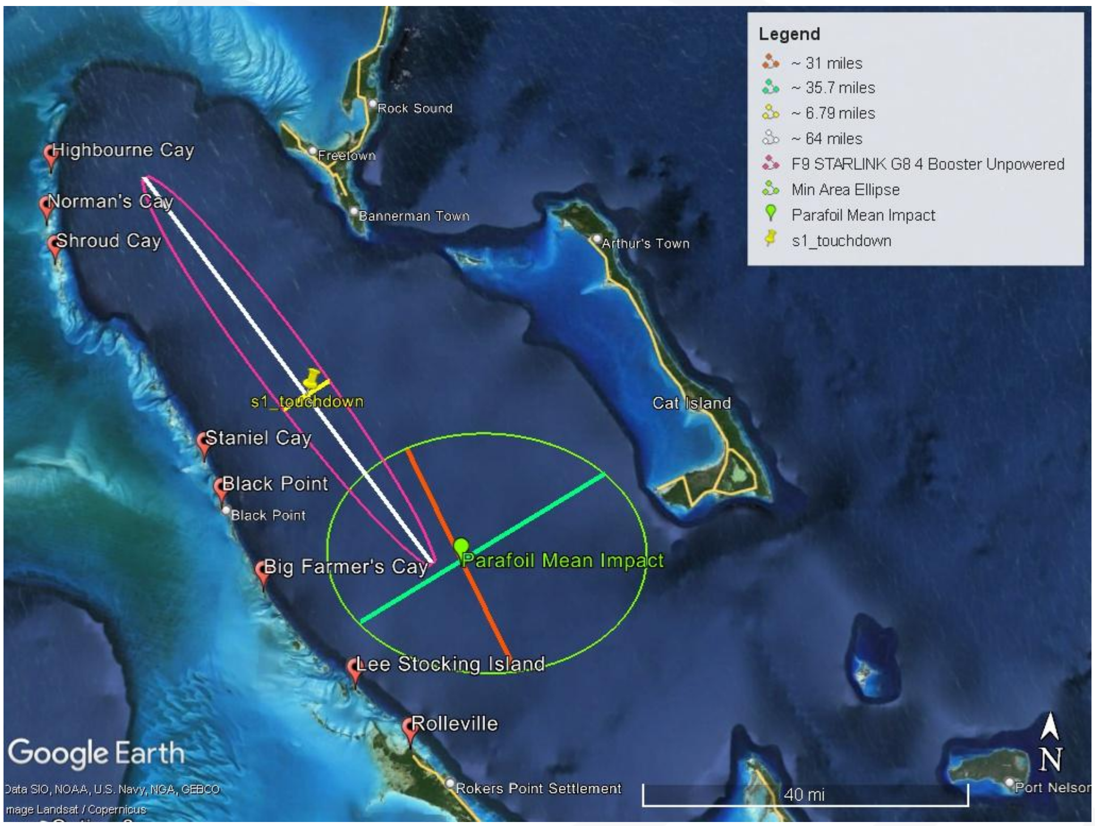

Figure 3-5. Proposed landing relative to the Exuma Cays, and Cat Island (Basemap from Google Earth, 2024)

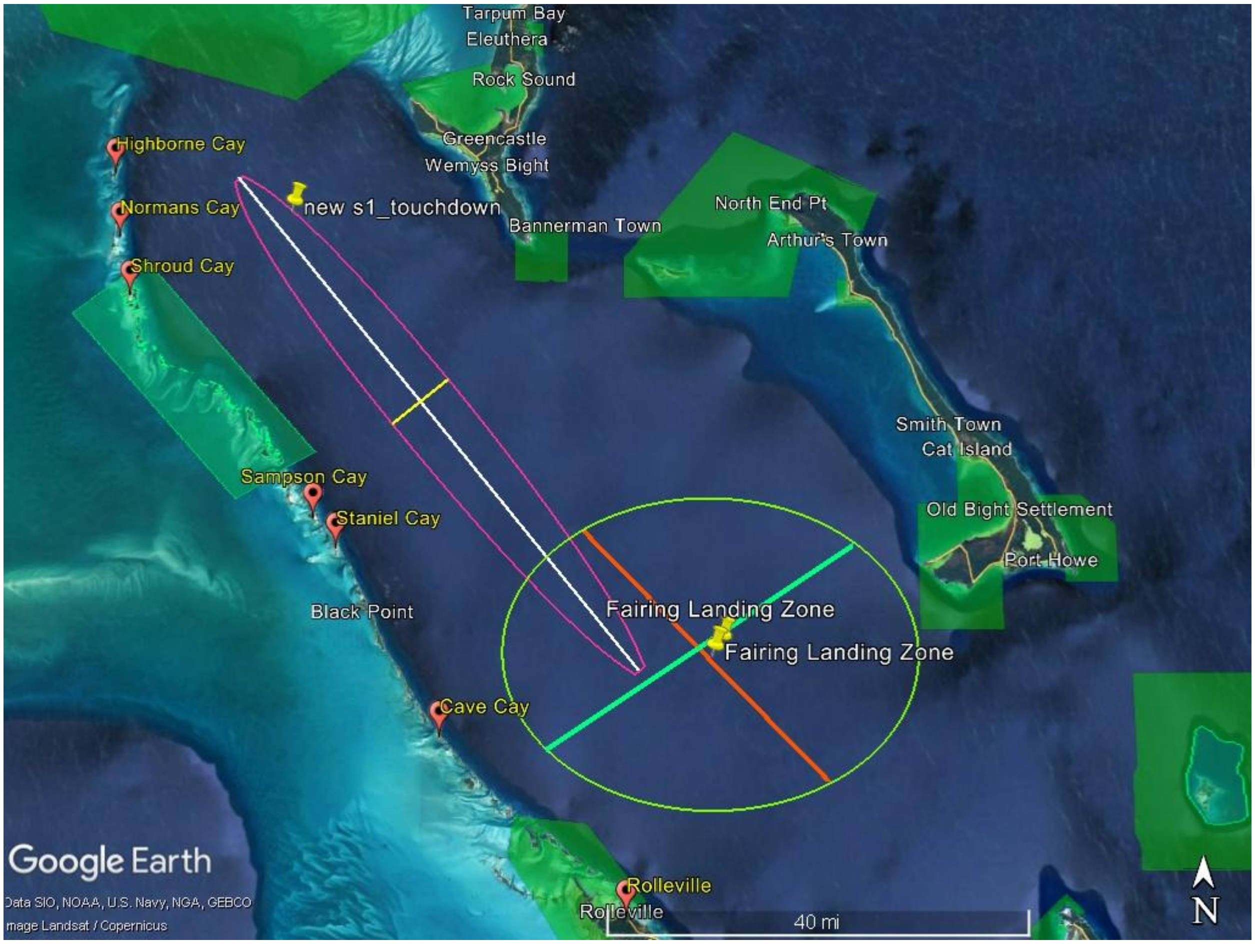

Figure 3-6. Updated landing site relative to the Exuma Cays, Cat Island, and protected areas (Basemap from Google Earth, 2025)

3.2 Proposed Project

3.2.1 Flight Plan (*Figure 3-7*)

Once the rocket launches, Stage 1 flight over Grand Bahama is expected to last for less than 2 seconds, with the Engine cutoff Stage Separation, and Stage 2 start then initiating prior to flight over The Bahamas. Stage I performs 'two burns' essentially a controlled landing on an autonomous droneship to successfully retrieve the equipment for future use. Two fairing halves come down under parafoil and land in the water to be picked up by a recovery vessel waiting nearby. Figure 3-7 provides general information on the Falcon9 flight. *Figure 3-8*Figure 3-8 and Figure 3-9 show the correlation between the flight plan and the map of The Bahamas.

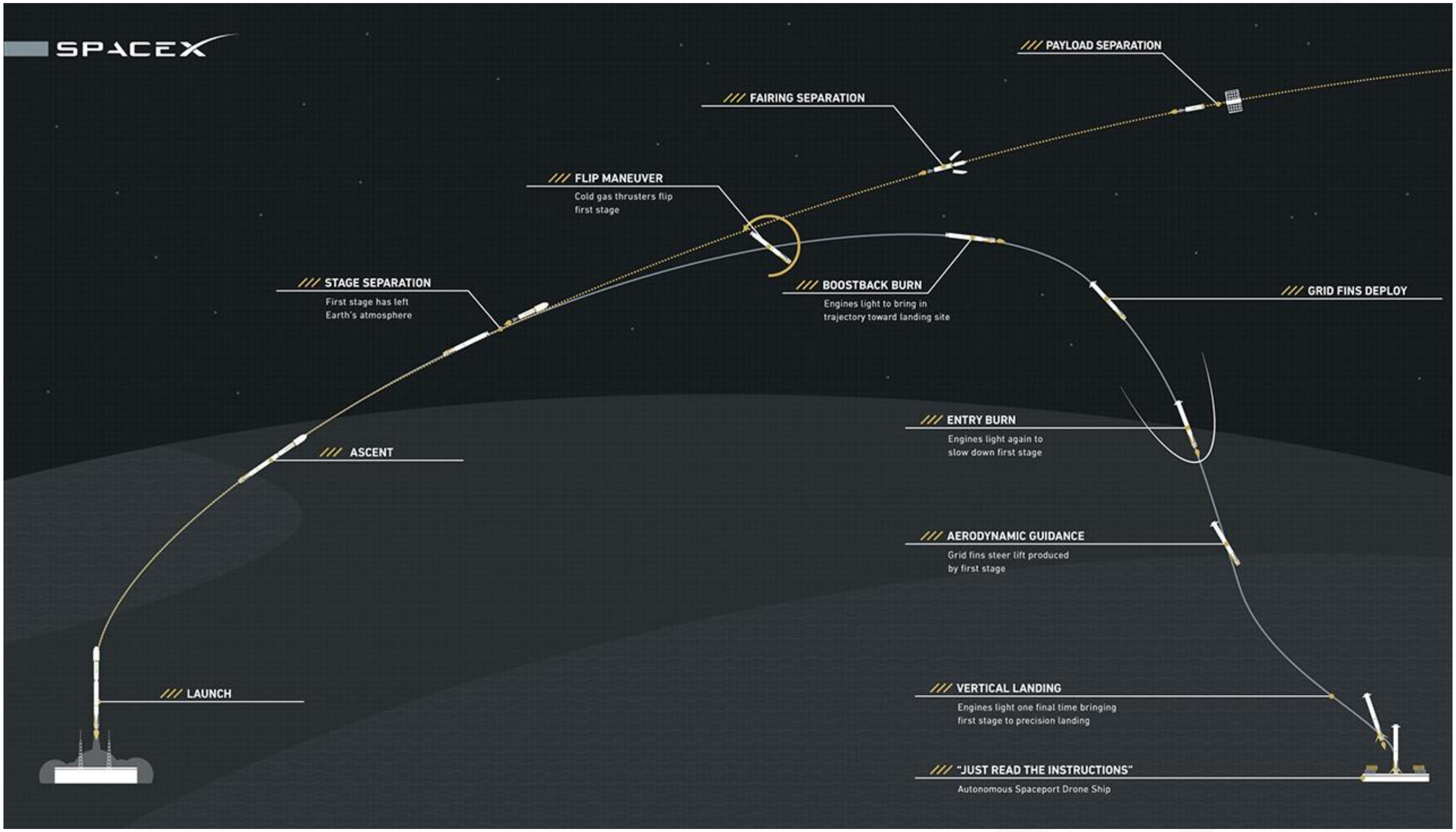

Figure 3-7. General launch and flight methodology for the Falcon 9. (Figure provided by SpaceX)

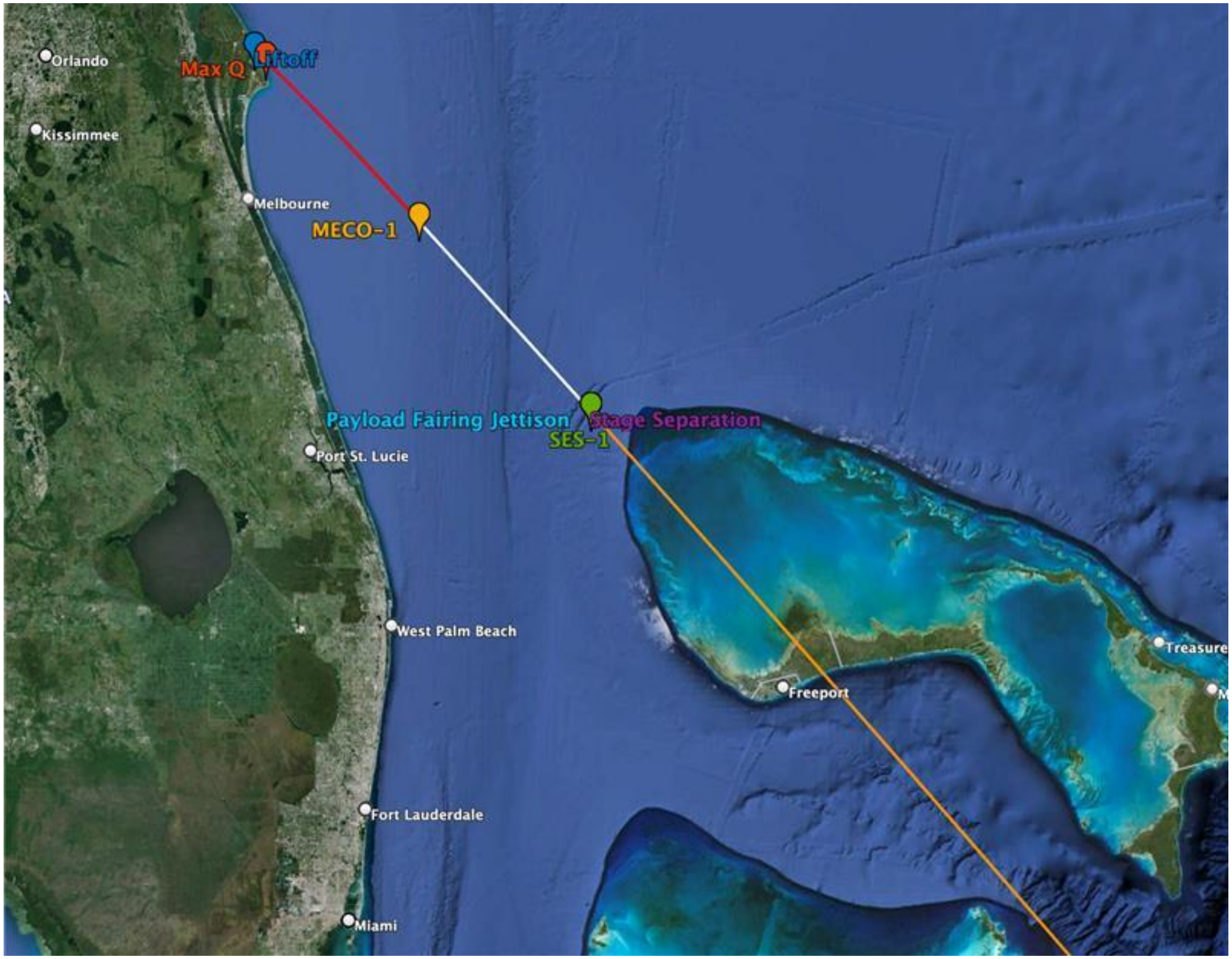

Figure 3-8. Correlation of General Flight Plan phases and map of the Northern Bahamas (Provided by SpaceX).

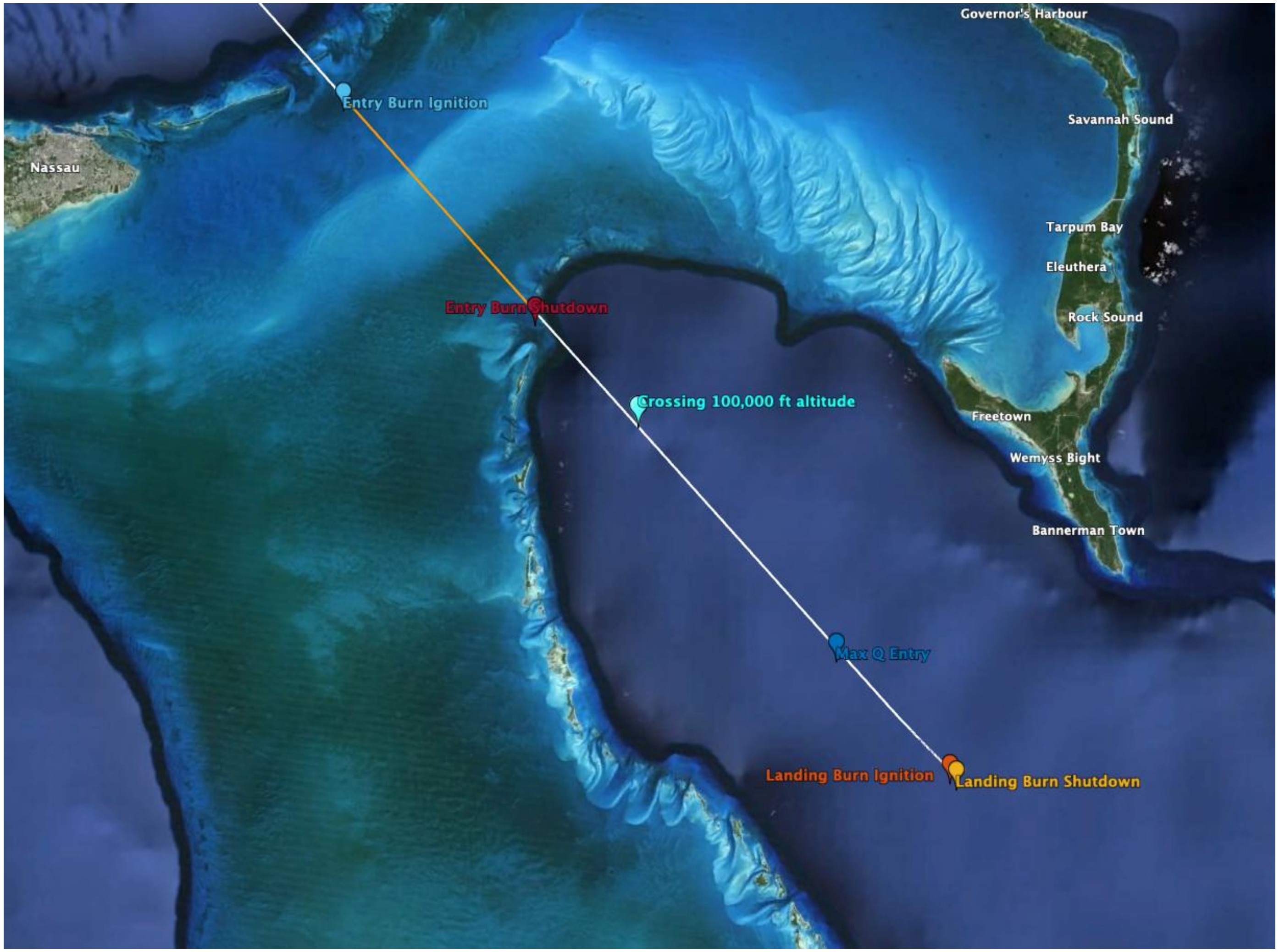

Figure 3-9. Correlation of General Flight Plan phases and map of the Central Bahamas (provided by SpaceX).

3.2.2 Booster Landing and Securing Operations

Operational Timeline:

After the Droneship and hazard area has been cleared of all personnel and surveilled prior to launching the following is then performed:

1. Rocket Lands on Droneship, exact coordinate – Residual fuel still left post landing estimated at:
   - **Liquid Oxygen:** 314 gallons (less then ~4 bathtubs)
     - Vented directly onto the Droneship deck and evaporates in pure O_2. No contact with ocean.
   - **RP-1:** 300 gallons (less than ~4 bathtubs)
     - Remains contained on the rocket post landing.
2. Falcon 9 is structurally secured to deck with a robot.
3. SpaceX crew boards the droneship and connects fluid and electrical connections to the rocket.
4. Remaining RP-1 is drained off the rocket to specialized fuel storage on Droneship.

3.2.3 Hazard Area Breakdown

The Fairing will steer into the wind during flight to minimize drift and improve aerodynamics. The selected area is large enough to account for variability for the day of launch in wind changes and conditions within the booster recovery area. All possible locations that the landing site could be designed for does not change from mission-to-mission. The Booster landing ellipse is a small (500m wide) circle for the planned stage 1 landing. The final location will be determined mission-to-mission but will generally remain inside the Booster recovery area. Stage 1 boasts a landing success rate of >95% from 2017 to the present, with debris always confined to the forecasted sites.

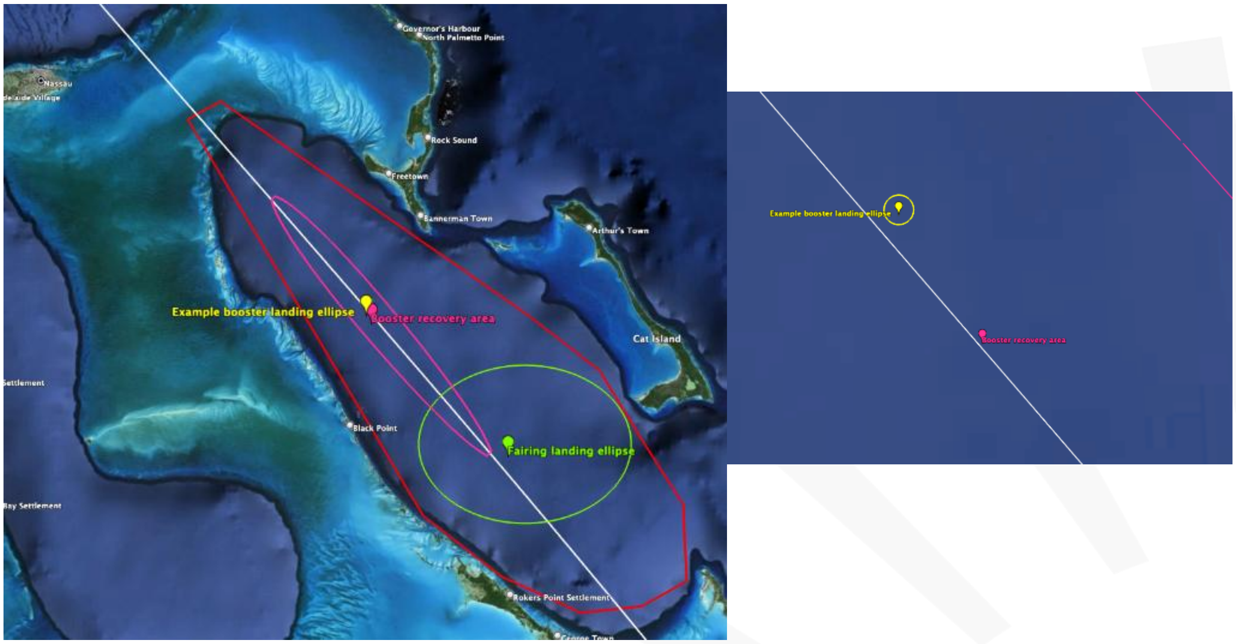

Figure 3-10. Hazard Area Breakdown (Provided by SpaceX).

3.2.4 Operational Timeline prior to Landing and recovery process.

A crewed fairing recovery vessel navigates to and remains in location prior to launch near the proposed landing location, approximately ~30nm downrange of the droneship/ booster Landing Zone. The Fairing recovery area is cleared of all personnel and surveilled prior to launch to ensure that it is free and clear of any potential hazards.

Figure 3-11. Image of the Booster Landing successfully landed on the droneship, the proposed methodology to be utilized for the Exuma sound mission (Provided by SpaceX).

3.2.5 Fairing Recovery Operations

During the rocket operation, Fairings will separate from the second stage once in the vacuum of space, with the fairings re-entering the atmosphere under the parafoil and soft landing into the ocean where they are designed to float, the Parafoils separate from the fairing halves and are retrieved out of the water by a small fastboat that is in location and waiting for the equipment to land. Fairing halves are recovered out of the water by a crane on the fairing recovery vessel.

The fairing consists of two halves which separate, allowing the deployment of the payload at the desired orbit. In the past, following the fairing separation, both halves of the fairing were left to splash down in the ocean, break apart, and sink. The parachute system consists of one drogue parachute and one parafoil. Following re-entry of the fairing into Earth's atmosphere, the drogue parachutes deploy at a high altitude (approximately 50,000 feet) to begin the initial slow down and to extract the parafoil. The drogue parachute (and the attached deployment bag) cuts away following the successful deployment of the parafoil. The parachute system slows the descent of the fairing to enable a soft splashdown so that the fairing remains intact. Both fairings, parafoils and drogue chutes are recovered during these operations. A detailed description of recovery procedures were discussed with DEPP and the Project coordination team.

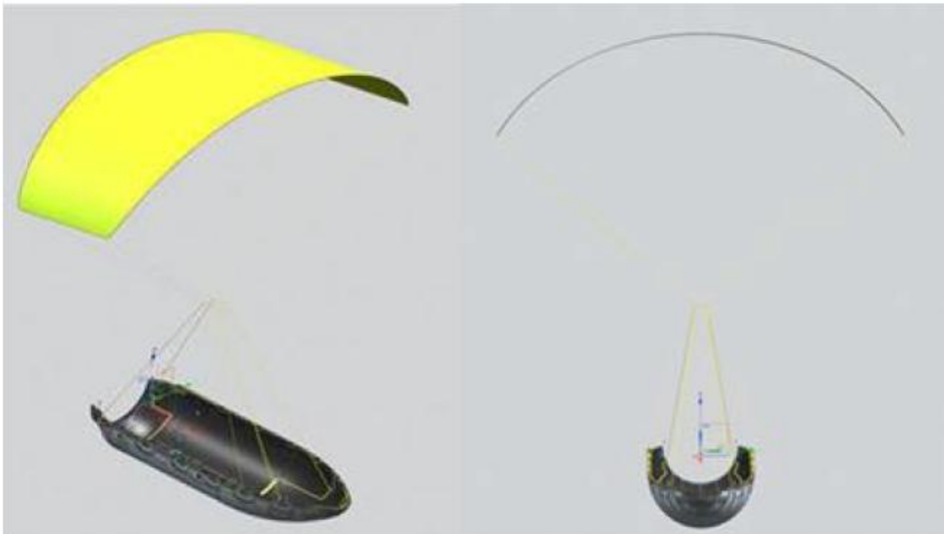

Figure 3-12. The parachute system consists of one drogue parachute and one parafoil (Provided by SpaceX).

3.3 PROJECT SCHEDULE AND PHASING

Table 3-1. Proposed Schedule for Initial Launch

Activity	Description	Duration / Timeline
Launch Preparation	Permitting with DEPP and other regulatory agencies	7 days before the Launch
	Deploy Recovery Vessels, Observation Vessels, and Environmental Monitoring Team. Environmental Monitoring Team to conduct Pre-Launch surveys. • Avian Studies • Air Quality Measurements • Water Quality Assessments • Marine Surveys	NET 5 days before the Launch
During Launch	See section 3.2 Proposed Project Environmental Monitoring Team to conduct surveys during launch activity.	February 18, 2025
Post Launch	Confirmation of successful completion of Launch and Post launch surveys begin. • Avian Studies (ongoing) • Air Quality Measurements (ongoing)	Up to 1 week after the launch for data collection.

	• Water Quality Assessments (ongoing) • Marine Surveys (ongoing)	
Post Launch Report	Environmental Monitoring Report produced and submitted to DEPP for review.	8 weeks post launch

4 Environmental Regulatory Bodies and Standards

Ministry names were listed as stated on The Government of The Bahamas website.

4.1 Relevant Regulatory Bodies

Office of the Prime Minister - Office of the Prime Minister coordinates ministries, government, and parliamentary business. Specific elated departments and agencies are listed below.

Department of Lands and Surveys - This department is responsible for planning, mapping, and monitoring of crown land (i.e. where beaches begin and end, high water marks, etc.).

National Emergency Management Agency (NEMA) - NEMA aims to reduce life and property loss in the event of a natural disaster.

Antiquities Monuments and Museum Corporation (AMMC) - The mission of AMMC is "to protect, preserve, and promote the Historic Cultural Resources of The Bahamas, and to be the number one conservation Agency in the world. We will do this while protecting our environment, encouraging research and archaeology, and by protecting, preserving, and promoting our Historical Sites."

Ministry of Agriculture and Marine Resources - The Ministry of Agriculture and Marine Resources is responsible for the implementation, monitoring and evaluation of policies related to agricultural lands and marine resources. The Ministry serves as the Management and Scientific Authority for the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in The Bahamas.

Department of Marine Resources (DMR) - DMR is primarily responsible for the administration, management, and development of fisheries in The Bahamas. The department was created to administer, manage, and develop the fisheries sector as stipulated by the Fisheries Resources (Jurisdiction and Conservation) Act. The department is also tasked with enforcement of Fisheries Regulations, Marine Mammal Regulations and the Seafood Processing and Inspection Regulations.

Ministry of Works and Family Island Affairs - The Ministry of Works and Family Island Affairs maintains the physical infrastructure and natural environment of The Bahamas by providing quality services to its client agencies.

Department of Works - The Department of Works maintains public infrastructure inclusive of government buildings, roads, docks, bridges, and cemeteries.

Department of Physical Planning - The Department of Physical Planning manages town, physical, country and land use planning, zoning, private roads and subdivisions for New Providence and the Family Islands.

Water and Sewerage Corporation - The Water and Sewerage Corporation is entrusted with managing, maintaining, distributing, and developing the water resources of The Bahamas.

Ministry of Environment & Natural Resources - The Ministry of Environment and Natural Resources serves to protect, conserve, and manage the environment of The Bahamas. This ministry focuses on environmental control, solid waste management, public sanitation, and the beautification of public areas such as parks and beaches.

Department of Environmental Planning & Protection (DEPP) - The functions of the Department are to provide for and ensure the integrated protection of the environment of The Bahamas and ensure the sustainable management of its natural resources." DEPP is responsible for the evaluation of EIAs and EMPs and managing international environmental conventions.

Department of Environmental Health Services (DEHS) - DEHS manages the disposal of all wastes and management of environmental pollution (on land or in water). This department also promotes planning and approves various measures designed to ensure wise use of the environment.

Forestry Unit - The Forestry Unit's mandate is "to develop the forest resources of The Bahamas to their maximum potential by applying sound, scientific and sustained yield forest management principles and concepts."

Bahamas National Trust (BNT) - The mission of the BNT is "Conserving and protecting the natural resources of The Bahamas, through stewardship and education, for present and future generations."

Ministry of Labour - The Ministry of Labour oversees and regulates labour relations within The Bahamas.

Department of Labour - The Mission of the Department of Labour promotes good industrial relations between employer and employee, while promoting a high level of employment.

Ministry of Tourism, Investments and Aviation – The Ministry of Tourism, Investments and Aviation oversees the promotion and development of tourism, relations with the Gaming Board and the Hotel Corporation of The Bahamas. As well as the promotion, facilitation and administrative processing of investments, and relations with the Bahamas Civil Aviation Authority, Airport Authority, and air transport licensing.

Department of Aviation - The Department of Aviation (DOA) was created to provide oversight to all government entities involved in the aviation sector, to adjudicate and resolve issues that develop between these entities, to provide a depository for all matters relating to the aviation sector, and to provide the necessary focus to the government's goals in aviation. The following stakeholders fall under the DOA; Air Accident Authority (AAIA), Airport Authority (AA), Bahamasair, Bahamas Air Navigation Services Authority (BANSA), Civil Aviation Authority Bahamas (CAAB), Freeport Airport Development Company (FAD), Nassau Airport Development Company (NAD), and Nassau Flight Services (NFS).

Ministry of National Security – The Ministry if National Security is responsible for the public safety of The Bahamas. This Ministry has policy oversight for the following security agencies: the Royal Bahamas Police Force (RBPF), the Royal Bahamas Defence Force (RBDF) and the Bahamas Department of Corrections. The portfolio also includes responsibility of the Parliamentary Registration Department, Prerogative of Mercy and the specialised areas of the National Anti-Drug Secretariat and Security Guards and Inquiry Agents Licensing.

4.2 National Laws and Regulations

Agriculture and Fisheries Act, 1964 - "An Act to provide for the supervision and development of agriculture and fisheries in The Bahamas," where Section 4 explains that "The Minister may make rules for all or any of the following purposes, (a) to define area hereinafter called 'protected areas' within which it shall be unlawful for any person except a licensee especially licensed in that behalf to plant, propagate, take, uproot or destroy any species of plant…".

Antiquities, Monuments and Museum Act, 1998 (Ch. 51) - "An Act to provide for the preservation, conservation, restoration, documentation, study and presentation of sites and objects of historical, anthropological, archaeological and paleontological interest, to establish a National Museum, and for matters ancillary thereto or connected therewith", where, section 3 speaks to the declaration of a monument by reason of its historical, anthropological, archaeological or paleontological significance.

Bahamas National Wetlands Policy[1] – see Ramsar Convention.

Bahamas Public Parks and Public Beaches Authority Act, 2014 – An Act to establish the public parks and public beaches authority, to provide for the property rights and liabilities of the public parks and public beaches authority and to identify, regulate, maintain, develop and conserve public parks and public beaches and for connected purposes." Where section 5 speaks to functions of the Authority.

Coast Protection Act, 1968 (Ch. 204) - "An Act to make provision for the protection of the coast against erosion and encroachment by the sea and for purposes connected therewith", where, section 8 speaks to approval for coastal protection work and section 9 speaks to the excavation of materials that compose of the seashore.

Conservation and Protection of the Physical Landscape of The Bahamas Act, 1997 (Ch. 260) - "An Act to make provision for the conservation and protection of the physical landscape of The Bahamas. The Act contains parts regarding administration, regulation of excavation and landfill operations, provisions governing dangerous excavations, landfill operations, quarries or mines, zoning of The Bahamas for the purposes of quarrying and mining operations, protected trees, and general entries", where, Section 27 speaks to applications, permits and licenses, appeals, fees, offences, and penalties.

Coast Protection Act, 1968 (Ch. 204) - "An Act to make provision for the protection of the coast against erosion and encroachment by the sea and for purposes connected therewith", where, section 8 speaks to approval for coastal protection work and section 9 speaks to the excavation of materials that compose of the seashore.

Disaster Preparedness and Response Act, 2006 (Ch. 34A) - "An Act to provide for a more effective organization of the mitigation of, preparedness for, response to and recovery from emergencies and disasters." This Act contains parts regarding Director of NEMA, Advisory Committee, policy review and plan; emergency operation centers and shelters; obligations of other public officers; specifically, vulnerable areas; disaster alerts and emergencies; and miscellaneous entries.

Environmental Health Service Act, 1987 (Ch. 232)- "An Act to promote the conservation and maintenance of the environment in the interest of health, for proper sanitation in matters of food and drinks and generally, for the provision and control of services, activities and other matters connected therewith or incidental thereto", where section 5 speaks to functions of the Department of Environmental Health.

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[1] https://faolex.fao.org/docs/pdf/bha175035.pdf

Environmental Health Services (Collection and Disposal of Waste) Regulations, 2004 (Ch. 232) - "These Regulations may be cited as the Environmental Health Services (Collection and Disposal of Waste) Regulations, 2004", where section 18 speaks to removal of construction waste and section 19 speaks to industrial waste disposal.

Environmental Impact Assessment Regulations, 2020 – An extension of the Environmental Planning and Protection Act that outlines the Environmental Impact Assessment Regulations which apply throughout the territory of The Bahamas including every island and cay; "The Minister, in exercise of the powers conferred by section 12 of the Environmental Planning and Protection Act, 2019 (No. 40 of 2019)".

Environmental Planning and Protection, 2019 – An Act to establish the department of environmental planning and protection; to provide for the prevention or control of pollution, the regulation of activities, and the administration, conservation, and sustainable use of the environment; and for connected purposes.

Environmental Planning and Protection (spot) Fines Regulations, 2024 – The regulations list the fines associated with the Environmental Planning and Protection Act.

Forestry Act, 2010 – An Act to provide the conservation and control of forests and for matter related thereto.

Forestry (Declaration of Protected Trees) Order, 2021 – The declaration of protected trees for the purpose of this Act are specified in Part I (Endemic or Endangered or Threatened Protected Trees) and II (Cultural or Historical and Economic Protected Trees).

Forestry (Amendment) Regulations, 2021 – "The Minister, in excise of the powers conferred by section 34 of the Forestry Act, 2010, makes the following Regulations." Where the amendment speaks to Regulation 36 subsection 3A "The Minister, acting on the advice of the Director of Forestry, may where a hurricane, tornado, or any other natural disaster has occurred in any island, islet or cay throughout The Bahamas which causes grave damage to any forest, forest estate, forest reserve, conservation forest or protected forest to be payable as specified in the Second Schedule, for royalties, permits and licenses for the purpose of these regulations."

Fisheries Resources Jurisdiction and Conservation Act Regulations, which prohibits the removal of Sea Oats, *Uniola paniculata*. "13. No person shall cut, harvest or remove from any beach or shore or from any area immediately adjacent thereto any Sea Oats except with the written permission of the Minister.[2]"

[2]laws.bahamas.gov.bs/cms/images/LEGISLATION/SUBORDINATE/1986/1986-0010/FisheriesResourcesJurisdictionandConservationRegulations_1.pdf

Health and Safety Work Act, 2002 (Ch. 321C) - "An Act to make provisions relating to health and safety at work and for connected purposes." where, Section 4 speaks to general duties of employers to their employees and where, Section 7 speaks to general duties of employees at work.

Health and Safety at Work (Amendment) Act, 2015 - (repeal and replacement of Section 17 of Ch. 321C) Contains parts regarding applications, permits and licenses, appeals, fees, offences, and penalties.

Marine Mammal Protection Act, 2005 (Ch. 244A) – "An Act to make provision for the protection of marine mammals".

Marine Mammal (General) Regulations (Ch. 244A) – "These Regulations may be cited as the Marine Mammal Protection (General) Regulations and shall come into force on the first day of May 2006", where Section 18 speaks to Marine Mammal Protection (General) Regulations and Section 19 speaks to Marine Mammal (Captive Dolphin Facilities) Regulations.

Wild Birds Protection Act, 1952 (Ch. 249) – "An Act to make provision for the protection of wild birds."

Wild Animal Protection Act, 1968 (Ch. 248) – "An Act to make provisions for the control of the taking and export of wild animals."

Civil Aviation (Amendment) Act, 2012 – "An Act to amend Civil Aviation Act, Chapter 284, to establish measures for the organization and designated responsibilities within The Bahamas for the safeguarding of passengers, crew, ground personnel and general public against acts of unlawful interference with Civil Aviation and for connected matters."

Civil Aviation (Air Navigation) Regulations, 2001 (Ch. 284) – "For the purposes of the Civil Aviation Act and of these Regulations, the provisions of the Convention on International Civil Aviation signed at Chicago on the 7th December, 1944 ("the Chicago Convention") and the Annexes thereto together with the Standards and Recommended Practices established by the International Civil Aviation Organization (ICAO) thereunder and such other internationally recognized standards and practices, including the Joint Airworthiness Requirements issued from time to time by the Joint Aviation Authorities, shall be adopted and applied (as appropriate) in The Bahamas".

Civil Aviation Air Navigation (Investigation of Accidents) Regulations, 2002 (Ch. 284) – Subsidiary Legislation under the Civil Aviation Act, 1949 (12, 13 and 14 Geo. 6 c. 67) of the United Kingdom, in force under section 20 of the Civil Aviation Act. (Ch. 284) "These Regulations relate to civil aviation only and shall apply to accidents arising out of or in the course of air navigation which occur to any civil aircraft in or over The Bahamas or elsewhere to civil aircraft registered in The Bahamas."

Anti-Terrorism Act, 2010 (Ch. 107) – An Act to implement the United Nations convention respecting the suppression of the financing of terrorism, the United Nations Security Council Resolution 1373 on terrorism and generally to make provision for preventing and combating terrorism.

Whereas Section 7 states: "Protocol for the Suppression of Unlawful Acts of Violence at Airports Serving International Civil Aviation, supplementary to the Convention for the Suppression of Unlawful Acts against the Safety of Civil Aviation, signed at Montreal on 24th February 1988."

4.3 International Standards

Federal Aviation Administration (FAA) is the lead federal agency (United States of America) responsible for analyzing the potential environmental impacts of the Proposed Action. As authorized by Chapter 509 of Title 51 of the U.S. Code, the FAA licenses and regulates U.S. commercial space launch and re-entry activity, as well as the operation of non-federal launch and re-entry sites. The mission of the Office of Commercial Space Transportation is to ensure protection of the public, property, and the national security and foreign policy interests of the United States during commercial launch or re-entry activities, and to encourage, facilitate, and promote U.S. commercial space transportation[3]**.**

- **14 CFR 417.107(b)[4]** - This subpart contains public safety requirements that apply to the launch of an orbital or suborbital expendable launch vehicle from a Federal launch range or other launch site. If the FAA has assessed the Federal Launch Range, through its launch site safety assessment, and found that an applicable range safety-related launch service or property satisfies the requirements of this subpart, then the FAA will treat the Federal launch range's launch service or property as that of a launch operator without need for further demonstration of compliance to the FAA if:

  (a) A launch operator has contracted with a Federal launch range for the provision of the safety-related launch service or property; and

  (b) The FAA has assessed the Federal launch range, through its launch site safety assessment, and found that the Federal launch range's safety-related launch service or property satisfy the requirements of this subpart. In this case, the FAA will treat the Federal launch range's process as that of a launch operator.

  The Federal Launch Range performs safety analysis for all phases of the flight including overflight of The Bahamas.

[3] Federal Aviation Administration. (July 2020). Final Environmental Assessment and Finding of No Significant Impact for SpaceX Falcon Launches at Kennedy Space Center and Cape Canaveral Air Force Station.
[4] https://www.customsmobile.com/regulations/expand/title14_chapterIII_part417_subpartB_section417.107

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

- **ISO 23312:2022** - Space systems — Detailed space debris mitigation requirements for spacecraft.
- **ISO/DIS 5461** - Space systems — Failure reporting, analysis, and corrective action (FRACA) process requirements.
- **ISO 19924:2017** - Space systems — Acoustic testing.

National Aeronautics and Space Administration (NASA) is a U.S. government agency that is responsible for science and technology related to air and space. Federal oil pollution prevention regulations are in the Code of Federal Regulations (CFR) Title 40 Part 112[5]. These regulations require the preparation and implementation of Spill Prevention, Control and Countermeasure (SPCC) plans for all non-transportation related facilities that store oil in excess of the quantities below and that have either discharged or could reasonably be expected to discharge oil into navigable waters of the United States or its adjoining shorelines.

4.4 Conventions and Agreements

Stockholm Convention on Persistent Organic Pollutants – "As set out in Article 1, the objective of the Stockholm Convention is to protect human health and the environment from persistent organic pollutants."

Kyoto Protocol – The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change, which commits its Parties by setting internationally binding emission reduction targets. The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005.

Basel Convention on the Control of Transboundary Movement of Hazardous Wastes – "The Basel Convention is a global agreement between countries to protect human health and the environment against the adverse effects of hazardous wastes."

Ramsar Convention on Wetlands – "the intergovernmental treaty that provides the framework for the conservation and wise use of wetlands and their resources. The Convention was adopted in the Iranian city of Ramsar in 1971 and came into force in 1975."

[5] The Code of Federal Regulations (CFR). (2024). Retrieved from <https://www.ecfr.gov/current/title-40/chapter-I/subchapter-D/part-112?toc=1>

Minamata Convention - "The Minamata Convention on Mercury is a global treaty to protect human health and the environment from the adverse effects of mercury. The Convention draws attention to a global and ubiquitous metal that, while naturally occurring, has broad uses in everyday objects and is released to the atmosphere, soil, and water from a variety of sources. Major highlights of the Minamata Convention include a ban on new mercury mines, the phase-out of existing ones, the phase out and phase down of mercury use in a number of products and processes, control measures on emissions to air and on releases to land and water, and the regulation of the informal sector of artisanal and small-scale gold mining. The Convention also addresses interim storage of mercury and its disposal once it becomes waste, sites contaminated by mercury as well as health issues."[6]

5 ENVIRONMENTAL MANAGEMENT ORGANIZATION STRUCTURE

The organization chart below delineates the roles and responsibilities of SpaceX, various government agencies, and BRON to ensure the Project remains in compliance with the approved EMP.

[6] https://minamataconvention.org/en

5.1 ORGANIZATIONS AND RESPONSIBILITIES CHART

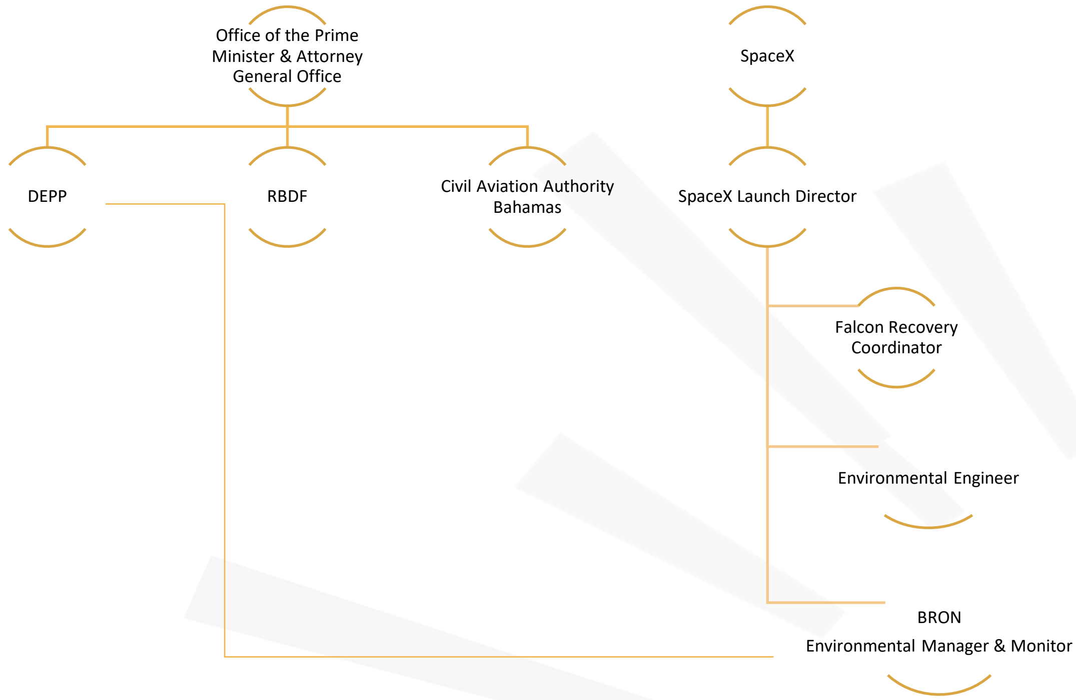


Figure 5-1. Organization Chart

SpaceX- SpaceX is responsible ultimately for the environmental compliance of the Project. SpaceX will liaise directly with DEPP, the Environmental Manger and/or Environmental Monitor as needed to ensure the Project remains in compliance with the EMP.

- SpaceX conducts active surveillance. It is SpaceX responsibility to ensure the hazard area is clear in accordance with the Standard Operating Procedures and licenses.

Launch Director (LD)- The Launch Director reports to SpaceX and liaises regularly with the Falcon Recovery Coordinator (FRC), and the Environmental Manager to ensure all site activities are coordinated to follow the EMP. The LD and the Environmental Manager is also responsible for the Grievance Response Mechanism (GRM) for the site. If a grievance should be escalated to SpaceX, the LD or the Environmental Manager will inform the DEPP as soon as possible. See Section 9.2 for a more detailed description of the GRM. Other responsibilities of the LD include:

- Ensuring adequate resources are available to implement and maintain the EMP.
- Applying necessary interventions to comply with the best management practices described in the EMP document.

Falcon Recovery Coordinator (FRC) - FRC reports to the LD and will observe landing activities to ensure activities follow the various permit conditions. Additional FRC responsibilities include:

- Adhering to existing plans and procedures or preparing plans and procedures independent of the EMP that comply with Bahamian environmental laws and regulations.
- Notifying the Vessel Response Team of shipboard emergencies. An example of the Vessel Response team structure is shown below.

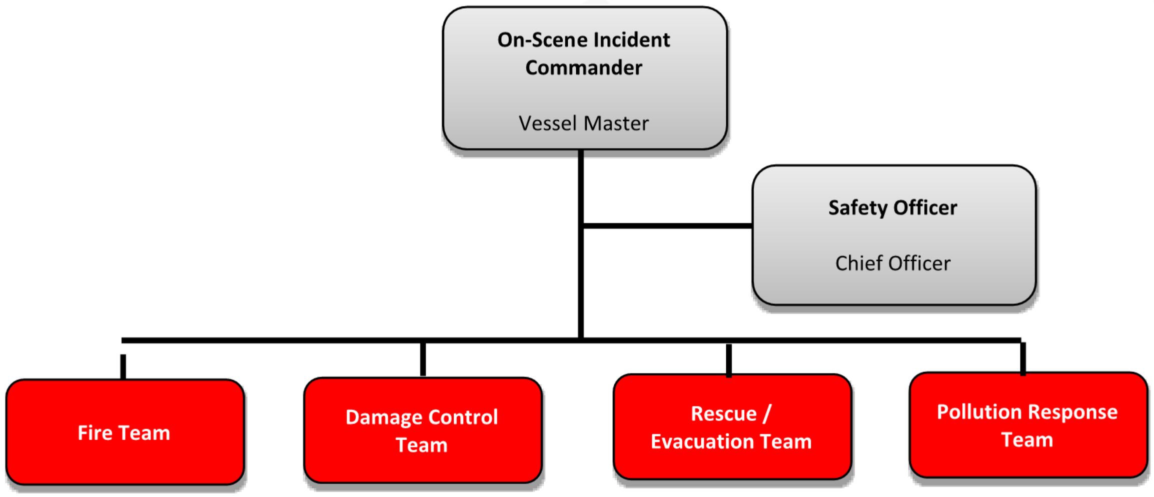


Figure 5-2. Vessel Response Team as referenced in the Emergency Management Manual submitted to DEPP.

Environmental Manager - The Environmental Manager reports to the LD and oversees the Environmental Monitor. The Environmental Manager will liaise with the Project Manager and submit Environmental Monitoring Checklists (EMC) to DEPP. Additional responsibilities include the following:

- To ensure full compliance and reporting relative to the approved EMP and the conditions associated with the Certificate of Environmental Clearance.
- To provide daily oversight of all environmental matters associated with landing activities.
- The engagement of the Environmental Monitor, which is subject to review by DEPP. The resume of the person to be engaged is provided to ensure qualification and experience commensurate with the work required.
- Schedule training sessions with the Environmental Monitor and staff on the Project site about the conditions and strategies described in the EMP and other established policies.
- Respond to concerns and queries raised by DEPP, the LD, and the Environmental Monitor as soon as possible.
- Investigate environmental incidents and develop action plans in collaboration with the Environmental Monitor and LD.
- Oversee and enforce the implementation of the EMP including the monitoring, inspection, documentation, submission of Post Launch Reports.

- Adjust the EMP as required under the direction of DEPP.
- Implement the EMP in collaboration with the Environmental Monitor.
- Integrate environmental requirements and mitigation efforts into project planning and launch.
- Ensure project personnel are aware of environmental requirements.
- Provide Environmental Monitoring Checklists with guidelines outlined in the EMP.
- Submit EMC, relevant forms associated with environmental monitoring, and other associated documentation to the DEPP based on the agreed-upon reporting schedule.

Environmental Monitor - The Environmental Monitor reports to the Environmental Manager and liaises with the LD to ensure day to day activities follow mitigation strategies described in the EMP. The appointed Environmental Monitor's CV will be submitted to DEPP once the Project is approved. Additional responsibilities include:

- The implementation of the EMP in collaboration with the Environmental Manager.
- Ensuring a 3rd party is in proximity to 'monitor' the preparation, landing, and recovery on a different vessel to be known as the monitoring vessel. The list of people on the monitoring vessel will include the Environmental Monitor/Manager and DEPP official(s).
- Full-time presence in proximity to observe and/or inspect all environmental risks and/or conditions and to ensure that during daily operations all environmental requirements are achieved. The monitoring location will be finalized on the day of the launch with coordination with the SpaceX team to ensure the vessel is outside the hazard area. A prelaunch preparation meeting will be conducted. The monitoring vessel will shadow the tug and fairing recovery vessel. The fairing recovery vessel and the monitoring will be in constant contact with each other and ~5 to 10 nautical miles from the fairing landing location or the booster landing. The monitoring vessel will be staged with the tug for the droneship and will be based on weather and other environmental conditions.
- Monitor and provide reporting based on the EMP criteria and liaise with all parties on any matters arising from non-compliance.

Environmental Engineer – The Environmental Engineer collaborates with the Launch Director to design the Project. The Environmental Engineer will work closely with the Environmental Manager to monitor the landing to ensure the Project remains in compliance with Bahamian environmental laws and regulations. This includes air quality assessments, noise level measurements, and checking for any fuel or chemical spills in areas where Bahamian Environmental Monitors are not permitted per safety protocols.

5.2 Environmental, Health and Safety Training

5.2.1 Environmental Training

Environmental training for the SpaceX team will target species identification training for protected species that may have been observed on site, spill response training, and solid waste management for the site. FRC and other SpaceX Personnel will also be trained.

All recovery personnel are required to have environmental training including the following courses:

- Marine Protected Species Trained Lookout Certification Course
- Spill Response Training
- Solid Waste Management

The Marine Protected Species Course is designed to train recovery personnel to monitor, notify, and avoid wildlife during recovery operations. Spill management and solid waste management training are designed to help prevent and mitigate impacts to crew safety and environment.

5.2.2 Health & Safety Training

The Health and Safety Program (HSP) will be followed during the pre-launch phase and during the landing. A designated member of the Vessel Recovery Personnel will be trained as an Emergency First Responder (EFR). The main components of the training program are listed below. These will be regularly reviewed and updated to ensure the program remains relevant and effective.

1. Introduction to Emergency Health and Safety
    - Overview of emergency health and safety
    - Importance of emergency preparedness
    - Understanding potential hazards and risks
    - Overview of local emergency response agencies and site protocols
2. Emergency Response Planning
    - Developing an emergency response plan
    - Identifying emergency response team roles and responsibilities
    - Establishing emergency communication procedures
    - Conducting regular drills and exercises
3. First Aid and CPR Training
    - Basic first aid techniques
    - Cardio-pulmonary resuscitation (CPR)
    - Handling emergencies such as heart attacks, choking, and allergic reactions
4. Fire Safety Training
    - Fire prevention techniques
    - Proper use of fire extinguishers
    - Evacuation procedures and routes

- Fire safety equipment and maintenance

5. Hazardous Materials Training
   - Understanding hazardous materials on the recovery vessels and Falcon9
   - Proper handling and storage of hazardous materials
   - Personal Protective Equipment (PPE) and its proper use
6. Workplace Violence Prevention
   - Understanding workplace violence
   - Identifying warning signs and risk factors
   - De-escalation techniques
7. Record-keeping and Documentation
   - Proper documentation of emergencies and incidents
   - Reporting requirements to authorities
   - Record-keeping requirements for health and safety incidents
8. Conclusion and Evaluation
   - Recap of training program
   - Participant evaluation and feedback
   - Identifying areas for improvement and future training needs

6 ENVIRONMENTAL IMPACTS AND MITIGATION SUMMARY

6.1 METHODOLOGY

The impact analysis evaluates the potential impacts resulting from the interaction between the landing activities and the surrounding environment during and post-landing. Impacts are described as changes brought about to the surrounding environment because of project-related activities.

Project-related activities have the potential to impact the surrounding environment negatively or positively and directly or indirectly. Negative impacts are activities that result in an adverse change or degradation from the environmental baseline, while positive impacts result in a beneficial change or improvement to the environmental aspect under consideration. Direct impacts result from the direct interaction between project-related activities and the surrounding environment. Indirect impacts alter the surrounding environment on a larger time and distance scale. Other parameters such as Significance, Duration, Intensity and Likelihood are used in determining the scale of environmental impact. The summary of positive and negative impacts and their description is discussed in the following tables. A more detailed description of each category is provided in the Environmental Baseline Statement (EBS).

Table 6-1. Impact Significance Key

Not Applicable / Negligible (White)	Minor (Yellow)	Moderate (Orange)	Severe (Red)	Beneficial (Green)

6.2 SUMMARY TABLE

Every effort was made by SpaceX to design the landing to fall within the landing ellipses identified in Figure 3-4. The following tables show the landing impact in the worst-case scenario and the nominal or 'best' case scenario. SpaceX considers the worst-case scenario as an incident that may have a significant adverse impact and may result in death or serious injury, pollution to the environment, property damage, and other irreversible consequences. This impact significance rating for the Project would be Moderate (Orange) in the Environment and Socioeconomics Impact category. In the nominal case scenario, the rocket launch proceeds as planned with no fatalities, nor impact to the environment. This impact significance rating for the nominal scenario would be Negligible (White) or Minor (Yellow).

A Severe (Red) impact i.e. mortality of biological resources and or a vessel strike, is unlikely for the Project. The Environmental Monitor will conduct a preclearance survey and provide the all-clear related to marine species. SpaceX will provide the all clear related to marine vessels. It is unlikely that a vessel may move into the hazard area after it is cleared, and the launch proceeds, as the total flight time is 8 minutes. Additionally, the droneship is equipped with an Automatic Identification System (AIS) and other surveillance tools including a VHF that enables live communication with vessels nearby.

An Incident Action Plan (IAP) will be developed and adapted to the laws of The Commonwealth of The Bahamas that addresses all these situations. The SpaceX Marine Operations Incident Management Team (IMT) is designed to manage the response to any emergency event involving SpaceX Marine Operations. The local Emergency Response Team operates within a tiered response framework, which allows for the mobilization of resources at varying levels, as dictated by incident circumstances. The Point of Contact in the emergency contact list provided to DEPP should be referenced.

Table 6-2. Summary Table of Mitigation Strategies and Best Management Practices.

Impact Categories	Worst Case Scenario	Nominal Scenario	Mitigation Strategy / Best Management Practice
Land Use	Negligible (white)	Negligible (white)	N/A
Water Quality	Moderate (orange)	Negligible (white)	Baseline Water Quality parameters will be measured pre-launch, also see Spill Management Plan Section 7.3
Biological Resources	Moderate (orange)	Negligible (white)	Biological Resource surveys will be conducted pre- and post-launch. See Section 7.1
Air Quality	Minor (yellow)	Negligible (white)	A portable air quality monitor will be used to measure air quality from the monitoring vessel.
Noise Quality	Moderate (orange)	Minor (yellow)	A hydrometer will be used to measure the in-water sound before, during and post-launch The final landing location will be determined in collaboration with DEPP.
Cultural Resources	Negligible (white)	No Impact (white)	N/A
Energy (Fuel)	Minor (yellow)*	Negligible (white)	See Spill Management Section 7.3
Socioeconomics & Community Services	Beneficial (green)	Beneficial (green)	N/A
Aesthetics	Minor (yellow)	Negligible (white)	N/A
Marine Traffic	Moderate (orange)	Minor (yellow)	Frequent communication between Port Department and DEPP to keep the boating community informed of the hazard area.

7 MANAGEMENT PLANS AND MITIGATION STRATEGIES

7.1 BIOLOGICAL RESOURCE MANAGEMENT

The biological resource management section of this Environmental Management Plan (EMP) addresses the potential impacts on both marine and avian species as well as terrestrial biological resources resulting from the SpaceX landing and recovery. The Project activities, particularly those conducted from a boat, have the potential to affect these biological resources through debris, spills, noise, and air emissions. Ensuring the protection and conservation of these resources is paramount, and this section outlines the potential impacts and proposes robust mitigation strategies to minimize harm.

7.1.1 Avian Resource Management

The Exuma archipelago is home to a high diversity of avian species with 167 native and migratory species recorded. Most of these birds are migrants that visit The Bahamas during the Spring and Fall. The Spring migrants breed, in the archipelago and many of them are seabirds. These include Bridled Terns, Brown Noddies, Magnificent Frigatebirds, and Audubon Shearwaters. Seabirds are of great conservation concern because they represent the most threatened group of birds in the world. The Bahamas has many important bird areas scattered throughout the archipelago including the Exumas with significant nesting colonies of some seabirds being found including the largest known nesting colony of Audubon Shearwater.

Anthropogenic disturbance can have a significant impact on bird colonies. In the event of an oil or fuel spill, marine spill kits must be readily available and properly utilized for effective cleaning of spills. All used absorbents must be placed in biohazard bags for safe storage before being sent to the proper facilities for disposal.

Pre and Post Wildlife Survey Methodology

Prior to launch, pre- seabird and shorebird surveys must be conducted to determine the locations and sizes of nesting colonies within the sphere of the retrieval site. Because the peak nesting period for seabirds is May to the end of July, surveys will be done within this period. Each location will take 3-4 days to survey and will involve surveys from a distance using binoculars and spotting scopes, and walking transects through nest colonies. Surveys through colonies will be done as quickly and as carefully as possible to minimize disturbance to nesting seabirds and shorebirds. Important locations to consider based on the original landing coordinates for surveying include the Exuma Cays Land and Sea Park, South Cat Island (Hawksnest Creek), Southern Exuma Cays, and North Long Island. Important locations to consider based on the updated landing coordinates for surveying include the Exuma Cays Land and Sea Park, North Cat Island (Orange Creek), and Northern Exuma Cays. Most of these areas are protected sanctuaries for wildlife. Information that will be collected include species, location, number of nests, chicks, eggs, presence of other native or endemic animals and invasive species. Signs of pollution and weather conditions will also be recorded. Post surveys will occur after rocket recovery efforts for the same length of time at each site as pre surveys. Surveyors will keep a vigil for bird mortality. Tissue samples from dead animals will be collected and sent for testing to a lab and veterinarian in Nassau to determine the cause of death and concentration of toxins in their tissues.

Water sampling should also occur to determine pre and post seawater quality. Seabirds forage in the waters in and around the Exuma Cays, so oil spills or other contaminants can greatly impact the health of bird populations. Marine spill kits and active monitoring during and after the launch will be in place in the event of an accident and all spills will be cleaned up immediately.

7.1.2 Marine Resource Management

The potential impacts on the Marine Biological Resources are summarized in section 6.2. Impacts were determined for the nominal case scenario and the worst-case scenario.

- Debris - Floating or submerged debris from the landing and recovery may pose physical threats to marine mammals and other marine life, leading to injury or entanglement. In the event the parafoil and Falcon9 cannot be recovered or the Falcon9 does not land on the landing pad, both the parafoil and the Falcon9 will contribute to marine debris. The marine debris may impact marine life as it is transported through the water column.
- Spills - Accidental spills of oil, chemicals, or other hazardous substances from the recovery vessels can lead to significant contamination of the marine environment, affecting water quality and marine species' health.
- Noise Pollution - Operational noise from the recovery vessels, deploying the landing pad, and the landing may disrupt the natural behavior of marine species, leading to stress, altered communication, and disorientation.

To mitigate these impacts the following mitigation strategies and best management practices will be followed.

- Debris Management – Strict waste management protocols will be implemented to ensure no debris is released in the marine environment and regular clean-up operations to remove any accidental debris will be conducted. See Solid Waste Management section for information related to waste management on the recovery vessels.
- Spill Prevention and Response - Utilize spill containment booms and to quickly address and contain any spills. More information is provided in section 7.3. The Spill Management Plan is adapted from the USCG Nontank Vessel Response Plan and a MARPOL 73/78 Annex I, Regulations 37 Shipboard Oil Pollution Emergency Plan (SOPEP) document which is a part of the established Falcon 9 policy and procedures. Spill Management measures include the prevention, location, containment, clean up, and reporting.
- Noise Control – Noise levels will be monitored regularly, and data will be provided to the DEPP. Additional information is discussed in section 7.2.2.

Update - The updated location moves further away from the Exuma Cays Land and Sea Park (ECLSP) and is positioned as closely possible to be equidistant to each of these MPAs in proximity to the landing. One the landing coordinates were updated the Landing Hazard Area (LHA) adjusted as well as shown in Figure 7-1. This updated LHA intersected the Marine Protected Area (MPA) as shown in the same image.

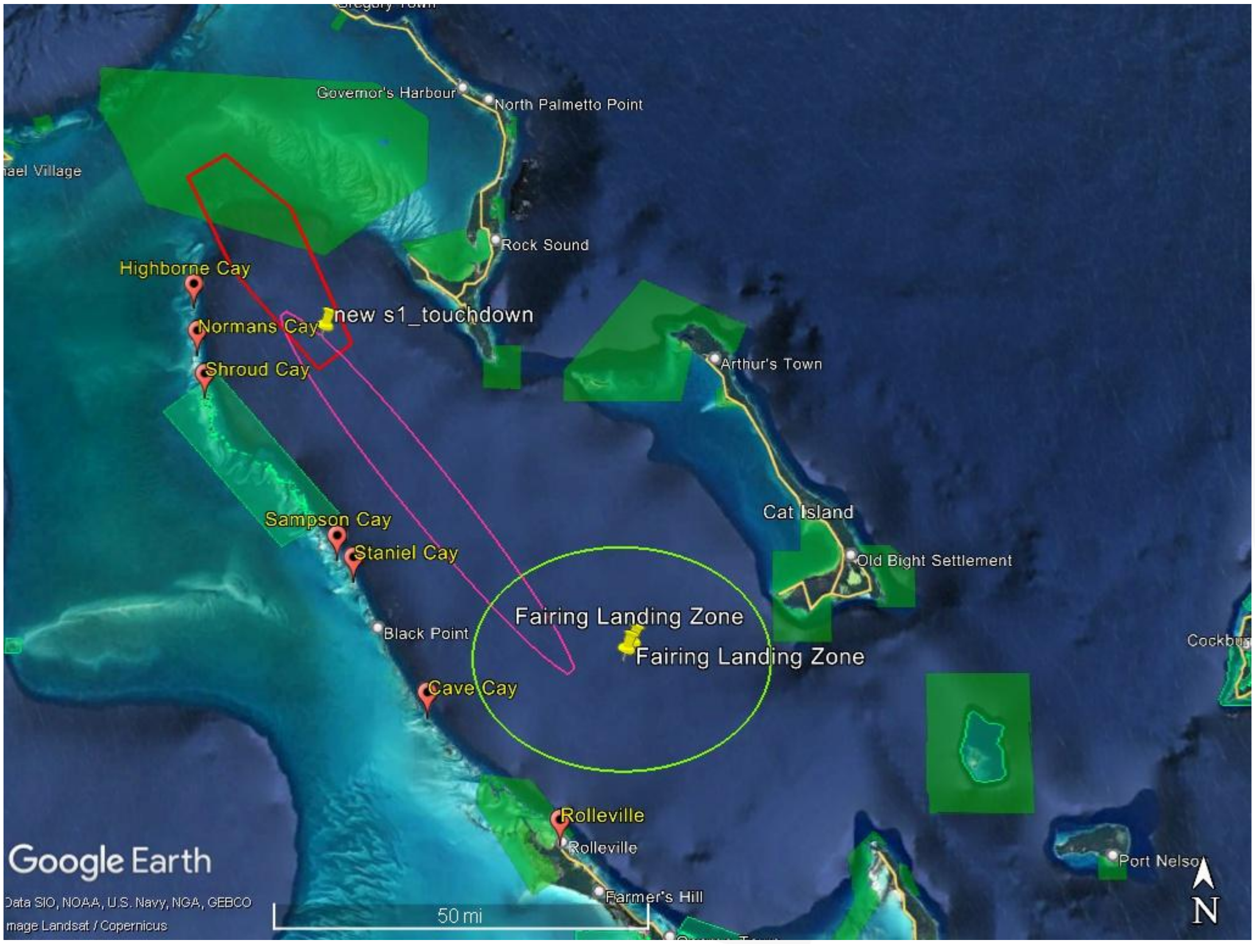


Figure 7-1. The landing hazard area (LHA) is shown in red. The LHA intersects the West Schooner Cays MPA.

As requested by the DEPP prior to launch approval, SpaceX and BRON provided the distance of the new landing coordinates from each of the protected areas in proximity to ensure the site is at least 10 nautical miles from the MPAs. SpaceX confirmed the landing location remains about 20 miles to the southwest of Schooner Cays. It should be noted that the landing location remains within the pink ellipse submitted in the EBS and original submission of the EMP in June 2024 to avoid impact to any MPAs. While the LHA remains south of Schooner Cays and extends to the protected area to the northwest, the LHA also include protections for aircraft flying overhead and is not necessarily a high-risk area to boaters or other marine activities. The following figures show the distance of the landing site to the MPAs in the area.

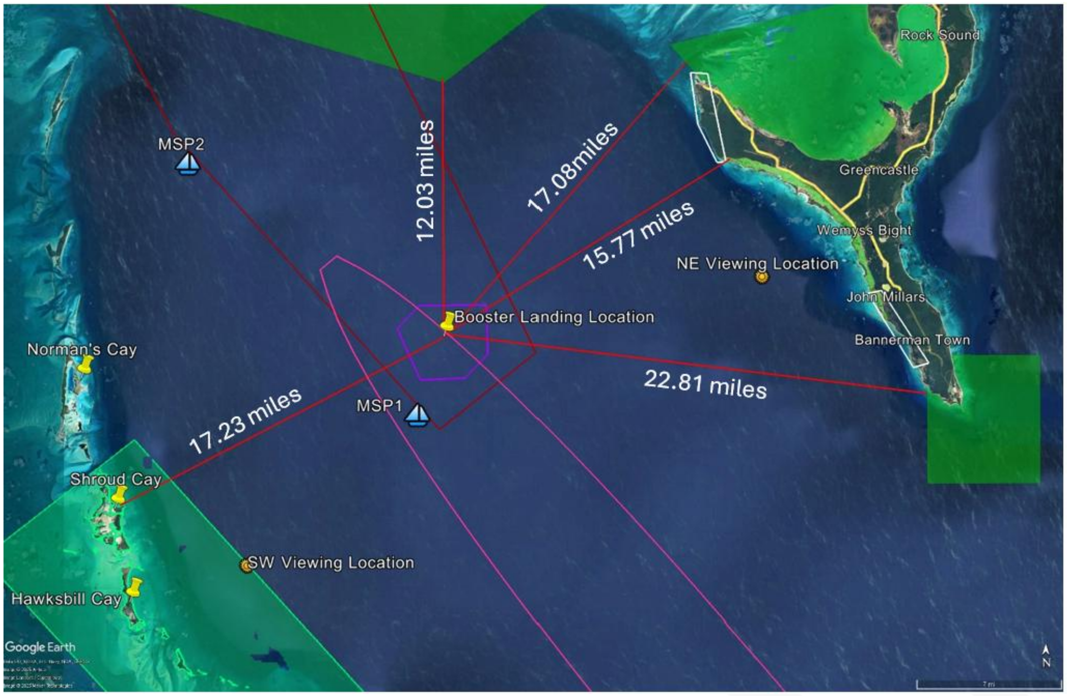


Figure 7-2. Booster landing location distance from nearby MPAs.

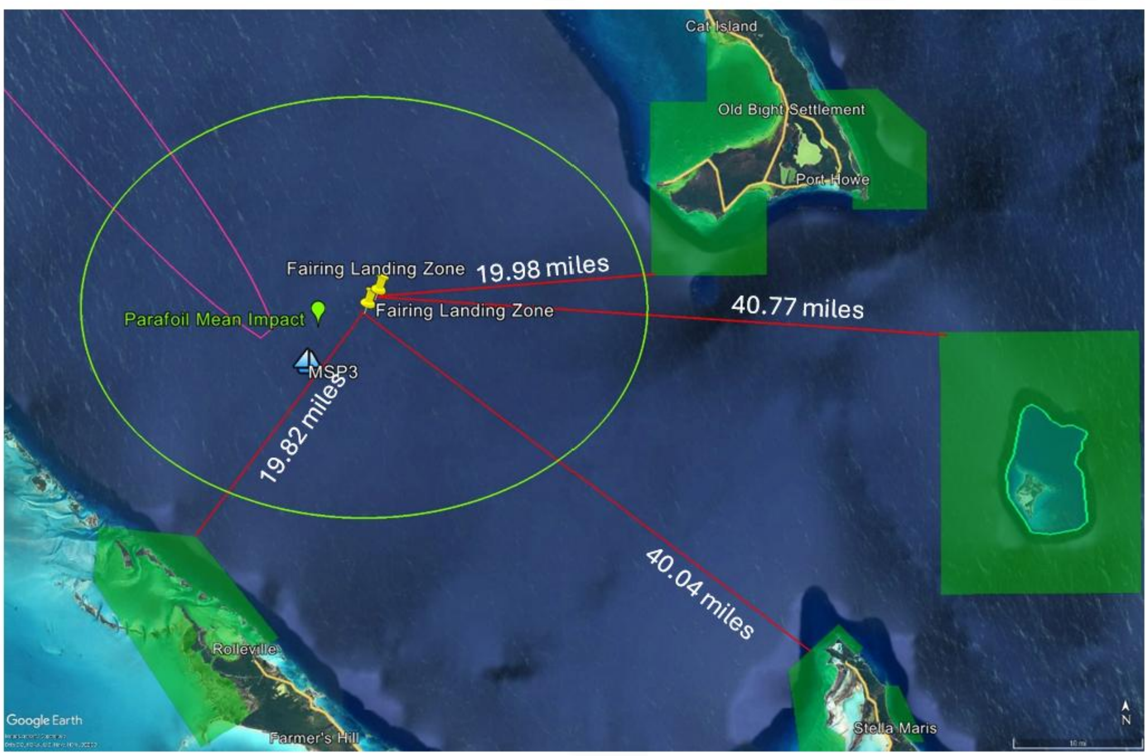


Figure 7-3. Fairing landing locations distances from nearby MPAs.

Pre and Post Marine Survey Methodology

Marine surveys will be conducted before and after the landing to document species within the area that might be impacted by the droneship placement and the booster landing. The original marine survey methodology was S-shaped Manta Tow surveys. However, the vessel approved for the mission by the Port Department was the RBDF Lignum Vitae which was not approved for Manta Tow Surveys. Based on this information, the marine survey methodology was adapted. A Remote Operated Vehicle (ROV) was deployed throughout the Minimum Safe Area (MSA) around the landing coordinates and at the landing coordinated. Water quality, air, sound in the air and in the water column, were also measured within the MSA. A marine mammal spotter was on board the monitoring vessel as well.

7.2 MANAGEMENT OF AMBIENT ENVIRONMENTAL CONDITIONS

7.2.1 Air Quality Management

During Stage 1 of the flight plan Falcon 9 will initiate two burns, one to bring the trajectory of the rocket toward the landing site and the second to slow it down before re-entry. These two burns are expected to last a few seconds. There is one final burn to bring the rocket to precision landing onto the droneship. During these burns carbon particulates, $CO2$, CO, and water vapour are expected to occur but not have long lasting impacts due to their short duration.

A portable air quality meter will be used prior to the landing to record the baseline air quality. It will also be used to monitor air quality at different intervals during flight and after landing. Air quality will be documented and included in the monitoring report. Monitoring the air quality will help the Environmental Management team assess the impacts to air quality, if any, and address for any potential future landings.

The presence of the recovery vehicles will temporarily impact air quality through emissions that are expected from boats of their size. Before entry into Bahamian waters, recovery vessels should be serviced and maintained to limit the extent and thus the impact of emissions to the region. Documentation of confirming recent maintenance or similar for both the Falcon 9 and recovery vessels should be provided to DEPP. The following table outlines the prevention methods to help maintain good air quality during landing and operation of recovery vessels.

Table 7-1. Air Quality Management.

Prevention	Description of Prevention Method
Fumes / Exhaust Prevention	Equipment will be inspected prior to takeoff to ensure fuel storage on Falcon9 is secured. Equipment and operation vessels will be maintained regularly by SpaceX to reduce emissions. Fuel will only be kept in sealed fuel storage containers.
Odor Control	Solid waste should be contained aboard recovery vessel in a sealed compartment. No type of waste should be left exposed for extended periods of time. See section 7.4 Waste Management for more detailed information.

7.2.2 Noise Quality Management

Noise can be defined as "any unwanted sound." Sound is the result of fluctuations in the air pressure caused by vibrations, and these pressure fluctuations are typically measured in decibels (dB). Heightened ambient noise levels may be expected to occur from surrounding recovery vessels, the droneship on which the rocket will be landing, and the landing operation itself. Noise generated from the engine thrusts necessary to land the rocket are expected to range between 100 - 110dbA and only last for a few seconds. The safe period of exposure to noise is directly related to the level of noise. Protection against the effects of noise exposure shall be provided when the sound levels exceed those shown in the following table when measured on the A-scale of a standard sound level meter at slow response.

Table 7-2. Permissible Noise Exposure

Exposure Per Day (Hours*)	Sound Level dBA in Hours
8	90
6	92
4	95
3	97
2	100
1 ½	102
1	105
½	110
¼ or less	115
*The duration of the sonic boom will be a few seconds.	

Noise levels generated should not have long lasting impacts provided exposure does not exceed 30 minutes to 2 hours per day. A sound level meter will be used to establish baseline data prior to the launch, during the launch, and landing of the Falcon9. Measurements during and after the landing will be conducted to document the level and duration of noise experienced within the landing area.

When employees are subjected to sound levels exceeding those listed in the table above, the following steps should be taken.

- Feasible engineering controls shall be utilized to reduce or attenuate the noise levels enough that hearing protection is not necessary or is minimally required. For short term projects, engineering controls are not cost effective and proper ear protection is required. Engineering controls refers to equipment repair, and or replacement of equipment to reduce noise caused by poorly maintained equipment.
- Personal protective equipment (PPE), such as earmuffs or ear plugs, will be provided and used to reduce sound levels within the levels of the table above. The proper individual fitting of both types of ear protectors is critical as any leakage can seriously impair efficiency.

7.2.2.1 Marine Species Noise Quality Management

Update - Overpressure is the brief intense spike in air pressure that can occur from explosive events such as thunderclaps. This increase in pressure if often much stronger than typical sound waves and is measure in pound per square foot (psf). It should be noted that the overpressure of a thunderclap is roughly 1 psf. There is a likelihood that a sonic boom may be experienced due to the reduced velocity in landing the rocket. For boosters that can currently land on a barge in the ocean such as the SpaceX Falcon 9, overpressures at the ocean's surface could be up to 8 psf. The study by Richardson et al. (1995)[7], as cited in the NOAA Programmatic Concurrence Letter for Launch and Reentry, found that acoustic energy in the air does not efficiently penetrate the air-water interface, with most of the noise being reflected off the water surface. The NOAA Programmatic Concurrence Letter for Launch and Reentry is available in the appendices. A discussion on sound begins on page 61 of this appendix. The droneship will also act as a barrier to the most intense portion of overpressure from landings. The underwater sound pressure levels from in-air noise are not expected to reach or exceed threshold levels for injury or harassment to marine species. Section 4 in The Rocket Noise Study for SpaceX Flight and Static Test Operations at Cape Canaveral Air Force Station and Kennedy Space Center discussed Booster Reentry/Landing Noise Levels. The complete report was submitted to DEPP.

[7] Book Editors: W. John Richardson, Charles R. Greene, Charles I. Malme, Denis H. Thomson, Marine Mammals and Noise, Academic Press, 1995, Page iii, ISBN 9780080573038,https://doi.org/10.1016/B978-0-08-057303-8.50001-X. or https://www.sciencedirect.com/science/article/pii/B978008057303850001X

At lower altitudes, the perceived noise will be louder, but it will decrease rapidly as the aircraft moves away. Individual marine species that occur at or very near the surface (e.g., marine mammals, sea turtles, giant manta ray and sharks) at the time of an overflight would be exposed to some level of elevated sound for a few seconds. A hydrometer will also be used to measure in-water sound before, during, and after the landing. The data will be provided to DEPP in the Post Launch Report.

7.2.3 Water Quality Management

Baseline conditions for water quality surrounding the droneship and within the landing ellipse will be measured within the week leading up to the landing. Due to the type of fuel used in the rocket, possible impacts to water quality are considered negligible to moderate. The amount of fuel available in the droneship to be released in the marine environment at landing is negligible as most the fuel is entry burn. In the case of an anomaly where the rocket is destroyed before landing and fuel enters the water, the Spill Management Plan (SMP) found in section 7.3 should be followed for mitigation. In addition to the SMP, the SpaceX Emergency Management Manual provided to DEPP is a guideline for all employees who may observe a spill or pollution impacting water quality. Section 2 of the Emergency Management Manual classifies 3 levels of incidents and section 3 lists the internal points of contact. Table 8-2 provides the Point of Contact in The Bahamas.

Operation of recovery vessels and transfer of the remaining fuel from the rocket to the specialized fuel storage on the droneship can also impact water quality. Waste generated aboard recovery vessels and the droneship will be stored on their respective vessels until their return to the United States. More information regarding waste management can be found in section 7.4. Any spills or leaks that may occur through the operation of recovery vessels and fuel transfers should be mitigated using the spill management plan.

Water quality parameters inclusive of pH, salinity, dissolved oxygen, and others will be measured after landing. This data will be included in the Post Launch Report submitted to the DEPP.

7.3 Spill Management Plan (SMP)

The Spill Management Plan is adapted from the USCG Nontank Vessel Response Plan and a MARPOL 73/78 Annex I, Regulations 37 Shipboard Oil Pollution Emergency Plan (SOPEP) document which is a part of the established Falcon9 policy and procedures. It includes the necessary materials, reporting protocols, and responsibilities to ensure compliance with environmental regulations and minimize environmental impact.

The objective of the SMP is to prevent fuel spills from occurring, to respond promptly and effectively to contain and clean up spills, and to minimize the environmental impact of spills. The SMP also aims to comply with all relevant environmental regulations and reporting requirements.

PREVENTION MEASURES

- Regularly inspect fuel systems, hoses, and tanks for leaks or damage on the Recovery Vessels. This will be conducted before the Vessel arrives in The Bahamas. The Falcon9 will also be inspected before its launch from Cape Canaveral.
- Ensure proper fueling procedures are followed to avoid overfilling.
- Maintain equipment in good working order to prevent accidental spills.

LOCATION

The most likely location for operational spills may occur in the pipelines of the recovery vessels, cargo tanks or bunker tanks, or a leak at the hull. SpaceX employees are informed of the various hazardous areas during the required Health and Safety training, which includes a detailed introduction to the SpaceX Marine Operations Manual. The Vessel Familiarization Checklist is integrated into the Health and Safety Training as well. Vessel Familiarization Checklist was provided to DEPP. If a spill occurs in the marine environment, GPS coordinates that map out the extent of the spill will be plotted and documented in a spill report form.

SPILL RESPONSE PROCEDURE

Onboard Spills

1. **Immediate Actions**
   - Stop the source of the spill, if safe to do so.
   - Use absorbent materials to contain and clean up the spill.
   - Place contaminated materials in sealed containers for proper disposal.
2. **Materials Needed for Cleanup**
   - Absorbent pads and rolls
   - Absorbent socks/booms
   - Spill kits with appropriate PPE (gloves, goggles, protective clothing)
   - Disposal bags and containers
3. **Materials Needed to Contain the Spill**
   - Absorbent booms and pads
   - Spill containment kits - Mobile Universal, Hazardous Material (Hazmat) and Oil spill kits will be accessible on the droneship and recovery vessels to clean up accidental oil or fuel spills. Employees will be trained in the proper use of spill kits and reporting requirements. All personnel present on vessels should be aware of the location and type of the spill kits provided on each vessel. Appropriate signage, similar to the poster shown in the following figure, with instructions will be installed near the spill kits to identify the various types of kits.

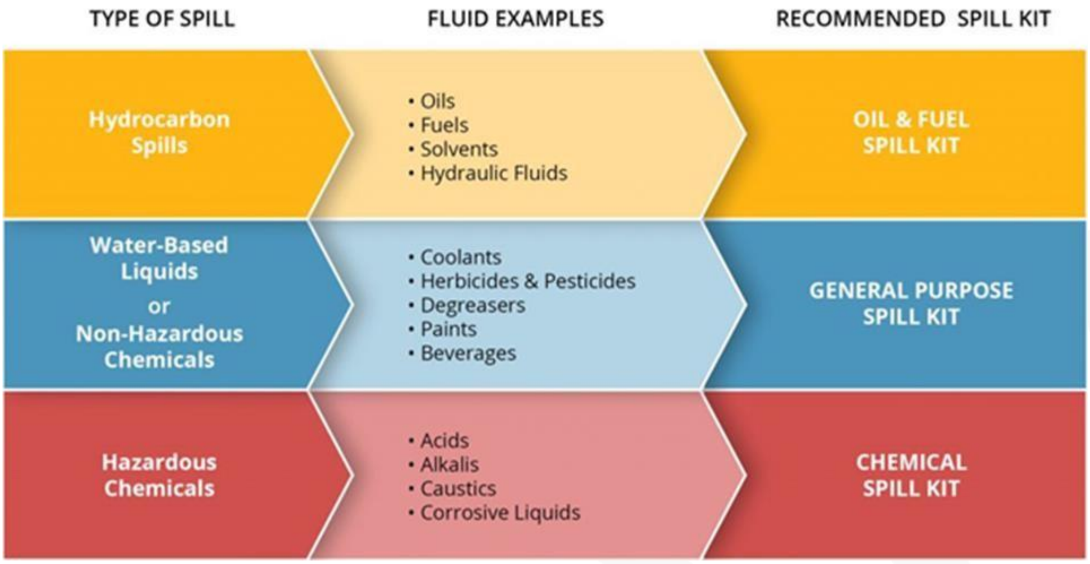


Figure 7.4. Example of the type of sign that will be installed near the spill kits.

Marine Spills

1. **Immediate Actions**
   - The source of the spill will be identified and stopped immediately. All personnel shall wear suitable safety gear before approaching fuel or other hazardous waste material.
   - Deploy absorbent booms around the spill area to contain it.
   - Notify the DEPP immediately.
   - The type of fluid will also be identified to determine which spill kit should be used to clean up the spill.
   - The spill extent and type will be photo-documented.
2. **Materials Needed for Cleanup**
   - Absorbent booms and pads
   - Oil skimmers (if available)
   - Spill kits with appropriate PPE (gloves, goggles, protective clothing)
   - Disposal bags and containers
3. **Materials Needed to Contain the Spill**
   - Absorbent booms
   - Oil containment booms
   - Spill containment kits

Reporting Procedures

1. **Initial Report**
   - Contact the DEPP immediately following a spill. The Environmental Manager will notify the local Department of Environmental Health Services and the Department

of Environmental Planning and Protection, and the Department of Marine Resources (DMR).

- DEHS -1 (242) 323-2295;
- DEPP - 1 (242) 322-4546;
- DMR -1 (242) 393-1777

- Provide initial details about the spill, including location, type and amount of substance spilled, and actions taken. The impact of the spill will be assessed by taking photos and listing the species and habitat impacted by the spill. Once the impact is measured, the mitigation plan will be developed with the Department of Environmental Planning and Protection. The Environmental Manager will oversee the cleanup and implementation of the agreed upon mitigation strategy on site.

2. **Written Report**
   - Submit a detailed written report within 24 hours of the spill.
   - Include the following information:
     - Date and time of the spill
     - Location of the spill
     - Type and quantity of substance spilled
     - Cause of the spill
     - Actions taken to contain and clean up the spill
     - Any environmental impact observed
     - Preventive measures implemented to avoid future spills
3. **Follow-Up Reports**
   - Provide follow-up reports as required by DEPP until the spill is fully remediated and no further environmental impact is observed.

Reporting Frequency

- Initial report immediately after the spill.
- Detailed written report within 24 hours.
- Follow-up reports as required by DEPP

7.4 Waste Management

7.4.1 Wastewater Management

The Space Support Vessel (BOB/DOUG) and ocean going tug boat have holding tanks on board for all grey and black water. This wastewater is discharged overboard when the vessel is more than 12 miles from land. The holding tank is approximately 5,000 gallons which is enough holding capacity for several days without needing to discharge.

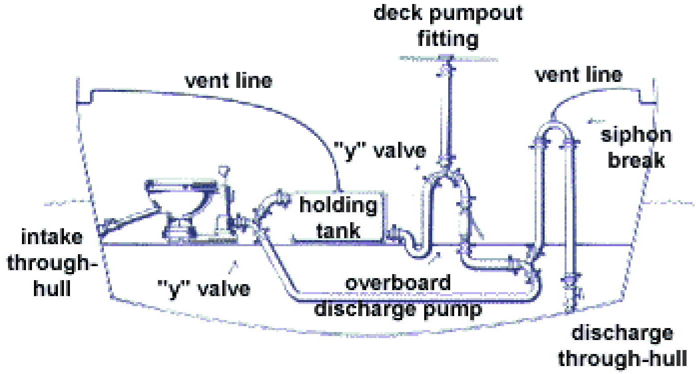


Figure 7-4. Example of pump-out holding tank with overboard discharge option.

7.4.2 Solid Waste Management

In the event there are no incidents during launch and landing the collection of the parafoil and fairing halves is top priority. There are one silvership fast boats (Maverick/Goose) in waiting to recover the fairing halves. Fairing halves are recovered out of the water by a crane on the fairing recovery vessel. The landing will happen on the droneship barge and once secured the barge will be towed by an ocean-going tugboat. The solid waste on the tow and support vessels should be collected in garbage bins and stored until docked where it can be appropriately disposed of.

In the event of an incident where marine debris is scattered it is the responsibility of the SpaceX Marine Operations Incident Management Team (IMT) to clean up said debris. The support vessel and silvership fast boat are both equipped to retrieve the marine debris. Section 2 of the Emergency Management Manual provided to DEPP further describes the IMT. Recovery Procedures in the event of an anomaly were also provide to the DEPP.

Figure 7-5. Silvership fast boat

Figure 7-6. Ocean-going Tug Boat

7.4.3 Hazardous Waste Management

According to the United States Environmental Protection Agency (EPA), hazardous waste is defined as waste that meets the characteristics of a hazardous waste. A characteristic of hazardous waste is a property when present in waste, indicates that this particular waste product poses a sufficient threat to merit regulation as hazardous. EPA established four hazardous waste characteristics: ignitability, corrosivity, reactivity and toxicity:

- Ignitability – Wastes that are hazardous due to the ignitability characteristic include liquids with flash points below 60°C, non-liquids that cause fire through specific conditions, ignitable compressed gases, and oxidizers.
- Corrosivity – Wastes that are hazardous due to the corrosivity characteristic include aqueous wastes with a pH of less than or equal to 2, a pH greater than or equal to 12.5 or based on the liquids ability to corrode steel.
- Reactivity – Wastes that are hazardous due to the reactivity characteristic may be unstable under normal conditions, may react with water, may give off toxic gases and may be capable of detonation or explosion under normal conditions or when heated.
- Toxicity – Wastes that are hazardous due to the toxicity characteristic are harmful when ingested or absorbed. Toxic waste presents a concern as they may be able to leach from waste and pollute groundwater.

Proper handling and disposal of hazardous waste on site consists of the presence of properly trained staff that is equipped with adequate personal protective equipment (PPE). This includes protective eyewear, gloves, masks, mask filters and full body disposable suit as illustrated in the figure below.

Hazardous Material Spill - If a hazardous material spill occurs, workers should immediately evacuate the area and notify the ERT.

Figure 7-7. Example of Hazardous Waste PPE

7.5 Marine Transportation Management

7.5.1 International Marine Traffic Management

Elements of the marine traffic management plans have been derived from 'The Formal Safety Assessment (FSA)' methodology adopted by the International Maritime Organization (IMO)[8] as a structured approach to the assessment of marine risks, and the effectiveness of control mechanisms in a real-world environment.

The criteria for the marine traffic plan for the project area located within the Exuma Sound will focus on:

- Understanding the patterns and impacts of vessel traffic for a specific area.
- The proposed landing area will be monitored using a mix of historical data and the most current readily available navigational charts. The droneship will involve collecting data on vessel movements, types of vessels, and their routes using AIS (Automatic Identification System) transponder system, satellite imagery, and field observations.

[8] https://www.imo.org/en/OurWork/Safety/Pages/FormalSafetyAssessment.aspx#:~:text=FSA%20consists%20of%20five%20steps,reduce%20the%20identified%20risks)%3B

- The droneship shall include surveillance tools onboard such as thermal and visual 360-degree camera, microphone, ability to talk over VHF for nearby vessel communication to avoid hazard areas.
- The collected data will be analyzed to identify peak traffic times, common routes, and areas of high vessel density. Special attention will be given to potential environmental impacts, such as noise pollution and disturbance to marine life. The Landing Hazard Area (LHA) will also be monitored by marine radar and thermal imagery.
- The study will also assess the safety and navigational aspects of marine traffic in the area.
- Recommendations will be developed based on the findings to improve the management and regulation of marine traffic in the Exuma Sound, to minimize environmental impacts and to enhance mariner safety.
- Creation of a no-go zone during landing operation to ensure no distractions or potentials to offset calculations such as establishing ‘no wake zones’ or ‘no go zones’ during operations such as landings where feasible.
- The determination of where boats are positioned from the LHA is performed by the safety analysis. The safety analysis is independent of the expected traffic will be and determines a safe area for boaters.
- Prior to launch SpaceX will perform surveillance of the landing location using AIS and radar to detect any vessels that may be transiting through the hazardous area. SpaceX is required to hold the launch if risk to the general public exceeds allowable thresholds defined in the international standards FFA 14 CFR 417.107(b).

7.5.2 Local Marine Traffic Management

Due to the changing nature and schedules of shipping, an area will be cordoned off to restrict access. This should be coordinated via Public Service Announcements and organized by the designated government agencies known as the Emergency Response Team as defined in Section 8.4.2. and Section 8.4.3. As the launch site is located in the middle of a less frequently marine transversed path, to further reduce navigational impacts.

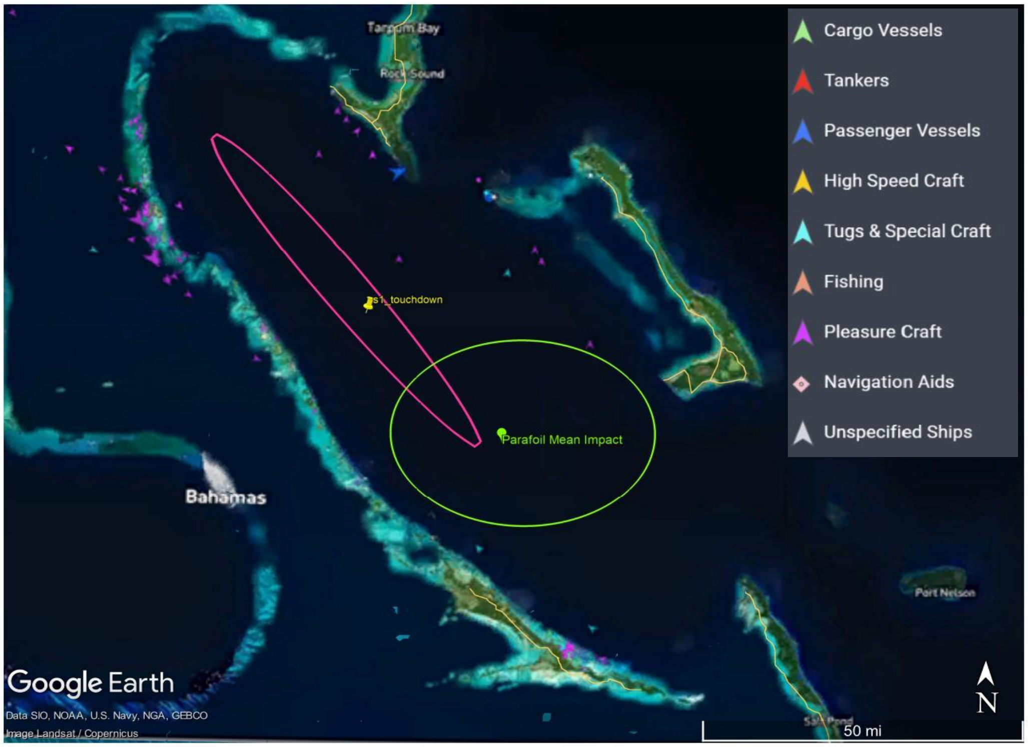


Figure 7.1. Exuma Sound marine live traffic map as of May 28, 2024, with SpaceX impact area outlines in pink and green.

The local marine traffic plan for the Project area located within the Exuma Sound consists of the following:

1. Coordination of the Emergency Response Team (Government Ministries).
2. Establishing effective cooperation and coordination among all stakeholders involved, including port authorities, vessel operators, and relevant regulatory bodies. Regular meetings, information sharing, and collaboration will help ensure smooth operations and address any potential conflicts or safety issues proactively.
3. Issuance of public notices related to Launch and/or Recovery operations in Bahamian waters to inform the public of the location and nature of the Hazard areas and to remain clear during the effective time.
4. Public notices should be issued at least four (4) days in advance and repeated weekly via all media platforms (social media, newspaper, television, radio, etc.).
5. In the event of an anomaly, The Emergency Response Team will establish a blockade along the Exuma Sound and surrounding islands (Cat Island, Exuma, and South

Eleuthera). The following islands surround the LHA and a buffer zone (distance) is provided for mariners as a general safety guide.

   a. Cat Island (mainland) – ~ 39 miles west
   b. Cat Island (south) – ~ 4 miles west
   c. Exuma Cays – ~12 miles east
   d. Great Exuma – ~ 10 miles northeast
   e. Eleuthera – ~16 miles west

6. While there will be no physical demarcation, the surveillance through the droneship and the onsite vessels will help ensure the Hazard Area remains clear.
7. During the launch, SpaceX will establish dedicated communication channels from the droneship such as VHF radio or designated frequencies, to facilitate effective communication between mariners and relevant authorities. This is necessary to alert Mariners near the hazard area to remain distant and allows for real-time information exchange and coordination to avoid conflicts and ensure safe navigation.
8. SpaceX will communicate safe areas to boaters.
9. SpaceX will utilize monitoring and surveillance systems to identify potential conflicts, encroaching vessels and monitor compliance with safety regulations. This enables real-time monitoring of the hazard area and facilitates prompt response to any safety concerns.
10. SpaceX to determine and establish an entrance and exit / evacuation route for project related vessels managed and operated by their team.

7.6 Historical & Cultural Resources Management

SpaceX operations that may impact Bahamian Land and/or Waters include the landing, recovery, and transit of SpaceX Launch and Re-entry Vehicles. In the event of an incident or an anomaly, consideration for Bahamian historical and cultural resources are outlined in this Section.

SpaceX has agreed with the Bahamian government that in the event of a mishap, anomaly, or any emergency during the course of SpaceX Launches and/or Re-entries that could affect the safety of Bahamian Land, Airspace or Waters, the Bahamian government will secure a perimeter around the impacted area to enable immediate SpaceX response. The Bahamas can provide security for recovery efforts, where possible, and allow SpaceX every opportunity for a smooth and seamless recovery of property. However, in the event of an incident (land or sea) it is recommended that Antiquities, Monuments and Museums Corporation (AMMC) of The Bahamas is present during recovery efforts by SpaceX, to ensure the preservation of Bahamian historical, paleontological, and cultural resources.

Additionally, it is recommended that AMMC be notified immediately if cultural resources are discovered during the deployment of the launch retrieval of the booster or navigating to the booster recovery area. The contact information is (242) 604-2662 and (242) 604-6800. The DEPP should also be made aware of any discovery of cultural or suspected culturally significant items. The contact information is (242) 322-4546 and information@depp.gov.bs.

8 Emergency, Health, and Safety

8.1 Hurricane and Storm Management

In The Bahamas, tropical storms and hurricanes are the predominant type of storms experienced. Tropical Storm systems progress to hurricanes as they intensify in wind speed. The SpaceX Heavy Weather Shelter Plan was provided to DEPP and key points from the Plan are described below.

All personnel must be on alert throughout the Hurricane Season. Designated SpaceX personnel shall monitor weather reports throughout the season and communicate potential threats as soon as practical. For vessels at sea, Captain fulfills this role. Once a Hurricane Warning is released by the Bahamas Department of Meteorology (http://www.bahamasweather.org.bs/), the hurricane prepared plan will be initiated. Communications regarding heavy weather threats may be generated and communicated internally by any individual with available information. However, the Compliance Team will closely monitor weather reports, apply for necessary services and communicate heavy weather tracking to assure Marine Operations is fully on alert when a heavy weather threat exists.

The Vessel Master will assign a person in charge who will be responsible for implementation of the Hurricane Plan. The Hurricane Plan is a series of checklists to make preparing for and recovering from the storm as straightforward as possible. In the event of a hurricane the launch should be postponed if coinciding or within a week before or after the storm.

General pre- storm checklist:

- Make a list of names, addresses and phone numbers for vendors and contractors who can provide recovery services or supplies.
- Keep evacuation routes open for all vehicles.
- Fully charge all devices and batteries.
- Have garbage containers consolidated and properly disposed.
- Fuel all emergency equipment.
- Establish a meeting place, if possible, for key recovery members.

In the event of a hurricane the launch must be postponed until all stakeholders and emergency response team is available. If harsh weather conditions were to occur post launch during the vessel's return to the U.S Port, it would be necessary to port at closest marina. Further details can be found in the Heavy Weather Shelter Plan.

8.2 Safety Hazards

Identifying and preventing safety hazards on the vessel is essential for maintaining a safe and healthy work environment for all personnel. By taking the following steps, safety hazards can be identified and prevented on the vessel during the landing and recovery, reducing the risk of accidents and injuries to personnel.

1. Conduct safety inspection- Conducting a safety inspection of the vessel will help identify potential hazards. Inspections should be conducted by trained personnel who can recognize potential hazards and take corrective action, such as the Vessel Master.
2. Implement a hazard communication program - A hazard communication program is designed to inform workers about the potential hazards they may encounter on the job. This program should include information about hazardous materials, personal protective equipment (PPE), and safe work practices.
3. Provide adequate training - All personnel on the vessel should be provided with adequate training on safety procedures and best management practices. This includes training on how and when to use PPE and how to respond to emergency situations.
4. Use engineering controls - Engineering controls are designed to eliminate or minimize exposure to hazards. This may include using barriers, ventilation systems, and other equipment to control the hazards.
5. Use administrative controls - Administrative controls are policies and procedures that are put in place to reduce the risk of exposure to hazards. This may include job rotation, work procedures, and training programs.
6. Implement a safety program - Implementing a safety program that outlines the hazards on the site, the procedures for dealing with them, and the responsibilities of workers can help prevent safety hazards from occurring. The safety program should be communicated to all workers and enforced by management.
7. All personnel should report any safety hazards observed in accordance with the Emergency Management Manual which was provided to DEPP.

Senior Managers are responsible for:

- Ensuring employees under their supervision receive the required training.
- Providing training to ensure that all employees understand the protocols, timeline and responsibilities.
- Ensuring that all equipment is inspected and tested at least monthly, or sooner if required, by a responsible individual.
- Setting personnel safety as the highest priority.

Personnel are responsible for:

- Watching for and reporting any unsafe conditions.

Table 8-1. Monitoring Form

OMSA

Vessel General Permit
Routine Visual Inspection

Vessel Name ____________________

Date	Time	Latitude & Longitude At Time Of Inspection	Printed Name Of Personnel Conducting Inspection[1]	Signature Of Personnel Conducting Inspection[2]	Monitoring, Training, Inspection Documentation[3]	Cargo Holds[3][4]	Accessible Areas Where Chemicals, Oils, Dry Cargo & Other Materials Are Stored, Mixed, Or Used[3][4]	Machinery Storage Areas (Including Boiler Areas)[3][4]	Deck Areas And Well Decks[3][4]	Visual Monitoring Of Water Behind And Around The Vessel[3][5]

Findings/Additional Documentation[5]:

____

____

____

NOTES:

(1) The person conducting the inspection must be the person in charge or a duly authorized representative.

(2) Initials of personnel conducting inspection shall be inserted for verification that each category is reviewed.

(3) The areas inspected should be free of garbage, exposed raw materials, oils, any visible pollutant that could be discharged and that pollution prevention mechanisms are in proper working order.

(4) The visual inspection of surrounding waters shall verify that there is no sheen, dust, chemicals, abnormal discoloration, foaming or other indicators of pollution originating from the vessel. If specific water streams cannot be inspected (i.e. discharge below the water line) a sample must be collected quarterly, visually examined and documented. Refer to Quarterly Visual Inspection Form.

(5) If any potential non-compliance issues or potential problems are noted corrective actions must be initiated and documented

8.3 FIRE / EXPLOSION RISK

Project personnel will be trained in fire/explosion prevention and response.

PREVENTION

- No burning or smoking will be allowed near the Recovery Vessels or droneship or Falcon9, or monitoring vessels.
- Fire extinguishers will be accessible at all times.
- No burning, welding, or other source of ignition shall be applied to any enclosed tank or vessel, even if there are some openings, until it has first been determined that no possibility of explosion exists and authority for the work is obtained from the foreman or Supervisor.
- The Project team should be aware of the locations of fire extinguishers that have been provided and know how to use them. A five-pound ABC rated fire extinguisher must be readily available.
- Gasoline must be stored and transported only in approved safety containers and gasoline must not be used for cleaning purposes. Compressed gas cylinders must be kept secured, upright, capped and separated when not in use.
- Empty gas cylinders should be marked and returned to the storage area for pickup.
- Do not store flammables near ignition sources.
- Do not overload outlets.
- Keep work areas clean and organized.
- Be mindful of thrown sparks from grinders and other machinery.
- Pick up litter and combustibles.
- Keep stove areas clear and a fire extinguisher nearby.
- Ensure proper ventilation when working with flammables.
- Utilize Lock Out/Tag Out for repairs and Hot Work Permits as applicable.
- No smoking or vaping while fuel transfer is taking place.

In case of fire, the following general guidelines are provided from the SpaceX Emergency Management Manual:

1. Upon discovery of a fire – sound the alarm (or get someone to sound the alarm) – before attempting to extinguish a fire in its incipient phase.
2. Officer of the Watch shall sound the fire alarm – rapid ringing of the general alarm or the ship’s whistle for ten (10) seconds or more is the signal for fire and emergency.
3. All crew members, passengers and other personnel should immediately don their life jackets (work vests are not acceptable) and proceed calmly to the assigned muster point or station.
4. Charge the fire main, hoses and have portable extinguishers ready as soon as possible.
5. The person who leads the fire team (Station Bill) will direct personnel.

6. Determine what area of the vessel the fire is in, what type of material and fire you are trying to extinguish.
7. Attempt to place the portion of the vessel that is on fire downwind to protect persons and to prevent from rapidly spreading to a nonengaged area of the vessel.
8. Reacting as quickly and safely as possible will increase your chances of gaining control of any firefighting situations.
9. If the fire cannot be rapidly extinguished, keep control of the situation. REMAIN CALM.
10. Isolate the fire, if at all possible, by closing watertight and weathertight doors and fittings. Stop any air conditioning, blowers and close ventilation – ventilating any onboard a vessel will only allow the fire to spread to another area or deck.
11. Should the fire be in the engine room and if it cannot be readily extinguished, close all fuel supply lines, clear the engine room space of all personnel, make sure that the area is closed off and sealed, and activate the fixed CO2 system (if fitted) – activation of the fixed CO2 system with someone in the space will result in fatalities – CO2 system activation should only be done with everyone accounted for.
12. The crew should always fight any engine room fire to the best of your abilities – if unable to extinguish, evacuate and seal the area.
13. If available, get help from nearby resources (e.g., other vessels, dock resources, shipyard resources, etc.).
14. Always fight any fire with the proper equipment and available manpower, making sure to utilize all resources wisely and quickly.
15. Should the situation warrant, notify surrounding traffic with the international distress signal (MAYDAY, MAYDAY, MAYDAY).
16. Be prepared to anchor or beach – abandon ship only as a last resort. The Exuma Cays and South Eleuthera would be the closest land masses.
17. As with any emergency, keep track of the location and activities of all personnel aboard.

A record of all fire related incidents must be noted in the Vessel Log. Further fire safety can be found in the Emergency Management Manual provided to DEPP.

8.4 Accidents and Emergencies

By implementing an Accident & Emergency Action Plan, the Project can minimize the risk of injuries and damage in the event of an accident and or emergency. All personnel will be informed about next steps in the event of an emergency, which will reduce the risk of injury and minimize the impact of an emergency.

8.4.1 Accident and Emergency Action Plan

Communication - All workers should be trained in the Accident & Emergency Action Plan and should know the location of emergency exits, alarms, and communication systems. In case of emergency, the following communication channels will be used:

- Site supervisor or designated person in charge

- Emergency services (919)

Emergency Response Team (ERT) - A designated emergency response team will be established for the Project, consisting of trained personnel who will be responsible for responding to emergencies and coordinating the emergency response efforts until the emergency services arrive on site (Governmental Agencies).

Emergency Procedures - The Vessel Master or designated person in charge will immediately call for emergency services and alert all workers on site. The following emergency procedures will be established and communicated to all workers on the Project.

- Fire - When a fire is detected, workers should immediately evacuate the area and notify the ERT. If it is safe to do so, workers may use fire extinguishers to extinguish small fires.
- Medical Emergency - If a medical emergency occurs, workers should immediately notify the ERT and provide first aid as needed. Only trained employees are authorized to perform emergency first aid. Outside emergency response services (919) is the primary source of critical medical treatment.
- Structural collapse - If a structural collapse occurs, workers should immediately evacuate the area and notify the ERT.
- Hazardous Material Spill - If a hazardous material spill occurs, workers should immediately evacuate the area and notify the ERT. Workers should also follow the hazardous material spill response plan provided in section 7.5 Spill Management.
- Emergency equipment and supplies - The following emergency equipment and supplies will be available on site.
    - First aid kits
    - Fire extinguishers
    - Emergency lighting
    - Communication devices, such as two-way radios or cell phones
    - Emergency communication plan - A communication plan will be established to ensure that all workers are aware of the emergency procedures and can quickly communicate with the ERT.
    - Training - All workers on the project will receive training in emergency procedures and the use of emergency equipment and supplies.
    - Emergency drill – An emergency drill will be conducted to ensure that all personnel are familiar with the emergency procedures and can respond quickly and effectively in the event of an emergency and all project team members are aware of the relevant muster locations.

8.4.2 Emergency Communication Plan

An Emergency Communication Plan (ECP) outlines the procedures for communicating during an emergency. It includes contact information for key personnel, communication protocols, and instructions for disseminating information to all relevant parties in a timely manner. The purpose of the ECP is to ensure that all individuals involved in an emergency are able to communicate effectively with each other and with external parties such as emergency services, regulatory agencies, and stakeholders.

Emergency Notification Procedures

In the event of an anomaly, ambient environmental conditions can be altered and adversely impact biological resources.

In the event of a marine spill the Department of Marine Resources (DMR) should be contacted using one of the numbers listed in Table 8-2. The following information should be relayed:

a. Observer name, position, and reason for calling
b. Location, type of spill, and approximate volume
c. Express need for assistance and describe methods be used to contain or address spill
d. Wait for questions or further instructions

The Royal Bahamas Defense Force may be contacted following the Department of Marine Resources for assistance if needed.

The Department of Environmental Planning and Protection must be notified of all oil spills whether marine on onboard a ship within 24 hours of the event. The oil spill is to be documented in the environmental report as well as attention is to be brought specifically to the oil spill via email.

Communication Channels

Multiple methods of communication are available to all team members including phone, fax, email, and VHF. Communication via phone may be unreliable in the middle of the ocean so the use of VHF to communicate with emergency services is highly encouraged to be the first channel used. Communication between recovery vessel and vessels that the environmental team will be on will be able to use VHF as well.

Chain of Command

The chain of command for emergency response is the same as the responsibilities chart shown in section 5.1

Roles and Responsibilities

Every crew member should be trained on the necessary procedures to take in case of an emergency. The following personnel will be primarily responsible for communicating with emergency services, regulatory agencies, and stakeholders.

Vessel Recovery Personnel (**VRP**)– Assignments will be given to specific personnel on whether they will be apart of the team that addresses the emergency or the team that relays information regarding the emergency to environmental monitor. Contact and position for the chosen environmental monitor will be announced to all personnel prior to landing.

Environmental Monitors – The Environmental Monitors are responsible for recording and documenting all changes in ambient environment conditions. Any accident or information that is provided to the monitors by vessel recovery personnel will be recorded in environmental reports. Significant information such as leaks, spills, or poor management of waste should be highlighted and brought to the attention of the Environmental Manager. In the case of an emergency, monitor will be responsible for contacting relevant emergency services such as the RBDF or CAA.

Environmental Manager – The Environmental Manager acts as a liaison between the environmental monitor and regulatory agencies. The manager will communicate regularly with the environmental monitor and flag pertinent information to bring to the attention of the relevant agency such as the DEPP or the DMR.

Communication Protocols

Communication of emergencies will incorporate emergency notification procedures, and the roles and responsibilities listed previously. All personnel should be trained on steps necessary to address emergencies and the appropriate means of communication to the relevant individual. Initial communication of the emergency if discovered by a VRP should be relayed to the environmental monitor who will then contact the relevant emergency service and follow the steps noted in the emergency notification procedures.

Alert System

All major events such as a marine oil spill, an oil spill aboard the ship, or a failed landing should be broadcasted across all ships related to the project. Information regarding the issue and next steps will be shared via the broadcast system. If gathering of personnel is required, this information will also be included in the broadcast message. Broadcast should be repeated a minimum of three times with information being consistent and clear.

Contact Information

Table 8-2 includes contacts for ministries, departments, and agencies that may be needed in the event of an emergency. Names and contacts for other key personnel such as the environmental monitor, principal launch engineer, and environmental engineer will be provided to the project teams before the launch.

Table 8-2. Emergency Contact List

Name	Information
Ministry of Environment and Natural Resources	Phone: (242) 322-6027 (242) 322-6000 5/6
Department of Environmental Planning and Protection	Phone: (242) 322-4546 (242) 397-9350 Email: information@depp.gov.bs
Bahamas Air Sea Rescue Association	Phone: (242) 823-5487 (242) 357-4787
Ministry of Agriculture, Marine resources, and Family Island Affairs	Phone: (242) 397-7450 (242) 325-7413 Fax: (242) 325-3960 Email: departmentofagriculture@bahamas.gov.bs
Department of Marine Resources	Phone: (242) 393-1777 (242) 393-1014/5 (242) 393-1096/7 Fax: (242) 393-0238 Email: fisheries@bahamas.gov.bs
Ministry of Tourism, Investments, and Aviation	Phone: (242) 302-2000 (242) 322-7500 Fax: (242) 302-2098 Email: tourism@bahamas.com
Civil Aviation Authority Bahamas	Phone: (242) 397 - 4700 Fax: (242) 326-3591
Port Department	Nassau Office (242) 302 - 0200
Bahamas National Trust	VHF: Call "Exuma Park" on Channel #09 Channel #16 is monitored 24 hours a day by RBDF for emergencies. Phone: (242) 601-7438 Email: exumapark@bnt.bs
Royal Bahamas Defense Force	Phone (242) 362 - 1818

8.4.3 Evacuation Plan

The flight trajectory is designed to avoid off-nominal events impacting land. While the nominal scenario does not require an evacuation plan, in the event the parafoil or other debris were to land on land, the general public should not touch the debris and report it's location to SpaceX at recovery@spacex.com and Bahamian authorities for proper removal and disposal. The DEPP should be contacted at (242) 322-4546.

8.5 MALFUNCTIONS / ANOMALY SCENARIOS

In the event of a landing anomaly, debris would be contained to the booster landing ellipse. SpaceX would be responsible for recovering or disposing of any resulting launch vehicle debris. Debris would include the ~300 gallons of liquid propellant, which is expected to combust in the destruct action, be dispersed in the air, or expelled into the ocean upon impact and dissipate within hours. The droneship is expected to survive a landing failure scenario based on observations from SpaceX's early landing attempt failures.

In the event of an in-flight anomaly, there is a potential for debris to be dispersed along the flight path. Due to the very high altitudes that the vehicle is travelling during ascent, much of the debris is expected to demise from atmospheric heating before reaching land or the ocean's surface. The risk analysis performed by the United States Space Force for each Falcon9 launch assesses the risk from the resulting debris from a variety of failure scenarios. This analysis is used to verify the risk to any public individual does not exceed 1 in a million and that the cumulative risk to the public does not exceed 149 in a million.

Preventing malfunctions is essential for maintaining safety and avoiding delays. Steps to prevent malfunction include the following.

1. Conduct regular equipment inspections - Regular inspections of equipment and machinery can help identify potential malfunctions before they occur. Inspections should be conducted by trained personnel and include all safety-related components.
2. Maintain equipment properly - Proper maintenance of equipment is critical to prevent malfunctions. This includes regularly scheduled maintenance and repairs, as well as keeping equipment clean and properly lubricated.
3. Use high-quality equipment - Investing in high-quality equipment and machinery can help prevent malfunctions.
4. Train workers properly - Workers should be properly trained in how to use equipment and machinery safely. This includes training on how to recognize potential malfunctions and how to respond to them.
5. Follow manufacturer guidelines - Following manufacturer guidelines for the use and maintenance of equipment can help prevent malfunctions. This includes using equipment for its intended purpose, following recommended maintenance schedules, and using recommended parts and accessories.

In the event there is a malfunction, it is important to respond quickly and effectively to prevent injuries or further damage. The following steps should be taken in the event of an equipment malfunction.

1. Stop work immediately- If a malfunction is detected, work should be stopped immediately to prevent further damage or injury.
2. Secure the area -The area around the malfunctioning equipment should be secured to prevent workers from entering the area and to prevent additional damage.
3. Assess the situation -The malfunction should be assessed to determine the extent of the damage and to identify any safety hazards.
4. Notify the appropriate personnel -The appropriate personnel, such as a supervisor or safety manager, should be notified of the malfunction.
5. Take corrective action - Corrective action should be taken to repair or replace the malfunctioning equipment. This may include shutting down the equipment, repairing the equipment on site.

In the event of a grounding, when a vessel has gone hard aground, quick and appropriate decisions can prevent further damage. Caution must be exercised before attempting to float the vessel under its own power. The information below is described in further detail in the Emergency Management Manual.

1. The Master, as in any other emergency will make decisions based on the following priorities:
    a. Safety of Life and Health
    b. Protection of the Environment
    c. Protection of Company property
2. Once a vessel has grounded the following steps must be taken:
    a. Determine if the vessel hull has been breached.
    b. If there is a breach in the hull, then take whatever actions are possible to protect the crew, the vessel and to prevent pollution.
    c. Take note of range and state of the tide.
    d. Make every attempt to determine what type of bottom or structure the vessel is aground on.
    e. Notify the ERT
    f. Attempt to free the vessel only when it is apparent that to do so will not present a greater threat to the vessel than remaining aground.
    g. Record in vessel log

More details on emergency responses to malfunctions can be found in Emergency Management Manual Section 5, which was provided to DEPP.

9 PUBLIC CONSULTATION

9.1 STAKEHOLDER ENGAGEMENT

SpaceX conducted stakeholder engagement meetings throughout the planning phase of the Project by meeting with several agencies in The Bahamas. These agencies and their point of contact are listed below.

- Civil Aviation Authority Bahamas (CAAB)
  Point of Contact - Mr. Alex Furgeson
    - SpaceX and CAAB collaborating on licensing structure for the landing

- Port Department
  Point of Contact – Commander Wright
    - SpaceX will request a 'Notice to Mariners' is issued featuring the designated hazard area. A Notice to Mariners generally advises mariners of important matters affecting navigational safety. The notice consists of important items, such as a chart correction section, a publications correction section, and a summary of broadcast navigation warnings and miscellaneous information. This information is made available weekly by the Port Department prepared jointly with the Royal Bahamas Defence Force (RBDF) and the Meteorological Office. All notices are posted in the local newspapers and are also placed on The Bahamas Government Portal.
    - Example of Public Notices are provided below.

h. PUBLIC NOTICES: Examples of "public notices" required by this agreement include but are not limited to:

1) Notice to Air Missions (NOTAM) or other aviation warning publication: a notice filed with an aviation authority to alert aircraft pilots of potential hazards along a flight route or at a location that could affect the flight.

2) Notice to Mariners (NOTMAR) or other maritime warning publications: advises mariners of important matters affecting navigational safety, including new hydrographic information, changes in channels and aids to navigation, and other important data.

- Royal Bahamas Defense Force (RBDF)
  Point of Contact - Commander Wright
    - RBDF to publish notification to mariners of landing hazard area

- Department of Environmental Planning and Protection (DEPP)
  Point of Contact – Dr. Rhianna Neely
    - Environmental Compliance Process

- Ministry of Tourism, Investments and Aviation:
  Point of Contact – Hon. Chester Cooper

  - Primary approval for this project – responsible for agreement and all final airspace coordination

- Office of the Attorney General and Ministry of Legal Affairs:
  Point of Contact – Ryan Pinder
  - Review of landing agreement and release of diplomatic notice

- Bahamas Air Navigation Services Authority (BANSA)
  Point of Contact - Lenn King
  - BANSA to publish Notice to Air Mission (NOTAMs) and airspace coordination on day of launch

As a part of long-term stakeholder engagement for the Project, SpaceX will also liaise with the following agencies.

- Ministry of Education and Technical and Vocational Training – In the Memorandum of Agreement (MOA), SpaceX agreed to install Starlink terminals in schools, conduct educational outreach, and provide space tourism opportunities. As a result, the Ministry of Environment will be engaged to ensure SpaceX meets the terms of the MOA.

- Ministry of Agriculture and Marine Resources
  - Department of Marine Resources (DMR) – As the Department is responsible for the conservation and management of Bahamian fishery resources, DMR will be briefed on the Project and their input incorporated in the environmental management of the Project.

9.2 Grievance Response Mechanism

Any grievances stakeholders may have can be sent via email to recovery@spacex.com and or the DEPP at information@depp.gov.bs. They can also be reported to DEPP via phone at (242) 322-4546. Grievances shall be addressed within two (2) weeks. A public notice will be sent out regarding the Grievance Response Mechanism (GRM). To file a grievance, a form similar to the one shown in the following figure should be completed.

Table 9-1. Example GRM form adapted from Smartsheet.com[9].

GRIEVANT INFORMATION	Email completed form to information@depp.gov.bs
NAME	**DATE FORM SUBMITTED**
PREFERRED MODE OF CONTACT	**TIME OF DAY TO CONTACT YOU**

[9] https://www.smartsheet.com/

PHONE ☐ EMAIL ☐	
CONTACT INFORMATION	**MAILING ADDRESS**

DETAILS OF EVENT LEADING TO GRIEVANCE	
DATE, TIME, AND LOCATION OF EVENT	**WITNESSES** if applicable
ACCOUNT OF EVENT	**VIOLATIONS**
Provide a detailed account of the occurrence. Include the names of any additional persons involved.	Provide a list of any laws, policies, or EMP procedures and guidelines you believe have been violated in the event described.

PROPOSED SOLUTION

Please retain a copy of this form for your own records. As the grievant, please provide your signature below, as it indicates that the information you've included on this form is truthful.

SIGNATURES	
SIGNATURE	**DATE**
RECEIVED BY: PRINTED NAME AND SIGNATURE	**DATE**

10 Monitoring and Reporting

10.1 Planned Environmental Monitoring

The Environmental Management team will be available as the SpaceX team deploys the landing pad, during the landing, and during recovery. The Environmental Manager will report to the DEPP daily during this initial launch process.

Table 10-1. EMC Compliance Code

Site Code	Compliance Code Description	Next Steps
Project Compliant (Green)	Project is fully compliant with the EMP and reporting requirements.	No Action Required.
Partially Compliant (Orange)	Project is partially compliant with the EMP and reporting requirements. The required corrective action will be provided to SpaceX. SpaceX will have the opportunity to address the area of noncompliance before the project is issued a Red Compliance Code.	DEPP is informed of the area of noncompliance and the appropriate corrective action described.
Non-Compliant (Red)	Project is not compliant with the EMP and reporting requirements.	The Environmental Manager notifies DEPP of the area of noncompliance. DEPP may issue a cease work order.

10.2 Responsibilities and Accountability

Environmental Monitors will document relevant activities in the project area by taking notes and photographs of possible environmental issues and mitigation.

These activities include:

- Water Quality Tests
- Air Quality Tests
- Waste management on recovery vessels,
- Avian surveys
- Marine surveys
- Other note-worthy activities

Update - The initial methodology included marine snorkel surveys once a day for two weeks before the launch and once a day for two weeks post-launch. The marine surveys were to be conducted at select locations within the booster and parafoil landing ellipses and ambient environmental conditions were to be conducted simultaneously. The Environmental Monitors on board a monitoring vessel during the launch were to complete the Environmental Monitor

Checklist (EMC) which would be submitted to DEPP. SpaceX operations, responses, and reporting will be per the EMP in conjunction with SpaceX Operational Procedures and Marine Operations Manual which was previously submitted to DEPP.

During the launch coordination meeting in January 2025, the Port Department notified BRON the proposed survey vessel was not approved for the mission. Since that meeting, the vessel approved for the mission was the RBDF Lignum Vitae. During subsequent planning communications with the RBDF, BRON was informed that the proposed survey methodology was not approved from the vessel. As a result, the marine survey methodology was adapted to incorporate a Remote Operated Vehicle (ROV). The survey locations and data collected using the ROV will be provided to DEPP in a Post Launch Report. Ambient environmental conditions were documented before during and post launch. This information will also be included in the Post Launch Report submitted to DEPP.

10.3 Environmental Monitoring Checklist

Observer: ______________________________ Date: ____________________

Time Started: __________ Time Ended: __________

SpaceX Representative : ____

Site Description: ____

Weather: ☐ Sunny ☐ Cloudy ☐ Partly Cloudy ☐ Rainy ☐ Thunderstorm

Project Phase

☐ Pre Launch / Launch Preparations ☐ During Launch ☐ Post Launch

Site Safety and Health Conditions

Areas of Compliance with the Approved EMP	*Compliance with EMP* Yes	No	N/A	*Remarks*
i. Appropriate usage of Personal Protective Equipment (PPE).				
ii. Proper maintenance and availability of fire extinguishers				

iii. Proper maintenance and availability of first aid resources				
iv. Marine Traffic Notice (NOTMAR) published.				
v. Good housekeeping practices and general cleanliness of vessel.				
vi. Sewage being properly disposed of, with no drainage into marine environment.				

Marine Resource Management

Areas of Compliance with the Approved EMP	*Compliance with EMP*			*Remarks*
	Yes	*No*	*N/A*	
i. Megafauna observed on site.				
ii. Preclearance survey conducted.				
i. Spill kits and absorbents easily accessible for quick spill response.				

Incidents / Emergencies

Accident/Incident Reporting

Areas of Compliance with the Approved EMP	Yes	No	*Remarks*
i. Did an accident or emergency occur on-site?			
ii. Was the Incident Investigation Report completed?			
iii. Were external Emergency First Responders contacted?			

Daily EMP Compliance Code

Compliance Code:	☐ Green ☐ Orange ☐ Red	
Additional Comments:		
Report prepared by:		
BRON POSSIBILITIES UNLIMITED	Environmental Monitor	

11 Conclusion

The landing of the Falcon 9 in Bahamian waters is an unprecedented event. The Falcon 9 has a high success rate for landing and recovery operations and its design allows for impacts during an anomaly to be negligible to moderate. Significant and long-term impacts are not expected to occur from a failed landing of the Falcon 9 because of the specialized RP-1 fuel that easily combusts and dissipates. Possible impacts from the operation of recovery vessels are also expected to be minimal and temporary. Mitigation efforts have been described to account for multiple possible events that may have significant impacts to the surrounding environment.

This Project will allow for a Starlink satellite to be delivered into low earth orbit that will expand the reach of their internet services. SpaceX has agreed to provide multiple Starlink terminals for placement in public schools and is committed to providing educational outreach in STEM and space-focused presentations amongst other things.

12 Appendices

12.1 Appendix A – NOAA Programmatic Concurrence Letter for Launch and Reentry

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
1315 East-West Highway
Silver Spring, Maryland 20910

1/31/22

Refer to NMFS No: OPR-2021-02908

Michelle Murray
Manager, Operations Support Branch (A), ASA-140
FAA Office of Commercial Space Transportation
800 Independence Ave SW, Suite 325
Washington, DC 20591

RE: Programmatic Concurrence Letter for Launch and Reentry Vehicle Operations in the Marine Environment and Starship/Super Heavy Launch Vehicle Operations at SpaceX's Boca Chica Launch Site, Cameron County, TX

Dear Ms. Murray:

On August 25, 2021, the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) Endangered Species Act (ESA) Interagency Cooperation Division received a request for concurrence with the Federal Aviation Administration's (FAA) determination that launch and reentry vehicle operations in the marine environment may affect, but are not likely to adversely affect ESA-listed species or designated critical habitat under the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 et seq.). On August 11, 2021, the FAA submitted a consultation request letter to the ESA Interagency Cooperation Division seeking concurrence on their determination that issuing experimental permits and/or a Vehicle Operator License that would allow SpaceX to launch the Starship/Super Heavy from the Boca Chica (Cameron County, TX) Launch Site may affect, but are not likely to adversely affect ESA-listed species or designated critical habitat. Because of the similarities in the two proposed actions, NMFS decided to batch the two consultations into a single programmatic letter of concurrence. This response to your consultation requests was prepared by NMFS pursuant to section 7(a)(2) of the ESA, implementing regulations at (50 CFR §402), and agency guidance for preparation of letters of concurrence.

This letter underwent pre-dissemination review using standards for utility, integrity, and objectivity in compliance with agency guidelines issued under section 515 of the Treasury and General Government Appropriations Act of 2001 (Data Quality Act; 44 U.S.C. 3504(d)(1) and 3516). A complete record of this informal consultation is on file at NMFS Office of Protected Resources in Silver Spring, Maryland.

Consultation History

Because of the history of the FAA requesting individual consultations for different components of space launches and reentries, NMFS proposed a programmatic consultation focused on commercial space launches and reentries to the FAA in March 2018. The FAA agreed to a programmatic approach to combine space launches and reentries into a single consultation. The

National Aeronautics and Space Administration (NASA) and the U.S. Space Force (USSF) are included as federal action agencies in this programmatic consultation due to their involvement with commercial space launch operations that are part of the proposed action, such as leasing launch complexes and launch-related infrastructure to commercial launch operators.

The FAA submitted a consultation request letter to the ESA Interagency Cooperation Division on August 11, 2021, seeking concurrence on their effects determination for the proposed issuance of experimental permits and/or a Vehicle Operator License that would allow SpaceX to launch the Starship/Super Heavy from the Boca Chica (Cameron County, TX) Launch Site. NMFS ESA Interagency Cooperation Division decided to combine the two consultations into a single programmatic letter of concurrence. Programmatic ESA section 7 consultations allow the Services to consult on the effects of programmatic actions such as: (1) multiple similar, frequently occurring or routine actions expected to be implemented in particular geographic areas; and (2) a proposed program, plan, policy, or regulation providing a framework for future actions (50 C.F.R. §402.02).

The history of this consultation is as follows:

- During early coordination and technical assistance, the FAA submitted a draft Programmatic Biological Evaluation (BE) to NMFS on February 25, 2021, to solicit review and comments. The ESA Interagency Cooperation Division subsequently distributed the draft BE to NMFS regional offices for review. NMFS comments on the BE were combined and provided to the FAA on June 4, 2021.
- The FAA provided a revised BE to NMFS on August 25, 2021. The revised BE was reviewed by ESA Interagency Cooperation Division staff and sent to the NMFS regional offices. NMFS provided the FAA with questions following review of the revised BE on September 13, 2021. FAA provided responses on October 13, 2021. NMFS had additional questions regarding these responses, which were sent to the FAA on October 18, 2021, and the FAA responded on October 22, 2021.
- The SpaceX concurrence request letter was subsequently distributed to NMFS regional offices for review by the ESA Interagency Cooperation Division. NMFS comments on the letter were combined and provided to the FAA on September 15, 2021. The FAA provided responses on November 4, 2021, that included a revised letter and an expanded action area in the Gulf of Mexico for the consultation.
- On October 15, 2021, the ESA Interagency Cooperation Division staff requested a meeting with the FAA to discuss combing the Starship-Super Heavy proposed activities with the programmatic launch and reentry vehicle operations consultation. The meeting occurred on November 5, 2021, and, due to the significant overlap of proposed activities, action areas and effects analysis, NMFS and the FAA agreed to incorporate the Starship-Super Heavy consultation into the programmatic launch and reentry vehicle operations consultation.

The FAA, NASA, the USSF, and the U.S. Air Force (USAF) prior to the creation of USSF, have completed informal consultations with NMFS for the types of activities included in this programmatic consultation.

Previous consultations for the activities included in this programmatic consultation include:

- **SER-2016-17894:** On April 11, 2016, the FAA, USAF and NASA submitted a request for concurrence under ESA section 7 to NMFS's Southeast Regional Office (SERO) for SpaceX launch operations occurring from Cape Canaveral, Kennedy Space Center, and the SpaceX Texas Launch Site (now referred to as the SpaceX Boca Chica Launch Site), and launch recovery operations occurring in open waters in the Atlantic Ocean and Gulf of Mexico. On August 8, 2016, NMFS issued a Letter of Concurrence for those proposed activities.
- **FPR-2017-9231:** After concluding the 2016 consultation, SpaceX informed the FAA that parafoils and parachutes associated with the payload fairings that descend through the Earth's atmosphere and land in the Atlantic Ocean after a launch might not be fully recovered by SpaceX. The FAA also learned the parachutes associated with other spacecraft (e.g., Dragon) reentry were not always recovered. These aspects of the project were not considered in the 2016 consultation because it was assumed all parachutes and parafoils would be fully recovered. SpaceX also proposed to conduct Falcon 9 launch vehicle and Dragon spacecraft recovery operations in the Pacific Ocean, which were not addressed in the 2016 consultation. Actions in the Pacific Ocean include recovery of parafoils and parachutes associated with payload fairings and the Dragon spacecraft. On June 7, 2017, via conference call, staff from the FAA, USAF, NASA, and NMFS Protected Resources staff (from Headquarters and SERO) discussed ongoing operations and ESA coverage needs for future operations. The parties mutually agreed that NMFS ESA Interagency Cooperation Division would complete the ESA section 7 consultation for the expanded operations. On October 2, 2017, NMFS issued a Letter of Concurrence for SpaceX's proposed launch and recovery operations in the Atlantic Ocean, Gulf of Mexico, and Pacific Ocean.
- **SER-2018-19649 and FPR-2018-9287:** On October 15, 2018, the FAA reinitiated ESA consultation with NMFS (Headquarters and SERO) to consider the effects to the giant manta ray (*Manta birostris*) and the oceanic whitetip shark (*Carcharhinus lonigmanus*) because these species were federally listed subsequent to the 2016 and 2017 consultations. On November 21, 2018 and November 30, 2018, NMFS SERO and NMFS Headquarters, respectively, issued Letters of Concurrence.
- **OPR-2020-00268:** On October 7, 2019, the FAA reinitiated ESA consultation with NMFS (Headquarters) because SpaceX expanded their proposed launch trajectories to include a southern trajectory for payloads requiring polar orbits. The change expanded the action area for which Falcon first stage booster return and recovery operations in the Atlantic Ocean could occur. On February 26, 2020, NMFS Headquarters issued a Letter of Concurrence.

The purpose of this programmatic consultation is to streamline the FAA's, USSF's, and NASA's compliance with ESA section 7 for the actions as described in the *Proposed Action* section of this letter. This programmatic consultation includes all the project-specific activities evaluated in the above-mentioned consultations (including the environmental protection measures) and expands upon them to enable application to future launch projects or operations. Thus, this programmatic consultation supersedes the above-mentioned consultations.

Office of National Marine Sanctuaries

If a federal agency finds that a proposed action is likely to injure National Marine Sanctuary resources, the agency is required to consult with the NOAA Office of National Marine Sanctuaries (ONMS). The ESA Interagency Cooperation Division provided the Programmatic BE and the Starship Super Heavy concurrence request letter to ONMS on October 1, 2021, to determine if consultations would be needed for the proposed activities. The ONMS responded on October 12, 2021, stating that a permit might be needed if any material is expected to make its way into a sanctuary. The FAA determined none of the proposed activities are expected to occur within sanctuaries.

Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) requires that an incidental take authorization be obtained for the unintentional "take" of marine mammals (e.g., by harassment) incidental to otherwise lawful activities. The action agencies and/or their commercial space partners are required to apply for an MMPA authorization from the NMFS Office of Protected Resources, Permits and Conservation Division, if their activities could subject marine mammals to "take" as defined by the MMPA.

Proposed Action and Action Area

Agency Action Overview

The FAA, USSF, and NASA prepared the Programmatic BE to address the potential effects of the following federal actions on ESA-listed species and designated critical habitat:

1) FAA's action of issuing licenses or permits to commercial space applicants in general practice, and specifically for SpaceX Starship-Super Heavy operations launched from Boca Chica;
2) USSF's (Space Launch Delta [SLD] 30 and 45) action of conducting launch operations from Cape Canaveral Space Force Station (CCSFS) and Vandenberg Space Force Base (VSFB)[1], including the action of leasing launch complexes to commercial launch operators; and
3) NASA's action of conducting launch, landing, and recovery operations from Kennedy Space Center (KSC) and Wallops Flight Facility (WFF), including the action of leasing launch complexes and launch-related infrastructure to commercial launch operators.

The following subsections provide an overview of the FAA's, USSF's, and NASA's missions pertaining to this consultation.

Federal Aviation Administration

The FAA Office of Commercial Space Transportation oversees, licenses, and regulates U.S. commercial launch and reentry activity, as well as the operation of non-federal launch and reentry sites, as authorized by the Commercial Space Launch Act of 1984, as amended and codified at 51 U.S.C. 50901–50923. An FAA license or permit is required for any commercial launch or reentry, or the operation of any commercial launch or reentry site, by U.S. citizens anywhere in the world, or by any individual or entity within the United States. An FAA license

[1] With the creation of the USSF, Cape Canaveral Air Force Station and Vandenberg Air Force Base were renamed Cape Canaveral Space Force Station and Vandenberg Space Force Base. The 30th and 45th Space Wings were renamed Space Launch Delta (SLD) 30 and 45.

or permit is not required for launch or reentry activities carried out by the federal government, such as NASA or Department of Defense (DoD) launches. The FAA licensing and permitting evaluation consists of five major components: 1) a policy review, 2) a payload review, 3) a safety review, 4) a determination of maximum probable loss for establishing financial responsibility requirements, and 5) an environmental review.
The FAA defines a 'launch vehicle' as a vehicle built to operate in, or place a payload in, outer space, or a suborbital rocket. The FAA defines a 'reentry vehicle' as a vehicle designed to return from Earth orbit or outer space to Earth substantially intact. The FAA issues licenses or permits to commercial launch vehicle operators (referred to as vehicle operators or launch operators) for operation of launch and reentry vehicles. The same vehicle operators may also conduct operations for NASA or DoD. Additionally, NASA and DoD may conduct launches and/or reentries of launch and reentry vehicles that were built by the federal government.

The FAA Office of Commercial Space Transportation issues the following types of licenses and permits, in accordance with Title 14, Code of Federal Regulations (CFR) parts 420, 437, and 450:

- **Launch Site Operator License** (14 CFR Part 420): A license to operate a launch site authorizes a licensee to offer its launch site to a launch operator (i.e., a person or company conducting the launch of a launch vehicle and any payload) for each launch point, launch vehicle type, and weight class identified in the license application and upon which the licensing determination is based. Examples of launch site operators include airports and state or local governments. Examples of launch operators include companies such as SpaceX, Blue Origin, Firefly, Rocket Lab, Northrop Grumman, Virgin Orbit, and United Launch Alliance. Issuance of a launch site operator license does not relieve a licensee of its obligation to comply with any other laws or regulations, nor does it confer any proprietary, property, or exclusive rights in the use of airspace or outer space. A launch site operator license remains in effect for 5 years from the date of issuance unless surrendered, suspended, or revoked before the expiration of the term and is renewable upon application by the licensee. Actual launches cannot occur from a launch site until a launch operator receives a vehicle operator license for the site.
- **Vehicle Operator License** (14 CFR Part 450):A vehicle operator license authorizes a licensee to conduct one or more launches or reentries using the same vehicle or family of vehicles. Launch includes the flight of a launch vehicle and pre- and post-flight ground operations. Reentry includes activities conducted in Earth orbit or outer space to determine reentry readiness and that are critical to ensuring public health and safety and the safety of property during reentry flight. Reentry also includes activities necessary to return the reentry vehicle, or vehicle component, to a safe condition on the ground after impact or landing.
- **Experimental Permits** (14 CFR Part 437): An experimental permit authorizes launch or reentry of a reusable suborbital rocket. The authorization includes pre- and post-flight ground operations. A suborbital rocket is a vehicle, rocket-propelled in whole or in part, intended for flight on a *suborbital* trajectory. A permit is an alternative to licensing and is valid for a one-year renewable term.
- **SpaceX Starship-Super Heavy, Boca Chica:** SpaceX must obtain an experimental permit or launch vehicle operator license from the FAA for Starship (spacecraft)-Super

Heavy (rocket booster) launch and reentry operations that originate from the Boca Chica Launch Site. SpaceX proposed launch operations include suborbital and orbital launches.

U.S. Space Force

The USSF is the lease or license holder for the real property and ranges where launches occur from CCSFS and VSFB. The USSF uses its own launch and reentry vehicles, as well as those of commercial launch operators, to launch USSF payloads into space.

- **Space Launch Delta 45:** SLD 45 is responsible for overseeing the preparation and launching of U.S. government, civil, and commercial satellites from CCSFS, Florida, and operates the Eastern Range for the USSF. SLD 45 also provides launch facilities and services to support NASA and commercial space operations. A directive of the USSF is to provide efficient means of executing national security and military policy goals. The Eastern Range operations provide the resources and activities for safe flight, range instrumentation, infrastructure, and schedule to support space and ballistic launches. The Eastern Range consists of tracking stations at CCSFS, mainland annexes, and downrange tracking stations on islands located in the Caribbean Sea and South Atlantic Ocean. SLD 45 is the primary missile and rocket launch organization for the USSF on the east coast of the United States.
- **Space Launch Delta 30:** SLD 30 at VSFB is the Air Force Space Command organization responsible for DoD space and missile launch activities on the west coast of the United States. The primary mission of VSFB is to launch and track satellites destined for polar or near-polar orbit, test and evaluate America's Intercontinental Ballistic Missile systems, and support aircraft operations. SLD 30 supports West Coast launch activities for the DoD (including USAF and Missile Defense Agency), NASA, foreign nations, and various private contractors.

National Aeronautics and Space Administration

The National Aeronautics and Space Act is the U.S. federal statute that created NASA. The Space Act gives NASA the responsibility for planning, directing, and conducting the nation's civilian space program, aeronautics and aerospace research activities. It also gives NASA the authorization to enter into cooperative agreements, leases, and contracts with public and private entities in the use of NASA's services, equipment, and facilities in support of scientific research and discovery.

- **Kennedy Space Center:** Established in 1962 as the NASA Launch Operations Center, KSC has carried out launch operations for the Apollo, Skylab, Space Shuttle, and cargo and crewed launches to the International Space Station. KSC is NASA's only launch site for human spaceflight. KSC's mission is to function as a multi-user spaceport for launch operations operated by NASA and a growing number of private partners. In addition to providing all aspects of launch, landing, and recover operations for both government and commercial launch providers, KSC also provides payload processing, testing, and integration for government and commercial partners at facilities across KSC. KSC is located adjacent to CCSFS and the two entities work closely together to execute their missions, sharing resources, facilities, and infrastructure.

  KSC's launch complexes consist of Launch Complex 39A and 39B, Launch Complex 48, and the Shuttle Landing Facility. KSC also has land identified for up to two additional launch complexes for potential future development. In anticipation of missions to the moon and Mars, KSC will facilitate further research, development, and diverse partnerships to develop, integrate, and sustain space systems. Launch Complex 39A is designated as a multi-use complex that will support the NASA Space Launch System launch vehicle and the Orion crew capsule for manned missions beyond low Earth orbit. Launch Complex 39A is operated by SpaceX and supports Falcon vehicle launch operations with potential plans to support future SpaceX launch vehicle operations. Launch Complex 48 is a small class vehicle pad that is being developed to support commercial launches.

- **Wallops Flight Facility:** NASA Goddard Space Flight Center manages WFF, the oldest active launch range in the continental United States and the only rocket testing and launch range owned and operated by NASA. For over 70 years, WFF has flown thousands of research vehicles in the quest for information on the flight characteristics of launch vehicles and spacecraft, and to increase the knowledge of the Earth's upper atmosphere and the near space environment. The primary purpose of the WFF launch range is to provide the infrastructure, data services, logistics, and safety services necessary for flight projects supporting NASA science, technology, and exploration programs; DoD research and other government agency needs; and academic and commercial industry needs. WFF regularly provides launch support, range safety, and downrange tracking for the emerging commercial launch industry, either directly or through the Mid-Atlantic Regional Spaceport, which is a commercial launch site on Wallops Island licensed by the FAA and operated by the Virginia Commercial Space Flight Authority (Virginia Space). The Spaceport provides facilities and services for NASA, DoD, and commercial launches of payloads into space.

Launch Sites

USSF launches occur at CCSFS and VSFB. NASA launches occur at KSC and WFF. Commercial space launches are currently authorized to occur at several launch sites, including sites at CCSFS, VSFB, KSC, and WFF.[2] Existing launch sites that involve operations in the marine environment are listed in Table 1. The FAA, USSF, and/or NASA might receive proposals in the future for launch operations involving operations in the marine environment at other existing launch sites or new launch sites. Upon receipt of a new proposal that involves operations in the marine environment, the lead action agency will review the proposal and coordinate with NMFS to determine if the proposed launch operations fall within the scope of this consultation (see *Project Specific Review* for details).

Table 1. Launch Sites with Operations in the Marine Environment

Launch Site	FAA-License	Location	Site Operator	Type of Launch (Vertical or Horizontal)[a]
Cecil Airport	Yes	Jacksonville, FL	Jacksonville Aviation Authority	Horizontal
CCSFS (multiple launch and landing complexes)	No	Cape Canaveral, FL	U.S. Space Force	Vertical

[2] See the FAA's website for a current list of active licenses: https://www.faa.gov/data_research/commercial_space_data/licenses/.

Launch Site	FAA-License	Location	Site Operator	Type of Launch (Vertical or Horizontal)[a]
CCSFS Skid Strip	No	Cape Canaveral, FL	U.S. Space Force	Horizontal
CCSFS LC-46	Yes	Cape Canaveral, FL	Space Florida	Vertical
Ellington Airport	Yes	Houston, TX	Houston Airport System	Horizontal
Mojave Air and Space Port	Yes	Mojave, CA	Mojave Air & Space Port	Horizontal
NASA KSC (except SLF)	No	Merritt Island, FL	NASA	Vertical
NASA KSC SLF	Yes	Merritt Island, FL	Space Florida	Horizontal
NASA WFF (except LC-0)	No	Wallops Island, VA	NASA	Both
NASA WFF LC-0 (referred to as MARS)	Yes	Wallops Island, VA	Virginia Commercial Space Flight Authority	Vertical
NASA WFF Main Base	Yes	Wallops Island, VA	NASA	Horizontal
Pacific Spaceport Complex Alaska	Yes	Kodiak Island, AK	Alaska Aerospace Development Corporation	Vertical
Space Coast Regional Airport	Yes	Titusville, FL	Titusville-Cocoa Airport Authority	Horizontal
SpaceX Boca Chica Launch Site	No[b]	Brownsville, TX	SpaceX	Vertical
VSFB (multiple launch and landing complexes)	No	Vandenberg, CA	U.S. Space Force	Vertical

[a] Vertical = the launch vehicle takes off vertically from a launch pad (i.e., a traditional rocket launch); Horizontal = the launch vehicle takes off horizontally from a runway like an aircraft.
[b] SpaceX is the exclusive user of the Boca Chica Launch Site and therefore only need a vehicle operator license to launch.
AK = Alaska; CA = California; CCSFS = Cape Canaveral Space Force Station; FL = Florida; KSC = Kennedy Space Center; LC = Launch Complex; MARS = Mid-Atlantic Regional Spaceport; NASA = National Aeronautics and Space Administration; SLF = Shuttle Landing Facility; TX = Texas; VA = Virginia; VSFB = Vandenberg Space Force Base; WFF = Wallops Flight Facility

Launch Vehicles

A launch vehicle is a vehicle built to operate in, or place a payload in, outer space, or it is a suborbital rocket. Launch vehicles are commonly termed rockets. Launch vehicles take off either vertically from a launch pad or horizontally from a runway.

Currently, all of the vertical launch vehicles included in this consultation are expendable (i.e., individual stages are either disposed of in the ocean or in outer space), except for the first stages of SpaceX's Falcon 9, Falcon Heavy, and Super Heavy rockets, which are reusable (i.e., SpaceX recovers the first stages by either landing them at a launch site or on a barge in the ocean). In the future, the FAA, USSF, and/or NASA expect to receive proposals from other operators (e.g., Blue Origin) for first stage booster landings at a launch site or on a barge in the ocean, similar to SpaceX.

In addition to vertically launched rockets, there are three main types (or concepts) of horizontal launch vehicles: Concepts X, Y, and Z (Table 2). Concepts X and Y vehicles are reusable (i.e., they are not expended during a launch mission). Concept Y vehicles are similar to Concept X vehicles, except they are powered solely by rocket engines. Propellants include liquid oxygen and either kerosene or alcohol. The Concept Y vehicle takes off from the runway under rocket power and flies a suborbital trajectory. Upon atmospheric reentry, the vehicle conducts an unpowered descent and landing at the spaceport. The Concept Z vehicle is a two-part launch system consisting of a carrier aircraft (reusable) and a rocket (expendable or reusable). The turbojet engines of the carrier aircraft use Jet-A fuel (kerosene) and the hybrid rocket engine uses nitrous oxide and hydroxyl-terminated polybutadiene. During a launch, the carrier aircraft takes off from the spaceport runway with the rocket attached and ascends to an altitude of approximately 50,000 feet (ft), where the rocket is released from the carrier aircraft. The rocket ignites its engines and flies a suborbital trajectory. Upon atmospheric reentry, a reusable rocket makes an unpowered descent and landing at the spaceport. Meanwhile, the carrier aircraft makes a normal powered landing after releasing the rocket. Use of an expendable rocket for the Concept Z launch vehicle involves expending a booster stage into the ocean.

Table 2. Types of Horizontal Launch Vehicles

Type	Takeoff Propulsion	Propulsion to Reach Orbit	Landing Propulsion	Reusable or Expendable
Concept X	Jet	Rocket	Jet	Reusable
Concept Y	Rocket	Rocket	Unpowered (glide)	Reusable
Concept Z[a]	Jet	Rocket	Jet (carrier aircraft); Unpowered (rocket)	Both

Notes:
[a] The Concept Z vehicle is a two-part launch system consisting of a carrier aircraft (reusable) and a rocket (expendable or reusable).

Examples of launch vehicles (vertical and horizontal) for which operations could affect ESA-listed species under NMFS jurisdiction are listed in Table 3.

Table 3. Examples of Launch Vehicles that could affect the Marine Environment

Launch Vehicle	Type	Operator(s)	Launch Site(s)
Alpha	Vertical	Firefly	VSFB
Antares Family	Vertical	Northrop Grumman	WFF
Astra Rocket 3	Vertical	Astra Space, Inc.	PSCA
Atlas V	Vertical	ULA, Lockheed Martin	CCSFS, VSFB
Delta IV	Vertical	ULA	CCSFS, VSFB
Electron	Vertical	Rocket Lab	WFF
Falcon 9	Vertical	SpaceX	CCSFS, KSC, VSFB

Launch Vehicle	Type	Operator(s)	Launch Site(s)
Falcon Heavy	Vertical	SpaceX	KSC
Minotaur Family	Vertical	Northrop Grumman	CCSFS, WFF, VSFB
New Glenn	Vertical	Blue Origin	CCSFS, VSFB
Pegasus	Horizontal – Concept Z (expendable)	Northrop Grumman	CCSFS, WFF, VSFB
LauncherOne	Horizontal – Concept Z (expendable)	Virgin Orbit	MASP
RS1	Vertical	ABL Space Systems	CCSFS, VSFB
Sounding Rockets	Vertical	NASA	WFF
Starship/Super Heavy	Vertical	SpaceX	KSC, SpaceX Boca Chica Launch Site
Terran 1	Vertical	Relativity Space, Inc.	CCSFS, VSFB
Vector-H, Vector-R	Vertical	Vector	CCSFS, WFF
Vulcan	Vertical	ULA	CCSFS, VSFB
X-60	Horizontal	Generation Orbit	Cecil Airport, WFF

AFB = Air Force Base; CCSFS = Cape Canaveral Space Force Station; KSC = Kennedy Space Center; MASP = Mojave Air & Space Port; PSCA = Pacific Spaceport Complex-Alaska; ULA = United Launch Alliance; VSFB = Vandenberg Space Force Base; WFF = Wallops Flight Facility

Starship-Super Heavy Launch Vehicle

The fully integrated launch vehicle is approximately 400 ft tall by 30 ft diameter and comprised of two stages: Super Heavy is the first stage (or booster) and Starship is the second stage. Both stages are designed to be reusable. Unlike the SpaceX Falcon launch vehicle, Starship-Super Heavy will not have separable fairings or parachutes. The Super Heavy is expected to be equipped with up to 37 Raptor engines, and the Starship will employ up to six Raptor engines. The Raptor engine is powered by liquid oxygen (LOX) and liquid methane (LCH_4). Super Heavy is expected to hold up to 3,700 metric tons (MT) of propellant and Starship will hold up to 1,500 MT of propellant.

Reentry Vehicles

Reentry means to return or attempt to return, purposefully, a vehicle and its payload or human being, if any, from Earth orbit or from outer space to Earth. A reentry vehicle is a vehicle designed to return from Earth orbit or outer space to Earth intact. Examples of reentry vehicles are SpaceX's Dragon and Starship spacecrafts, NASA's Orion spacecraft, Boeing's Starliner spacecraft, and Sierra Nevada's Dream Chaser spacecraft. SpaceX's Dragon spacecraft has reentered Earth and landed in the Pacific Ocean and the Gulf of Mexico. SpaceX is proposing to have Starship landings occur in the Gulf of Mexico and a location in the Pacific Ocean (offshore Kauai Island, Hawaii; see Figure 5 in the *Action Area*).

SpaceX is able to conduct landings of the first stage of the launch vehicle shortly after launch (takeoff). These first stage operations are suborbital and are not considered by the FAA to be a reentry vehicle because they have not completed one orbit around the Earth. These first stage landings are considered part of a launch and it is expected that additional launch operators will utilize this strategy in the future.

Vertical Launches

Vertical launches occur from launch pads located at a launch site. After liftoff, the rocket quickly gains altitude and flies over the ocean. At some point downrange, the rocket reaches supersonic speeds (which generates a sonic boom) and pitches over to attain its intended orbital trajectory. Depending on the rocket's orientation, it is possible for the sonic boom to intercept the Earth's surface. Given the altitude at which the rocket reaches supersonic speeds, most of the sonic boom footprint that reaches the Earth's surface is usually of small magnitude (1–2 pounds per square foot [psf]), but there could be areas that experience a sonic boom up to 8 psf. The area exposed to the higher overpressure (up to 8 psf) is much smaller than the areas that experience lower overpressures. Sonic boom intensity, in terms of psf, is greatest under the flight path and progressively weakens with greater horizontal distance away from the flight track.

Vertical rocket launches may involve expending one or more stages (or boosters) in the ocean. After stage separation during the rocket's flight, the booster(s) falls into the ocean and sinks to the ocean floor. This has been the normal practice for decades. The commercial aerospace company SpaceX has developed the ability to recover first stage boosters for subsequent reuse instead of expending boosters in the ocean. For missions involving booster recovery, the booster conducts fly back and landing on a platform barge in the ocean or on a pad at a launch site. The platform barge[3] has its own azimuth thrusters to maintain position needed for landings. After securing the vehicle, the barge is towed (by an approximately 80 ft long tugboat) with the booster to a port or wharf (e.g., Port of Cape Canaveral, a CCSFS-located wharf, Port of Long Beach, or Port of Los Angeles). During booster landing in the ocean, a sonic boom is produced, up to 8 psf directly underneath and directed towards the landing barge platform. Other launch companies will likely develop technology to recover boosters in the future.

In addition to expended boosters falling into the ocean, payload fairings also fall into the ocean and sink. The fairing consists of two halves that separate to facilitate the deployment of the payload. Like booster recovery, SpaceX has developed the ability to conduct fairing recovery. SpaceX's fairing recovery operations use a parachute system hundreds of miles offshore in deep water. The parachute system consists of one drogue parachute and one parafoil (see Appendix A for characteristics of parachutes and parafoils). Drogue parachutes are thinner and smaller (65-113 foot square[ft^2]) than the parafoils (1,782-3,000 ft^2), deployed to gain control of the fairing at speeds that would destroy the larger parafoil, and therefore deployed before the parafoil. Following re-entry of the fairing into Earth's atmosphere, the drogue parachute is deployed at a high altitude (approximately 50,000 ft) to begin the initial slow down and to extract the parafoil. The drogue parachute is then cut away following the successful deployment of the parafoil. A salvage ship (approximately 170 ft long, offshore supply vessel) that is stationed in a designated safety zone near the anticipated splashdown area facilitates the fairing and parafoil recovery

[3] A converted Marmac freight barge (~300 ft x 100 ft) that SpaceX refers to as an autonomous drone ship. https://www.americaspace.com/2015/01/04/spacex-autonomous-spaceport-drone-ship-sets-sail-for-tuesdays-crs-5-rocket-landing-attempt/

operation. Upon locating the fairing, rigid-hulled inflatable boats (RHIBs; approximately 12 ft long) recover the fairing. If sea or weather conditions are poor, recovery of the fairing and parafoil may be unsuccessful. The salvage ship transports the fairing to a port, wharf, (e.g., Port of Cape Canaveral, Port of Long Beach or Port of Los Angeles). The drogue parachute assembly is deployed at a high altitude, so it can be difficult to locate, but if the recovery team can get a visual fix, recovery of the drogue parachute is attempted. The drogue parachute becomes saturated with seawater quickly and begins to sink (see Appendix A for approximate sink rates), which also makes recovery of the drogue parachute difficult.

Boosters and fairings that are expended in the ocean are made of materials that sink, strong metal with heavy duty components designed to stand up to the stressful forces of launch, reentry, and extreme temperatures. A few internal parts that are lighter items (e.g., carbon composite-wrapped aluminum containers) could be released upon impact and may float, but are expected to become waterlogged and sink within a few days (10 days maximum).

SpaceX Starship-Super Heavy Launches

During the program's development, SpaceX is proposing to conduct up to 20 Starship suborbital launches annually (Table 4). As the program progresses, SpaceX is proposing to conduct up to five Starship suborbital launches annually (operational phase). During a Starship suborbital launch, the Starship would ascend to high altitudes and then its engines would throttle down or shut off to descend, landing back at the Boca Chica Launch Site or downrange (no closer than 19 miles from shore) either directly in the Gulf of Mexico or on a platform barge (as described above for the Falcon booster landings) in the Gulf of Mexico. A Super Heavy launch could be orbital or suborbital and could occur by itself or with Starship integrated as the second stage of the launch vehicle.

Table 4. Proposed SpaceX Starship-Super Heavy Annual Operations

Operation	Program Development Phase	Operational Phase
Starship Suborbital Launch	20	5
Super Heavy Launch	3	5

Each Starship-Super Heavy orbital launch would include an immediate boost-back and landing of the Super Heavy. During flight, the Super Heavy's engines would cut off at an altitude of approximately 40 miles and the booster would separate from Starship. Shortly thereafter, Starship's engines would start and burn to the desired orbit location. After separation, Super Heavy would rotate and ignite engines to place it in the correct angle to land. Once Super Heavy is in the correct position, the engines would be shut off. Super Heavy would then perform a controlled descent using atmospheric resistance to slow it down and guide it to the landing location (like current Falcon 9 booster landings at Cape Canaveral Space Force Station). Once near the landing location, Super Heavy would ignite its engines to conduct a controlled landing. Super Heavy could have approximately up to 5 metric tons of LCH_4 onboard following an orbital flight.

When Super Heavy landings occur on a platform barge downrange in the Gulf of Mexico, the Super Heavy would then be delivered on the towed barge to the Port of Brownsville and transported the remaining distance to the Boca Chica Launch Site over roadways. Super Heavy landings would generate a sonic boom(s). The maximum overpressure from a sonic boom generated by a Super Heavy landing is predicted to be 15 psf. A maximum of five Super Heavy landings in the Gulf of Mexico could occur each year during the operational phase (Table 4).

It is SpaceX's goal to recover and reuse the Starship and Super Heavy boosters. However, during launches that are still early in the program development, SpaceX may require expending Super Heavy or Starship in the ocean (Gulf of Mexico or Pacific Ocean). When this occurs, SpaceX would not recover the Super Heavy or the Starship and expects they would breakup on impact with the ocean surface. Impact debris is expected to be contained within approximately one kilometer of the landing point. SpaceX expects debris to sink because the launch vehicle is made of steel, and if some lighter internal parts (e.g., carbon composite-wrapped aluminum containers as stated for other vertical launches) are released, they are expected to become waterlogged and sink within 10 days.

Horizontal Launches

Horizontal launches, including takeoff and landing, occur from a runway at the launch site. Concept X, Concept Y, and reusable Concept Z launch vehicle operations do not involve expending launch vehicle components in the marine environment. Horizontal launch vehicle operations can produce a sonic boom during flight over the marine environment that may affect the ocean's surface. The expendable Concept Z launch vehicle operations (e.g., Pegasus launches) involve expending a stage(s) into the ocean. The stage(s) is not recovered and rapidly sinks to the ocean floor.

Launch Failure Anomaly

An unintended launch failure (referred to as a launch anomaly) is possible during launch operations. Accidental failure could result in an explosion and/or breakup of a rocket booster and/or spacecraft on or near the launch pad or landing area. Anomalies could also occur later, during flight. Since 1989, there have been 415 commercial launches and 27 have resulted in mishaps that involved debris in the water.

Spacecraft Reentry and Recovery Operations

Some launch companies launch spacecraft as their payload into space (e.g., SpaceX Dragon spacecraft and Boeing Starliner spacecraft). After completing its mission in space, the spacecraft returns to Earth. Spacecraft reentry, splashdown, and recovery are the three elements of a spacecraft landing operation. After completing its mission in space, the spacecraft travels back to Earth where it completes a deorbit burn and reenters the atmosphere. During reentry, the spacecraft creates a sonic boom that may impact the ocean's surface. Spacecraft reentry would not be conducted in any type of stormy weather (i.e., weather that would compromise the success of the mission; e.g., a severe thunderstorm or hurricane) unless deemed necessary in an emergency (e.g., a medical emergency with an astronaut).

Spacecraft typically deploy two drogue parachutes and three to four main parachutes to assist in landing. The smaller drogue parachutes (19 ft^2 each) are deployed first to gain control of the spacecraft and then are released (and expected to land in the ocean within 0.5–1 mile from the spacecraft) before the larger main parachutes (116 ft^2 each) are deployed. The main parachutes slow the spacecraft enough to allow for a soft splashdown in the water (or on land). Drogue and main parachutes are typically made of Kevlar and nylon (see Appendix A).

During reentry, the spacecraft reenters Earth's atmosphere on a pre-planned trajectory and is tracked to a splashdown area in the ocean. Following splashdown, an electronic locator beacon on the spacecraft assists in locating and recovering the spacecraft by a pre-positioned 160 ft long recovery vessel equipped with up to six RHIBs.

Hypergolic fuels (e.g., nitrogen tetroxide [NTO] and monomethylhydrazine [MMH]) may be on the spacecraft during splashdown. A spacecraft's propellant storage is designed to retain residual propellant, so any propellant remaining in the spacecraft is not expected to be released into the ocean. In an unlikely event the propellant tank ruptures on impact, the propellant would evaporate or be quickly diluted and buffered by seawater.

The vehicle operator's personnel attempt to recover all parachutes deployed and load the spacecraft onto the recovery vessel. It is possible some or all the parachutes may not be recovered due to sea or weather conditions, and the drogue parachute may land well beyond sight of the spacecraft recovery area. For missions involving space crew (humans), the crew and any time-critical cargo may be transported via helicopter to the nearest airport. The recovery vessel transports the spacecraft to whatever port the launch operator uses (e.g., Port of Cape Canaveral, a CCSFS-located wharf, commercially available port or wharf on the Gulf Coast, Port of Long Beach, or Port of Los Angeles).

SpaceX Starship-Super Heavy Reentry and Recovery Operations

Each Starship-Super Heavy orbital launch would include a Starship reentry and landing after Starship completes its orbital mission. Starship landing could occur at the vertical launch area, downrange in the Gulf of Mexico (either on a floating platform or expended in the Gulf of Mexico), or expended in the Pacific Ocean approximately 62 nautical miles (NM) north of Kauai, Hawaiian Islands (Figure 5). Starship may have between 1 to 10 metric tons of LCH_4 onboard following an orbital flight. As Starship slows down during its landing approach, a sonic boom(s) with a maximum predicted overpressure of 2.2 psf will be generated. If a Starship landing occurs downrange in the Gulf of Mexico on a floating platform barge, it will be delivered on the barge to the Port of Brownsville, and transported the remaining distance to the Boca Chica Launch Site over roadways.

For missions involving the Starship landing in the Pacific Ocean, SpaceX will arrange an overflight to confirm that debris from the impact has sunk and attempt to locate the launch vehicle mission recording device (aka the 'black box') which has a global positioning system (GPS) tracking signal. If the tracking signal from the recording device is found, locally contracted scuba divers may be deployed to facilitate device retrieval. If there is floating debris found, a local contractor may be utilized to recover any floating debris that could drift into the Papahanaumokuakea Marine National Monument.

Launch Abort Tests

As part of research and development, launch operators may conduct launch abort tests that include waterborne landings. Abort tests may include pad abort tests and launch ascent abort tests. For both types of tests, operations may involve launching spacecraft on a low-altitude, non-orbit trajectory resulting in a waterborne landing in the Atlantic Ocean (see Atlantic Ocean in *Action Area*). Abort test operations typically involve a non-propulsive spacecraft landing using drogue and main parachutes. Recovery of the spacecraft will be similar to recovering a reentry vehicle (i.e., use of a recovery vessel and RHIBs). During an abort test, the launch vehicle could break apart (explode) and land in the ocean. In such a case, the launch operator will be responsible for retrieving as many pieces of debris as feasible. SpaceX's January 19, 2020 in-flight abort test is an example of a launch abort test. During that test, the Falcon 9 launch vehicle exploded and landed in the Atlantic Ocean. SpaceX personnel retrieved as many pieces of debris as they could locate.

Weather Balloon Deployment

Launch operators and federal government personnel (e.g., the Weather Squadron at VSFB) release weather balloons, typically 5 but up to 15 if there are any launch delays, to measure wind speed prior to launches. The data are used to create wind profiles that help determine if it is safe to launch and land the vehicle. A radiosonde, typically the size of a half-gallon milk carton, is attached to the weather balloon to measure and transmit atmospheric data to the launch operator. The latex balloon rises to approximately 20-30 kilometers (km) above Earth's surface and bursts. The radiosonde and shredded balloon pieces fall back to Earth and are not recovered. The radiosonde does not have a parachute and is expected to sink to the ocean floor.

Spotter Aircraft and Surveillance Vessels

A number of spotter aircraft and surveillance vessels (watercraft) are used during launch activities to ensure that designated hazard areas are clear of non-participating crafts. Combinations of radar and visual spotter aircraft, and surface surveillance and law enforcement vessels (watercraft), may be deployed prior to launch. Most fixed wing aircraft operate at altitudes of 15,000 ft but may drop to 1,500 ft to visually obtain a call sign from a non-participating vessel.

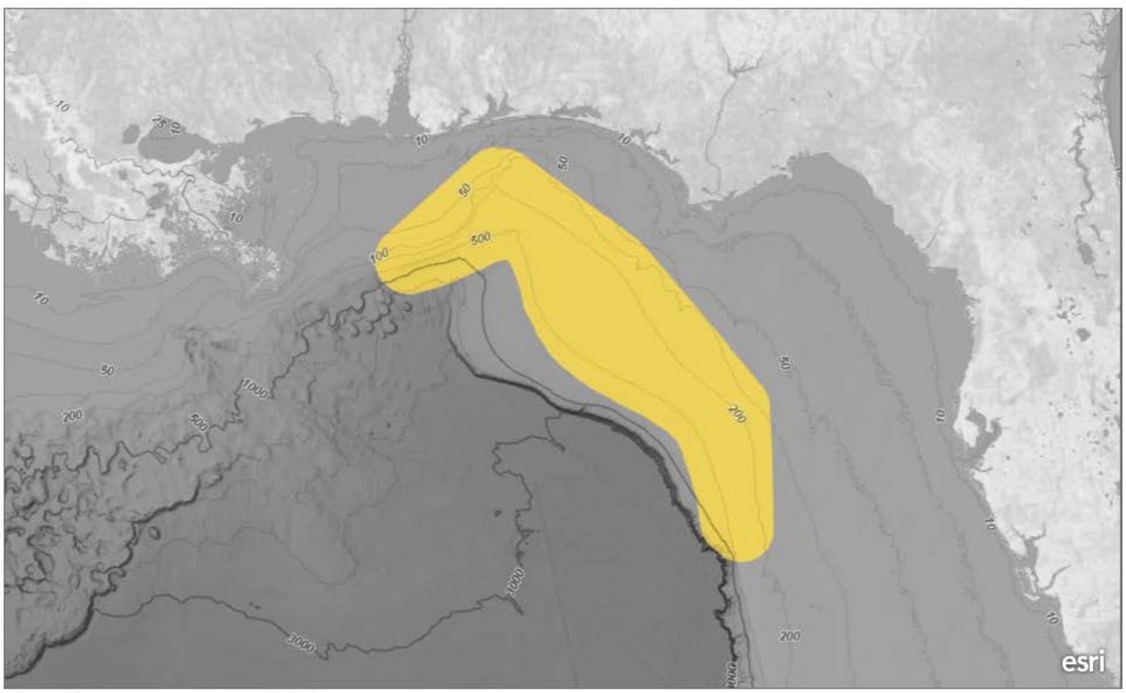
Project Design Criteria

Project design criteria (PDCs) are identified as part of a programmatic consultation and are applicable to future projects implemented under the program. In the case of this consultation, PDCs include environmental protection measures developed by the FAA to limit the effects of launch operations. These environmental protection measures will lead to avoidance and minimization of effects to ESA-listed species and designated critical habitat in the action area to assist in the conservation of these resources.

General PDCs applicable to this consultation:

- Launch and reentry operations will be conducted by the USSF, NASA, or an FAA-licensed (or permitted) commercial operator from a launch site identified in Table 1. Launch preparations will occur in compliance with standard operating procedures and best management practices currently implemented at these existing launch vehicle facilities.
- Launch operations will utilize launch vehicles identified in Table 3.
- Launch activities, including suborbital landings and splashdowns, and orbital reentry activities will occur in the proposed action area at least 5 NM offshore the coast of the United States or islands. The only operations component that will occur near shore will be watercraft transiting to and from a port when recovering spacecraft or launch vehicle components, or possibly for surveillance.
    - No launch operator will site a landing area in coral reef areas.

- o No activities will occur in or affect a National Marine Sanctuary unless the appropriate authorization has been obtained from the Sanctuary.
- Landing operations will not occur in the aquatic zone extending 20 NM (37 km) seaward from the baseline or basepoint of each major rookery and major haul-out of the Western Distinct Population Segment (DPS) Steller sea lion located west of 144° W.
- Launch abort testing will only occur in the Atlantic Ocean from CCAFS or KSC as previously analyzed (SER-2016-17894, FPR-2017-9231). In addition:
  - o It will not occur in designated critical habitat for the North Atlantic right whale.
  - o It will not occur during the North Atlantic right whale winter calving season from November to mid-March.
- Utilize all feasible alternatives and avoid landing in Rice's whale core habitat distribution area as much as possible. No more than one splashdown, reentry and recovery of the Dragon capsule, will occur in Rice's whale core habitat distribution area per year. No other operations, spacecraft, launch or reentry vehicle landings, or expended components will occur in Rice's whale core habitat distribution area. The Rice's whale core habitat distribution area map (Figure 1) and GIS boundary can be accessed here: https://www.fisheries.noaa.gov/resource/map/rices-whale-core-distribution-area-map-gis-data.



Rice's whale core area transparent with bathmetry

General Bathymetric Chart of the Oceans (GEBCO); NOAA National Centers for Environmental Information (NCEI)

Figure 1. Rice's Whale Core Distribution Area in the Gulf of Mexico.

Education and Observation

- Each launch operator will instruct all personnel associated with launch operations about marine species and any critical habitat protected under the ESA, and species protected under the MMPA that could be present in the operations area.[4] The launch operator will advise personnel of the civil and criminal penalties for harming, harassing, or killing ESA-listed and MMPA-protected species.

- Each launch operator will provide a dedicated observer(s) (e.g., biologist or person other than the watercraft operator that can recognize ESA-listed and MMPA-protected species) that is responsible for monitoring for ESA-listed and MMPA-protected species with the aid of binoculars during all in-water activities, including transiting marine waters for surveillance or to retrieve boosters, spacecraft, other launch-related equipment or debris.
  - When an ESA-listed or MMPA-protected species is sighted, the observer will alert vessel operators to apply the Vessel Operations protective measures.
  - Dedicated observers will record the date, time, location, species, number of animals, distance and bearing from the vessel, direction of travel, and other relevant information, for all sightings of ESA-listed or MMPA-protected species.
  - Dedicated observers will survey the launch recovery area for any injured or killed ESA-listed or MMPA-protected species and any discoveries will be reported as noted below.

Reporting Stranded, Injured, or Dead Animals

- Each launch operator will immediately report any collision(s), injuries or mortalities to, and any strandings of ESA-listed or MMPA-protected species to the appropriate NMFS contact listed below, and to Cathy Tortorici, Chief, ESA Interagency Cooperation Division by e-mail at cathy.tortorici@noaa.gov.
  - For operations in the Gulf of Mexico and Atlantic Ocean: 727-824-5312 or via email to takereport.nmfsser@noaa.gov, and a hotline 1-877-WHALE HELP (942-5343).
  - For operations on the west coast/Pacific Ocean: 562-506-4315 or via email to Justin.Viezbicke@noaa.gov, and a hotline for whales in distress 877-767-9245.
  - For operations near Alaska, statewide hotline: 877-925-7773.
  - Additional regionally organized contact information is here: https://www.fisheries.noaa.gov/report.
- In the Gulf of Mexico and Atlantic Ocean waters near Florida, each launch operator will report any smalltooth sawfish sightings to 941-255-7403 or via email Sawfish@MyFWC.com.
- Each launch operator will report any giant manta ray sightings via email to manta.ray@noaa.gov.
- In the Atlantic Ocean, each launch operator will report any injured, dead, or entangled North Atlantic right whales to the U.S. Coast Guard via VHF Channel 16.

Vessel Operations

All watercraft operators will be on the lookout for and attempt to avoid collision with ESA-listed and MMPA-protected species. A collision with an ESA-listed species will require reinitiation of consultation. Watercraft operators will ensure the vessel strike avoidance measures and reporting are implemented and will maintain a safe distance by following these protective measures:

- Maintain a minimum distance of 150 ft from sea turtles.

[4] The FAA is responsible for ensuring ESA compliance. The launch operator is responsible for MMPA compliance. Measures to protect all marine mammals are included here for animal conservation purposes.

- In the Atlantic Ocean, slow to 10 knots or less and maintain a minimum distance of 1,500 ft (500 yards) from North Atlantic right whales.
- In the Gulf of Mexico, slow to 10 knots or less and maintain a minimum distance of 1,500 ft (500 yards) from Rice's whale [formerly Gulf of Mexico Bryde's whale]. If a whale is observed but cannot be confirmed as a species other than a Rice's whale, the vessel operator must assume that it is a Rice's whale.
- Maintain a minimum distance of 300 ft (100 yards) from all other ESA-listed and MMPA-protected species. If the distance ever becomes less than 300 ft, reduce speed and shift the engine to neutral. Do not engage the engines until the animals are clear of the area.
- Watercraft operators will reduce speed to 10 knots or less when mother/calf pairs or groups of marine mammals are observed.
- Watercraft 65 ft long or longer will comply with the Right Whale Ship Strike Reduction Rule (50 CFR §224.105)[5] including reducing speeds to 10 knots or less in Seasonal Management Areas or in Right Whale Slow Zones, which are dynamic management areas established where right whales have been recently seen or heard.
  - The Whale Alert app automatically notifies when entering one of these areas.
- Check various communication media for general information regarding avoiding ship strikes and specific information regarding North Atlantic right whale sightings in the area. These include NOAA weather radio, U.S. Coast Guard NAVTEX broadcasts, and Notices to Mariners.
  - There is also an online right whale sightings map available at https://apps-nefsc.fisheries.noaa.gov/psb/surveys/MapperiframeWithText.html.
- Attempt to remain parallel to an ESA-listed or MMPA-protected species' course when sighted while the watercraft is underway (e.g., bow-riding) and avoid excessive speed or abrupt changes in direction until the animal(s) has left the area.
- Avoid vessel transit in the Rice's whale core distribution area. If vessel transit in the area is unavoidable, stay out of the depth range of 100 m to 425 m (where the Rice's whale has been observed; Rosel et al. 2021) as much as possible and go as slow as practical, limiting vessel speed to 10 knots or less.
- No operations or transit will occur at night in Rice's whale core distribution area.

Aircraft Procedures

Spotter aircraft will maintain a minimum of 1,000 ft over ESA-listed or MMPA-protected species and 1,500 ft over North Atlantic right whales. Additionally, aircraft will avoid flying in circles if marine mammals or sea turtles are spotted to avoid any type of harassing behavior.

Hazardous Materials Emergency Response

In the event of a failed launch operation, launch operators will follow the emergency response and cleanup procedures outlined in their Hazardous Material Emergency Response Plan (or similar plan). Procedures may include containing the spill using disposable containment materials and cleaning the area with absorbents or other materials to reduce the magnitude and duration of any impacts. In most launch failure scenarios, at least a portion (if not most) of the

[5] See: http://www.fisheries.noaa.gov/pr/shipstrike/.

propellant will be consumed by the launch/failure, and any remaining propellant will evaporate or be diluted by seawater and biodegrade over time (timeframes are variable based on the type of propellant and environmental conditions, but generally hours to a few days).

Project-Specific Review

Project-specific reviews for this programmatic consultation for launch and reentry vehicle operations in the marine environment are not required as long as the activities are within the scope of the *Proposed Action*, within the action area, and comply with the PDCs. If operations are proposed that are not a part of the *Proposed Action* and/or are not in the *Action Area*, an individual consultation will be needed. If operations in the future include the use of a new launch site, a new launch vehicle, or other substantial changes in technology and operations, an individual consultation or reinitiation of this programmatic consultation may be required.
A project specific review is required when proposed operations do not fully comply with the applicable PDCs identified in this consultation. For example, if a reentry landing and recovery operation could possibly happen at night in the Rice's whale core habitat distribution area, a project specific review would be needed.

When projects do not fully meet the requirements, the action agency should submit a request for project-specific review to the NMFS Office of Protected Resources ESA Interagency Cooperation Division. The request should be sent by email to cathy.tortorici@noaa.gov with the subject line "Project Specific Review Request, OPR-2021-02908, Programmatic Concurrence for Launch Vehicle and Reentry Operations" and include the following information: a project description that details the operations, where and when they will occur, any criteria or measures that may not be fully implemented, and determination of effects to ESA-listed species and critical habitat that could result from the project.

NMFS will review the request to determine if the scope of the project is within this programmatic concurrence, if a supplemental effects analysis is needed, or if an individual consultation is required. Requests for project-specific review should be submitted at least six months in advance of the proposed activity to allow time for completion of a formal ESA section 7 consultation if one is required.

Annual Reporting to NMFS

The FAA, USSF, and NASA, in collaboration with launch operators, propose to prepare and submit reports to NMFS by December 31 beginning the calendar year this consultation is completed and continuing each year activities covered under this consultation occur. The reports will document the outcome of each launch mission that may affect the marine environment. The FAA will report on FAA-licensed launches (i.e., commercial launches) and USSF and NASA will report on their respective launches (i.e., government launches), including those involving commercial space vehicle operations.

Annual reports will include the following for all activities covered under this programmatic:

1) The dates and locations of all missions, including launch site, launch and reentry vehicles and any relevant license or permit that authorized the activities;
2) Contact information for the agencies and commercial entities involved in the events;
3) Details of launch and reentry operations that may affect the marine environment, such as booster stage landings at sea, and particularly those that involve entry of materials into

the marine environment, such as payload fairing recovery missions, spacecraft reentries, and abort tests;

4) Dates of reentry and recovery operations if different from launch date;
5) Approximate locations with GPS coordinates when available of all landing and splashdown areas, including fairing recoveries (and drogue parachute recoveries, if applicable) and spacecraft recoveries (including abort tests). Information should also be provided regarding support vessels used during operations and transit routes, as well as aircraft activity associated with an event;
6) Any available information on the location and fate of unrecovered parachutes, parafoils, expended components and debris;
7) Information regarding the implementation of the *Environmental Protection Measures* described above, including any issues identified by an observer or other crew member, divers or other personnel engaged in in-water activities;
8) Any information regarding effects to ESA-listed species due to the activities; and
9) Sighting logs with observations of ESA-listed species with date, time, location, species (if possible to identify), number of animals, distance and bearing from the vessel, direction of travel, and other relevant information.

Annual reports should be submitted electronically to cathy.tortorici@noaa.gov with the subject line "Annual Review, OPR-2021-02908, Programmatic Concurrence for Launch Vehicle and Reentry Operations Starship/Super Heavy Launch Vehicle Operations at SpaceX's Boca Chica Launch Site."

Basic information regarding events conducted in a given year can be provided in tabular form accompanied by a narrative summary organized by geography: Pacific, Atlantic, and Gulf of Mexico. Copies of the annual reports should also be submitted electronically to the appropriate NMFS regional offices for their review and comment dependent on where launch and reentry activities occur in a given year: SERO (nmfs.ser.esa.consultations@noaa.gov), PIRO (EFHESAconsult@noaa.gov), and WCR (see https://www.fisheries.noaa.gov/west-coast/consultations/esa-section-7-consultations-west-coast for information on contacts based on geographic area).

The summary of annual aggregate activities and associated effects will allow NMFS to evaluate, among other things, whether the scope of the activities are consistent with the description of the proposed action and action area, and whether the nature and scale of the effects predicted continue to be valid. Annual reviews help monitor development of the industry and the potential for increased frequency of activities that may indicate the effects to ESA resources could change, requiring new analysis and/or adjustments to implementing requirements under the programmatic.

Landing Failure Anomaly

It is possible that a stage booster landing could have a failure. The FAA indicated that, for the past several years, SpaceX has been successfully landing boosters on land and offshore on a barge. A failure on the barge would be very rare. SpaceX has adjusted mission operations to avoid explosions on the barge. During reentry/descent, if the launch vehicle indicates any failures, SpaceX would expend it into the open ocean, rather than attempt a barge landing to avoid an explosion on the barge. Therefore, this consultation does not include stage booster landing failure. If a failure were to occur in the marine environment, reinitiation of this consultation may be required.

Action Area

The action area is defined in 50 CFR §402.02 as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action." In general, the action area includes portions of the Atlantic Ocean, Gulf of Mexico, and the Pacific Ocean where launch and reentry activities are anticipated (see Figures 2, 3 and 4). SpaceX is proposing to land the Starship after an orbital mission in the Pacific Ocean, approximately 62 NM north of Kauai, Hawaii, as shown in Figure 5.

The launch and reentry activities occurring in the marine environment would occur in deep waters at least 5 NM offshore the coast of the United States or islands, with most activities occurring hundreds of miles offshore. The only component of the launch and reentry operations that occurs near (less than 5 NM offshore) the coast of the United States are the vessels (watercraft) transiting to and from a port during pre-launch surveillance or when recovering and transporting spacecraft or launch vehicle components in the ocean. These nearshore vessel transit areas in the action area include marine waters that lead to the Port of Brownsville, Texas; Port Canaveral, Florida; Port of Los Angeles, California; Port of Longview, California; Port of Kodiak, Alaska; and a port facility at Vandenberg Space Force Base, California.

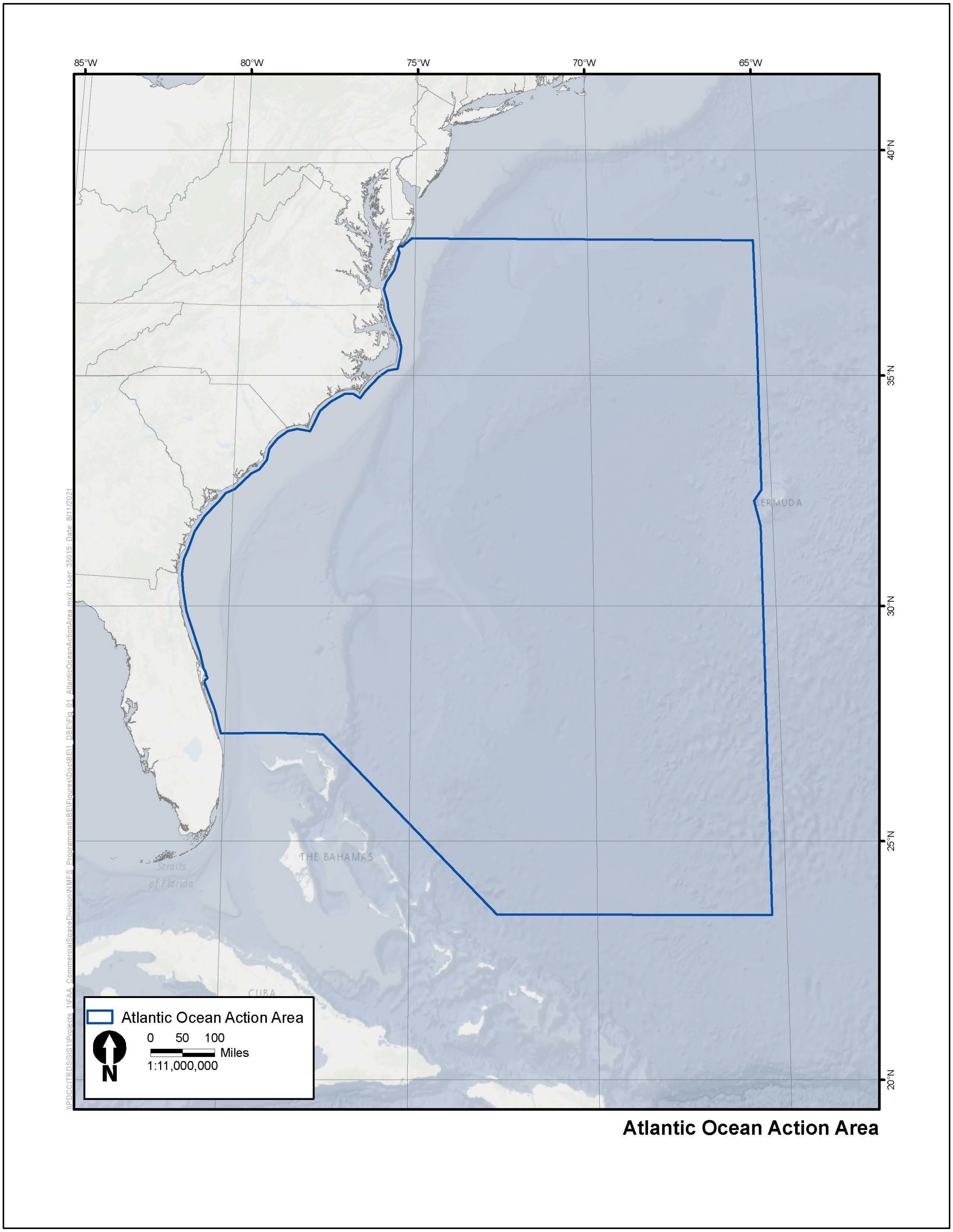


Figure 2. Atlantic Ocean Action Area

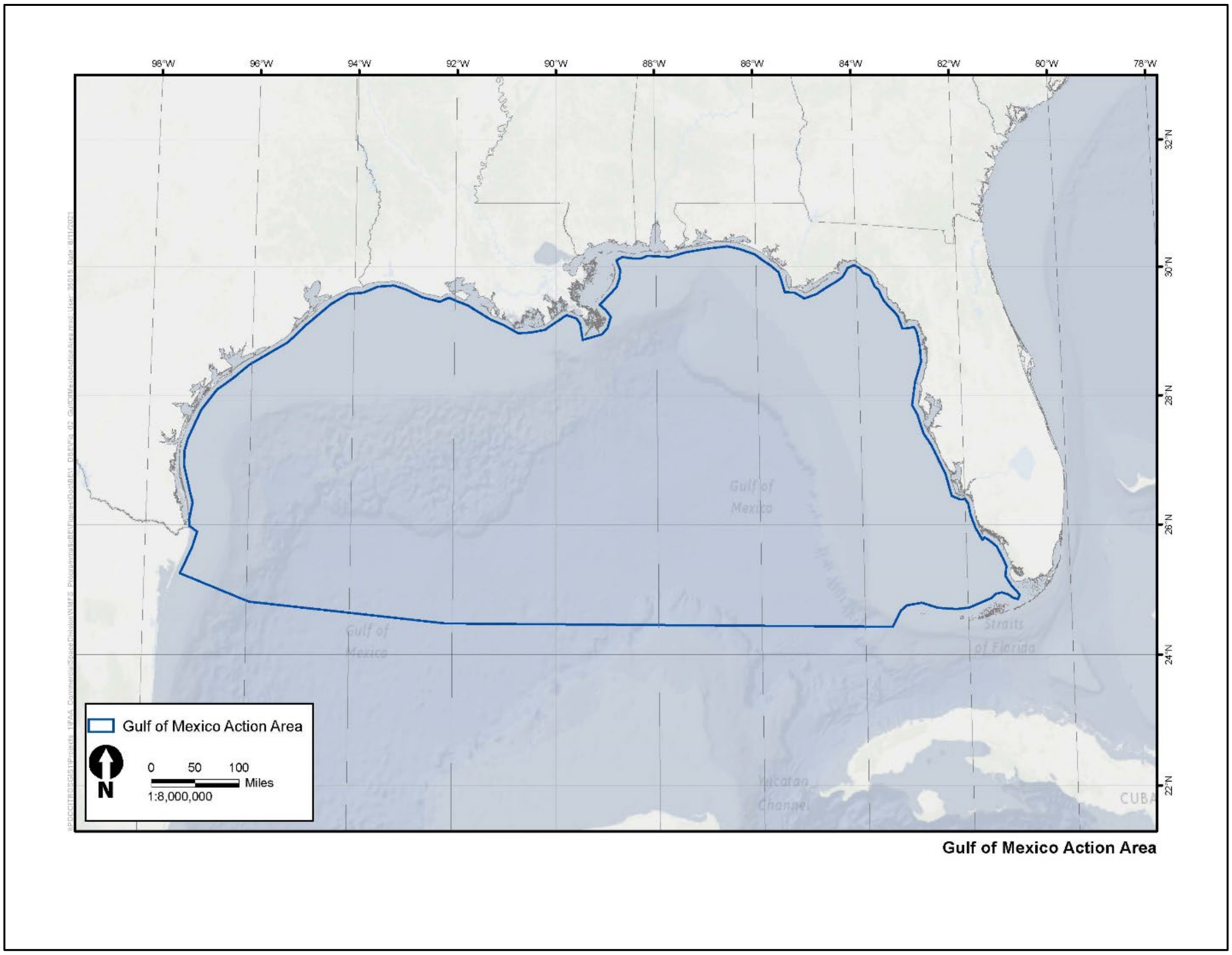


Figure 3. Gulf of Mexico Action Area

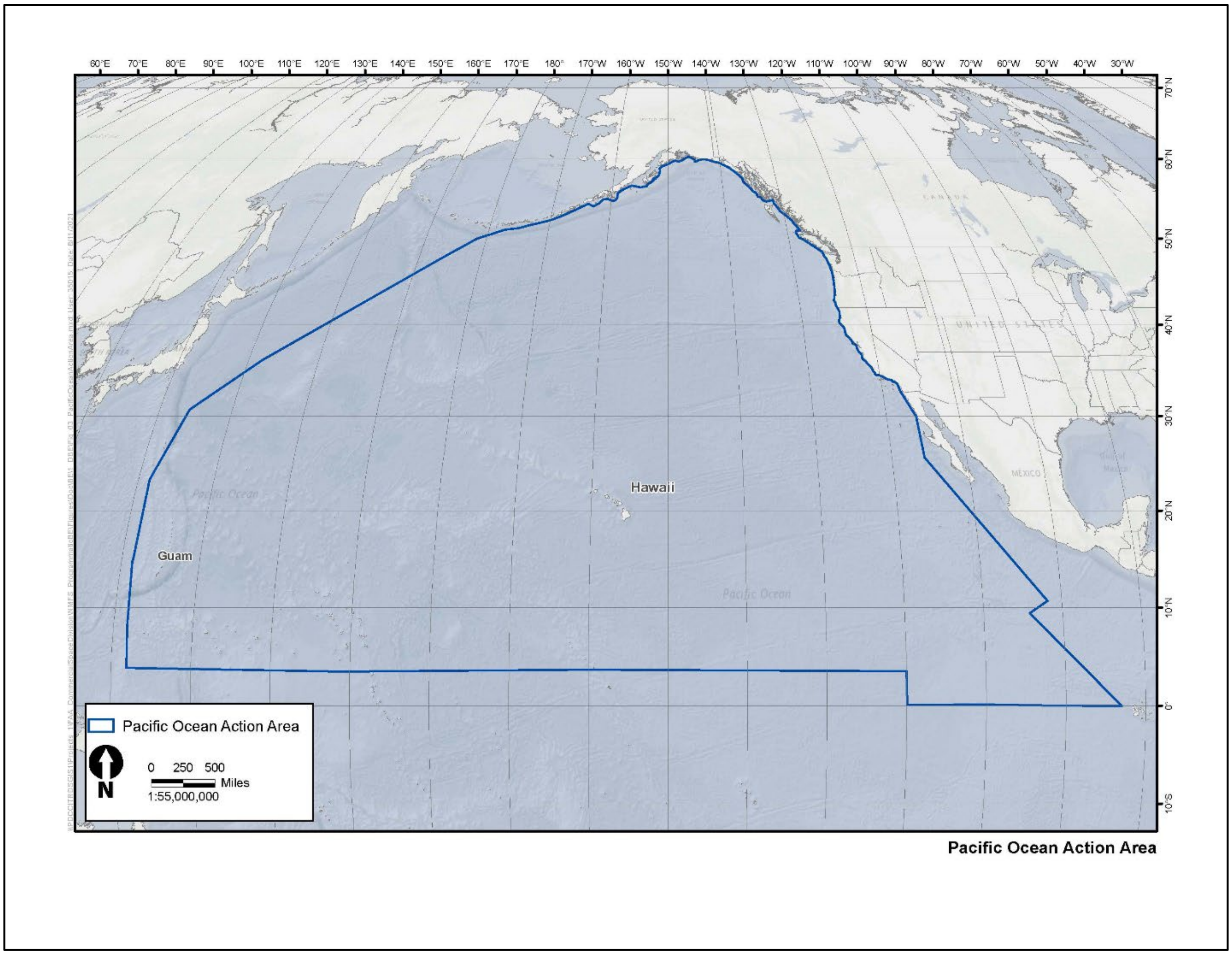


Figure 4. Pacific Ocean Action Area

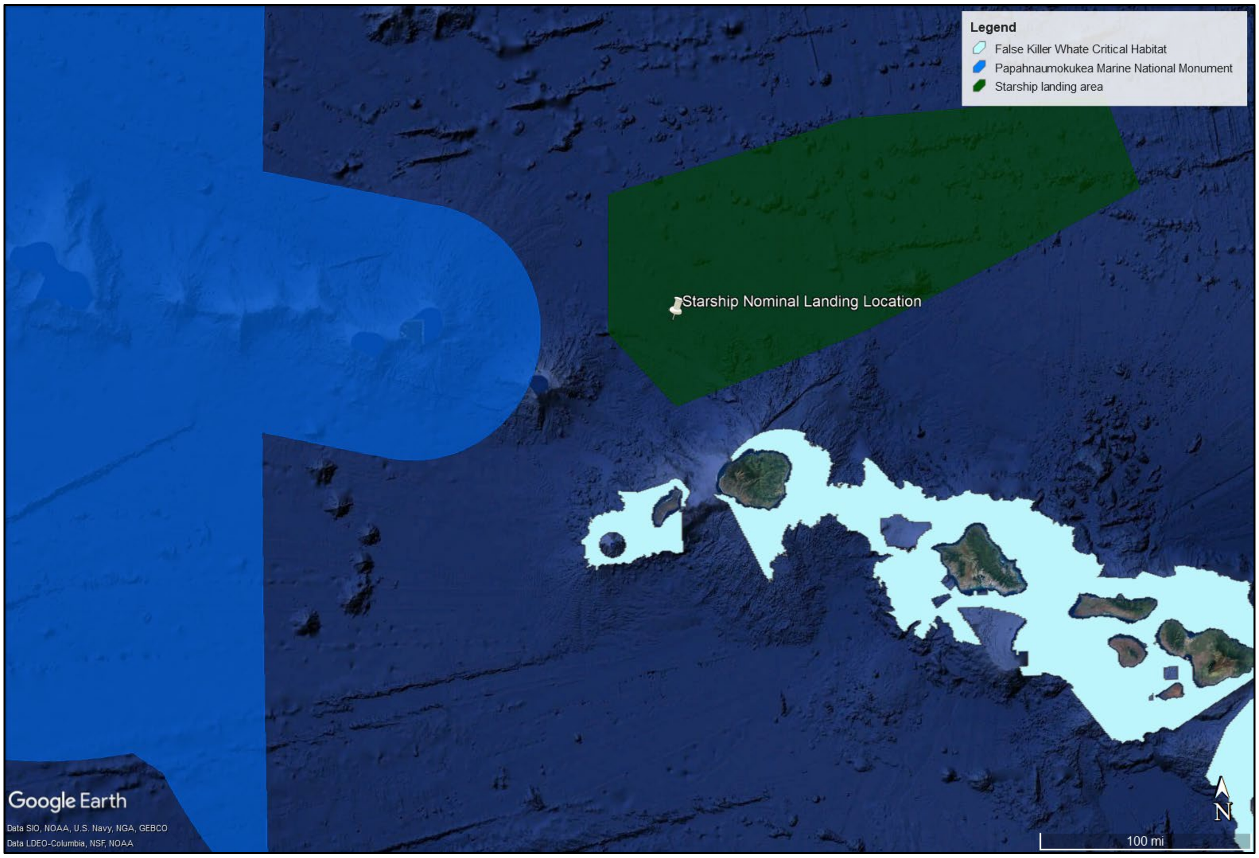


Figure 5. Proposed Landing Area in the Pacific Ocean for SpaceX Starship Orbital Missions.

Annual Operations per Ocean Area

Dependent on mission needs, the amount of annual launch and recovery operations can be variable. The table below outlines the maximum annual operations expected by the action agencies in the marine environment over the next five years (2022 through 2026) for the activities included in this consultation.

Table 5. Maximum Annual Operations

Type of Operation	Maximum # of Annual Operations
Atlantic Ocean Action Area	
Launches involving stages and fairings that are expended in the ocean (not recovered)	30
Launches involving attempted recovery of stages and fairings in the ocean	70
Spacecraft reentry and landing in the ocean	10
Launch abort test	1
Pacific Ocean Action Area	
Launches involving stages and fairings that are expended in the ocean (not recovered)	30
Launches involving attempted recovery of stages and fairings in the ocean	20
Spacecraft reentry and landing in the ocean	3
Gulf of Mexico Action Area	
Launches involving stages that are expended in the ocean (not recovered)	5

Type of Operation	Maximum # of Annual Operations
Launches involving attempted recovery of stages in the ocean	5
Spacecraft reentry and landing in the ocean	10

ESA-Listed Species and Critical Habitat in The Action Area

Several ESA-listed marine mammals (cetaceans and pinnipeds), sea turtles, fishes and designated critical habitats are known to occur or have the potential to occur in the action area (Table 6). The FAA, USSF, and NASA have determined that launch and reentry vehicle operations in the marine environment may affect, but are not likely to adversely affect any ESA-listed species or designated critical habitat.

The action area does not include nearshore areas where most ESA-listed coral species occur. There is proposed critical habitat for three coral species in the Gulf of Mexico farther offshore (i.e., > 5 NM). However, no launch operator would site a landing area in coral reef areas, and the location of the proposed critical habitat in the Gulf of Mexico is too far north of the launch trajectories from the Boca Chica Launch Site to be affected. Therefore, the FAA determined launch and reentry operations will have no effect on ESA-listed coral species or their proposed critical habitat in the action area.

Table 6. ESA-listed Species and Designated Critical Habitat Potentially Present in the Action Area

Species	ESA Status	Critical Habitat	Recovery Plan
Marine Mammals - Cetaceans			
Blue Whale (*Balaenoptera musculus*)	E – 35 FR 18319	-- --	07/1998 11/2020
False Killer Whale (*Pseudorca crassidens*) – Main Hawaiian Islands Insular DPS	E – 77 FR 70915	83 FR 35062	Draft – 85 FR 65791 9/2020
Fin Whale (*Balaenoptera physalus*)	E – 35 FR 18319	-- --	75 FR 47538 07/2010
Gray Whale (*Eschrichtius robustus*) – Western North Pacific Population	E – 35 FR 18319	-- --	-- --
Humpback Whale (*Megaptera novaeangliae*) – Central America DPS	E – 81 FR 62259	86 FR 21082	11/1991
Humpback Whale (*Megaptera novaeangliae*) – Mexico DPS	T – 81 FR 62259	86 FR 21082	11/1991

Humpback Whale (*Megaptera novaeangliae*) – Western North Pacific DPS	E – 81 FR 62259	86 FR 21082	11/1991
Killer Whale (*Orcinus orca*) – Southern Resident DPS	E – 70 FR 69903 Amendment 80 FR 7380	71 FR 69054 86 FR 41668	73 FR 4176 01/2008
North Atlantic Right Whale (*Eubalaena glacialis*)	E – 73 FR 12024	81 FR 4837	70 FR 32293 08/2004
North Pacific Right Whale (*Eubalaena japonica*)	E – 73 FR 12024	73 FR 19000	78 FR 34347 06/2013
Rice's Whale (*Balaenoptera ricei*)	E – 84 FR 15446 E – 86 FR 47022	-- --	-- --
Sei Whale (*Balaenoptera borealis*)	E – 35 FR 18319	-- --	12/2011
Sperm Whale (*Physeter macrocephalus*)	E – 35 FR 18319	-- --	75 FR 81584 12/2010
Marine Mammals - Pinnipeds			
Guadalupe Fur Seal (*Arctocephalus townsendi*)	T – 50 FR 51252	-- --	-- --
Hawaiian Monk Seal (*Neomonachaus schauinslandi*)	E – 41 FR 51611	80 FR 50925	72 FR 46966 2007
Steller Sea Lion (*Eumetopias jubatus*) – Western DPS	E – 55 FR 49204	58 FR 45269	73 FR 11872 2008
Marine Reptiles			
Green Turtle (*Chelonia mydas*) – North Atlantic DPS	T – 81 FR 20057	63 FR 46693	10/1991
Green Turtle (*Chelonia mydas*) – Central North Pacific DPS	T – 81 FR 20057	-- --	63 FR 28359 01/1998
Green Turtle (*Chelonia mydas*) – Central West Pacific DPS	E – 81 FR 20057	-- --	63 FR 28359 01/1998
Green Turtle (*Chelonia mydas*) – Central South Pacific DPS	E – 81 FR 20057	-- --	63 FR 28359 01/1998

Green Turtle (*Chelonia mydas*) – East Pacific DPS	T – 81 FR 20057	-- --	63 FR 28359 01/1998
Hawksbill Turtle (*Eretmochelys imbricata*)	E – 35 FR 8491	63 FR 46693	57 FR 38818 08/1992 – U.S. Caribbean, Atlantic, and Gulf of Mexico 63 FR 28359 05/1998 – U.S. Pacific
Kemp's Ridley Turtle (*Lepidochelys kempii*)	E – 35 FR 18319	-- --	09/2011
Leatherback Turtle (*Dermochelys coriacea*)	E – 35 FR 8491	44 FR 17710 and 77 FR 4170	10/1991 – U.S. Caribbean, Atlantic, and Gulf of Mexico 63 FR 28359 05/1998 – U.S. Pacific
Loggerhead Turtle (*Caretta caretta*) – Northwest Atlantic Ocean DPS	T – 76 FR 58868	79 FR 39855	74 FR 2995 10/1991 – U.S. Caribbean, Atlantic, and Gulf of Mexico 05/1998 – U.S. Pacific 01/2009 – Northwest Atlantic
Loggerhead Turtle (*Caretta caretta*) – North Pacific Ocean DPS	E – 76 FR 58868	-- --	63 FR 28359
Olive Ridley Turtle (*Lepidochelys olivacea*) – All Other Areas/Not Mexico's Pacific Coast Breeding Colonies	T – 43 FR 32800	-- --	-- --
Olive Ridley Turtle (*Lepidochelys olivacea*) – Mexico's Pacific Coast Breeding Colonies	E – 43 FR 32800	-- --	63 FR 28359
Fishes			
Atlantic Sturgeon (*Acipensar oxyrinchus oxyrinchus*) – Carolina DPS	E – 77 FR 5913	82 FR 39160	-- --
Atlantic Sturgeon (*Acipensar oxyrinchus oxyrinchus*) – Chesapeake DPS	E – 77 FR 5879	82 FR 39160	-- --
Atlantic Sturgeon (*Acipensar oxyrinchus*	T – 77 FR 5879	82 FR 39160	-- --

oxyrinchus) – Gulf of Maine DPS			
Atlantic Sturgeon (*Acipensar oxyrinchus oxyrinchus*) – New York Bight DPS	E – 77 FR 5879	82 FR 39160	-- --
Atlantic Sturgeon (*Acipensar oxyrinchus oxyrinchus*) – South Atlantic DPS	E – 77 FR 5913	82 FR 39160	-- --
Chinook Salmon (*Oncorhynchus tshawytscha)* – California Coastal ESU	T – 70 FR 37160	70 FR 52488	81 FR 70666
Chinook Salmon (*Oncorhynchus tshawytscha)* – Central Valley Spring-Run ESU	T – 70 FR 37160	70 FR 52488	79 FR 42504
Chinook Salmon (*Oncorhynchus tshawytscha)* – Lower Columbia River ESU	T – 70 FR 37160	70 FR 52629	78 FR 41911
Chinook Salmon (*Oncorhynchus tshawytscha)* – Puget Sound ESU	T – 70 FR 37160	70 FR 52629	72 FR 2493
Chinook Salmon (*Oncorhynchus tshawytscha)* – Sacramento River Winter-Run ESU	E – 70 FR 37160	58 FR 33212	79 FR 42504
Chinook Salmon (*Oncorhynchus tshawytscha)* – Snake River Fall-Run ESU	T – 70 FR 37160	58 FR 68543	80 FR 67386 (Draft)
Chinook Salmon (*Oncorhynchus tshawytscha)* – Snake River Spring/Summer Run ESU	T – 70 FR 37160	64 FR 57399	81 FR 74770 (Draft) 11-2017-Final
Chinook Salmon (*Oncorhynchus tshawytscha)* – Upper Columbia River Spring-Run ESU	E – 70 FR 37160	70 FR 52629	72 FR 57303
Chinook Salmon (*Oncorhynchus tshawytscha)* – Upper Willamette River ESU	T – 70 FR 37160	70 FR 52629	76 FR 52317

Chum Salmon (*Oncorhynchus keta*) – Columbia River ESU	T – 70 FR 37160	70 FR 52629	78 FR 41911
Chum Salmon (*Oncorhynchus keta*) – Hood Canal Summer-Run ESU	T – 70 FR 37160	70 FR 52629	72 FR 29121
Coho Salmon (*Oncorhynchus kisutch*) – Central California Coast ESU	E – 70 FR 37160	64 FR 24049	77 FR 54565
Coho Salmon (*Oncorhynchus kisutch*) – Lower Columbia River ESU	T – 70 FR 37160	81 FR 9251	78 FR 41911
Coho Salmon (*Oncorhynchus kisutch*) – Oregon Coast ESU	T – 73 FR 7816	73 FR 7816	81 FR 90780
Coho Salmon (*Oncorhynchus kisutch*) – Southern Oregon and Northern California Coasts ESU	T – 70 FR 37160	64 FR 24049	79 FR 58750
Eulachon (*Thaleichthys pacificus*) –Southern DPS	T – 75 FR 13012	76 FR 65323	9/2017
Giant Manta Ray (*Manta birostris*)	T – 83 FR 2916	-- --	-- --
Green Sturgeon (*Acipenser medirostris*) – Southern DPS	T – 71 FR 17757	74 FR 52300	2010 (Outline) 8/2018- Final
Gulf Sturgeon (*Acipenser oxyrinchus desotoi*)	T – 56 FR 49653	68 FR 13370	09/1995
Nassau Grouper (*Epinephelus striatus*)	T – 81 FR 42268	-- --	8/2018- Outline
Oceanic Whitetip Shark (*Carcharhinus longimanus*)	T – 83 FR 4153	-- --	9/2018- Outline
Smalltooth Sawfish (*Pristis pectinata*) – U.S. portion of range DPS	E – 68 FR 15674	74 FR 45353	74 FR 3566 01/2009
Scalloped Hammerhead Shark (*Sphyrna lewini*) – Central and Southwest Atlantic DPS	T – 79 FR 38213	-- --	-- --

Scalloped Hammerhead Shark (*Sphyrna lewini*) – Eastern Pacific DPS	E – 79 FR 38213	-- --	-- --
Scalloped Hammerhead Shark (*Sphyrna lewini*) – Indo-West Pacific DPS	T – 79 FR 38213	-- --	-- --
Shortnose Sturgeon (*Acipenser brevirostrum*)	E – 32 FR 4001	-- --	63 FR 69613 12/1998
Sockeye Salmon (*Oncorhynchus nerka*) – Ozette Lake ESU	T – 70 FR 37160	70 FR 52630	74 FR 25706
Sockeye Salmon (*Oncorhynchus nerka*) – Snake River ESU	E – 70 FR 37160	58 FR 68543	80 FR 32365
Steelhead Trout (*Oncorhynchus mykiss*) – California Central Valley DPS	T – 71 FR 834	70 FR 52487	79 FR 42504
Steelhead Trout (*Oncorhynchus mykiss*) – Central California Coast DPS	T – 71 FR 834	70 FR 52487	81 FR 70666
Steelhead Trout (*Oncorhynchus mykiss*) – Lower Columbia River DPS	T – 71 FR 834	70 FR 52629	78 FR 41911
Steelhead Trout (*Oncorhynchus mykiss*) – Middle Columbia River DPS	T – 71 FR 834	70 FR 52629	74 FR 50165
Steelhead Trout (*Oncorhynchus mykiss*) – Northern California DPS	T – 71 FR 834	70 FR 52487	81 FR 70666
Steelhead Trout (*Oncorhynchus mykiss*) – Puget Sound DPS	T – 72 FR 26722	81 FR 9251	84 FR 71379
Steelhead Trout (*Oncorhynchus mykiss*) – Snake River Basin DPS	T – 71 FR 834	70 FR 52629	81 FR 74770 (Draft) 11-2017-Final
Steelhead Trout (*Oncorhynchus mykiss*) – South-Central California Coast DPS	T – 71 FR 834	70 FR 52487	78 FR 77430

Steelhead Trout (*Oncorhynchus mykiss*) – Southern California Coast DPS	E – 71 FR 834	70 FR 52487	77 FR 1669
Steelhead Trout (*Oncorhynchus mykiss*) – Upper Columbia River DPS	T – 71 FR 834	70 FR 52629	72 FR 57303
Steelhead Trout (*Oncorhynchus mykiss*) – Upper Willamette River DPS	T – 71 FR 834	70 FR 52629	76 FR 52317

DPS=distinct population segment; ESU=evolutionarily significant unit; E=endangered; T=threatened; FR=*Federal Register*

ESA-Listed Marine Mammals in the Action Area

Blue whales, fin whales, and sei whales are widely distributed across the globe in all major oceans. All of these species typically winter at low latitudes, where they mate, calve and nurse, and summer at high latitudes, where they feed. They are most common in offshore continental shelf and slope waters that support productive zooplankton blooms.

Humpback whales are also widely distributed and winter at low latitudes, where they calve and nurse, and summer at high latitudes, where they feed. The Western North Pacific DPS of humpback whales breeds/winters in the area of Okinawa and the Philippines, which are not in the action area, and migrates to feeding grounds in the northern Pacific Ocean, primarily off the Russian coast outside of the action area, but also feeds near the Aleutian Islands and the Gulf of Alaska (81 FR 62259). The Mexico DPS of humpback whales breeds along the Pacific coast of mainland Mexico and the Revillagigedos Islands, and feeds in the action area across a broad geographic range from California to the Aleutian Islands (81 FR 62259). The Central America DPS of humpback whales breeds along the Pacific coast of Central America and feeds in the action area almost exclusively offshore of California and Oregon (81 FR 62259).

The Southern Resident DPS killer whale is found along the Pacific Coast of the United States and Canada. Southern Resident killer whales occur in the inland waterways (not in the action area) of Puget Sound, the Strait of Juan de Fuca, and the Southern Georgia Strait during the spring, summer and fall. During the winter, they move out into coastal waters primarily off Oregon, Washington, California, and British Columbia.

The Western North Pacific gray whales tend to feed near the bottom in productive waters closer to shore. Some Western North Pacific of gray whales winter in the action area on the west coast of North America, while most others migrate south to winter in waters off Japan and China and summer in the Okhotsk Sea off northeast Sakhalin Island, Russia, and off southeastern Kamchatka in the Bering Sea (Burdin et al. 2013).

The North Atlantic right whale is primarily found in the western North Atlantic Ocean from shallow coastal water breeding grounds in temperate latitudes off the coast of the southeastern

U.S. during the winter, and feeding in summer outside the action area on large concentrations of zooplankton in the sub-polar latitudes (Colligan et al. 2012) off the coast of Nova Scotia (Waring et al. 2016).

North Pacific right whales mostly inhabit coastal and continental shelf waters in the North Pacific Ocean. They have been observed in temperate latitudes during winter off Japan (outside the action area), California, and Mexico where they likely calve and nurse. In the summer, they feed on large concentrations of zooplankton in sub-polar waters around Alaska.

The range of Rice's whale is primarily in a relatively small biologically important area in the northeastern Gulf of Mexico near De Soto Canyon, in waters 100 to 400 meters (m) deep along the continental shelf break. It inhabits the Gulf of Mexico year round, but its distribution outside of this biologically important area is unknown. It should be noted that population estimates for Rice's whale are very low, in 2009 estimated at 33 individuals (Rosel et al. 2016). An estimate by Roberts et al. (2016) utilizing habitat-based density models that incorporate visual survey data from 1992 to 2009 is 44 individuals.

The sperm whale is widely distributed globally, found in all major oceans. Sperm whales mostly inhabit areas with a water depth of 600 m (1,968 ft) or more, and are uncommon in waters less than 300 m (984 ft) deep. They winter at low latitudes, where they calve and nurse, and summer at high latitudes, where they feed primarily on squid and demersal fish.

False killer whales prefer waters more than 1,000 m (3,280.8 ft) deep, feeding on fishes and cephalopods. The Main Hawaiian Islands Insular DPS of false killer whale is considered resident within 40 km (21.6 NM) of the Main Hawaiian Islands.

Guadalupe fur seals breed mainly on Guadalupe Island with another smaller breeding colony in the San Benito Archipelago, Baja California, Mexico (Belcher and T.E. Lee 2002). Guadalupe fur seals feed mainly on squid species (Esperon-Rodriguez and Gallo-Reynoso 2013) with foraging trips that can last between four to 24 days (average of 14 days) and cover great distances, with sightings occurring thousands of kilometers away from the main breeding colonies (Aurioles-Gamboa et al. 1999). Guadalupe fur seals are infrequently observed in U.S. waters but they can be found on California's Channel Islands.

The entire range of the Hawaiian monk seal is located within U.S. waters. The main breeding subpopulations are in the Northwestern Hawaiian Islands, but there is also a small growing population found on the Main Hawaiian Islands. Hawaiian monk seals are considered foraging generalist that feed primarily on benthic and demersal prey such as fish, cephalopods, and crustaceans in subphotic zones (Parrish et al. 2000).

The Western DPS Steller sea lions reside in the central and western Gulf of Alaska, the Aleutian Islands, as well as coastal portions of Japan and Russia that are not in the action area. Western DPS Steller sea lions typically forage in coastal waters on the continental shelf, but they sometimes forage in deeper continental slope and pelagic waters, especially in the non-breeding season.

ESA-Listed Sea Turtles in the Action Area

The green turtle has a circumglobal distribution, occurring throughout nearshore tropical, subtropical and, to a lesser extent, temperate waters. After emerging from the nest, hatchlings swim to offshore areas and go through a post-hatchling pelagic stage believed to last several years. Adult green turtles exhibit site fidelity and migrate hundreds to thousands of kilometers from nesting beaches to foraging areas. Green turtles spend the majority of their lives in coastal foraging grounds, which include open coastlines and protected bays and lagoons. Green turtles from the North Atlantic DPS range from south of the action area from the boundary of South and Central America throughout the Caribbean Sea (outside action area), into the Gulf of Mexico and the U.S. Atlantic coast (in the action area), and range north of the action area toward Canada (outside the action area). The range of the North Atlantic DPS of green turtle also extends east beyond the action area to the western coasts of Europe and Africa. The North Atlantic DPS of green turtle nesting occurs primarily outside the action area in Costa Rica, Mexico, and Cuba, but also in Florida. The Central North Pacific DPS of green turtle is found in the Pacific Ocean near the Hawaiian Archipelago and Johnston Atoll. The major nesting site for the Central North Pacific DPS of green turtle is at East Island, French Frigate Shoals, in the Northwestern Hawaiian Islands; lesser nesting sites are found throughout the Northwestern Hawaiian Islands and the Main Hawaiian Islands. Green turtles in the Central West Pacific DPS are found throughout the western Pacific Ocean, in Indonesia, the Philippines, the Marshall Islands, and Papua New Guinea. In the action area, Central West Pacific DPS green turtle nesting assemblages occur in the Federated States of Micronesia, and the Marshall Islands. Green turtles in the East Pacific DPS are found in the action area from the California/Oregon border to south of the action area, to central Chile. Nesting occurs outside the action area at major sites in Michoacán, Mexico, and the Galapagos Islands, Ecuador. Smaller nesting sites are found in the Revillagigedos Archipelago, Mexico, and along the Pacific Coast of Costa Rica, Columbia, Ecuador, Guatemala and Peru (Seminoff et al. 2015). The Central South Pacific DPS green turtle is found in the South Pacific Ocean extending north from northern New Zealand to Tuvalu and extending east over to Easter Island, Chile. The Central South Pacific DPS encompasses several island groups including American Samoa, French Polynesia, Cook Islands, Fiji, Kiribati, Tokelau, Tonga, and Tuvalu. Those island groups are south of the action area, except Kiribati breaches into the action area, the most northern island group. Central South Pacific DPS nesting occurs sporadically throughout the geographic distribution of the population, with isolated locations having relatively low to moderate nesting activity.

The hawksbill turtle has a circumglobal distribution throughout tropical and, to a lesser extent, subtropical waters of the Atlantic, Indian, and Pacific Oceans. In their oceanic phase, juvenile hawksbill turtles can be found in *Sargassum* mats; post-oceanic hawksbills may occupy a range of habitats that include coral reefs or other hard-bottom habitats, seagrass, algal beds, mangrove bays and creeks (Bjorndal and Bolten 2010; Musick and Limpus 1997).

The Kemp's ridley turtle occurs from the Gulf of Mexico and up along the Atlantic coast of the U.S. (TEWG 2000). The majority of Kemp's ridley turtles nest at coastal Mexican beaches in the Gulf of Mexico. During spring and summer, juvenile Kemp’s ridleys occur in the shallow coastal waters of the northern Gulf of Mexico from south Texas to north Florida. In the fall, most Kemp’s ridleys migrate to deeper or more southern, warmer waters and remain there through the winter (Schmid 1998). As adults, many Kemp's ridley turtles remain in the Gulf of Mexico, with only occasional occurrence in the Atlantic Ocean (NMFS et al. 2010).

Globally, olive ridley sea turtles can be found in tropical and subtropical waters in the Atlantic, Indian, and Pacific Oceans. Major nesting beaches are found outside the action area in Nicaragua, Costa Rica, Panama, India and Suriname. Olive ridleys may forage across ocean basins, primarily in pelagic habitats, on crustaceans, fish, mollusks, and tunicates. The range of the endangered Pacific coast breeding population extends as far south as Peru and up to California. Olive ridley turtles of the Pacific coast breeding colonies nest outside the action area on arribada beaches at Mismaloya, Ixtapilla and La Escobilla, Mexico. Solitary nesting takes place all along the Pacific coast of Mexico.

Loggerhead turtles are circumglobal, and are found in the temperate and tropical regions of the Atlantic, Indian, and Pacific Oceans. The post-hatchling stage is in pelagic waters and juveniles are first in the oceanic zone and later in the neritic zone (i.e., coastal waters). While in their oceanic phase, loggerhead turtles undertake long migrations using ocean currents. Adults and sub-adults occupy nearshore habitat important for foraging and inter-nesting migration. The Northwest Atlantic Ocean DPS of loggerhead turtle hatchlings disperse widely, most likely using the Gulf Stream to drift throughout the Atlantic Ocean. Genetic evidence demonstrates that juvenile loggerheads from southern Florida nesting beaches comprise the vast majority (71 to 88 percent) of individuals found in foraging grounds throughout the western and eastern Atlantic (Masuda 2010). North Pacific Ocean DPS of loggerhead turtles are found throughout the Pacific Ocean, north of the equator. Their range extends from the West Coast of North America to eastern Asia. Two major juvenile foraging areas have been identified in the North Pacific Basin: Central North Pacific and off Mexico's Baja California Peninsula. Hatchlings from Japanese nesting beaches outside the action area use the North Pacific Subtropical Gyre and the Kurishio Extension to migrate to those foraging grounds (Abecassis et al. 2013; Seminoff et al. 2014). The leatherback sea turtle is unique among sea turtles for its large size and ability to maintain internal warmth (due to thermoregulatory systems), which allows it to range worldwide from tropical into subpolar latitudes. Leatherbacks occur throughout marine waters, from nearshore habitats to oceanic environments (Shoop and Kenney 1992). Leatherback sea turtles migrate long, transoceanic distances between their tropical nesting beaches and the highly productive temperate waters where they forage, primarily on jellyfish and tunicates. Detailed population structure is unknown, but the leatherback distribution is assumed dependent upon nesting beach locations in the Pacific, Atlantic, and Indian Oceans. Movements are largely dependent upon reproductive and feeding cycles and the oceanographic features that concentrate prey, such as frontal systems, eddy features, current boundaries, and coastal retention areas (Benson et al. 2011).

ESA-Listed Fishes in the Action Area

Atlantic sturgeon spawn in freshwater, but spend most of their adult life in the marine environment. Atlantic sturgeon occupy ocean waters and associated bays, estuaries, and coastal river systems from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida (ASMFC 2006; Stein et al. 2004). Five DPS's of Atlantic sturgeon are listed under the ESA: Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic. Juveniles typically spend two to five years in freshwater before eventually becoming coastal residents as sub-adults (Boreman 1997; Schueller and Peterson 2010; Smith 1985). Atlantic sturgeon exhibit high fidelity to their natal rivers but can undergo extensive mixing in coastal waters (Grunwald et al. 2008; King et al. 2001; Waldman et al. 2002).

The Pacific salmon (chinook, coho, chum and sockeye) and steelhead trout are anadromous fishes and the ESA-listed DPSs and ESUs spawn in their natal rivers in Washington, Oregon and California. Juvenile Chinook may reside in freshwater for 12 to 16 months, but some migrate to the ocean as young-of-the-year within eight months of hatching. Chinook salmon spend a few years feeding in the ocean, and sexually mature between the ages of two and seven but are typically three or four years old when they return to spawn, generally in summer or early fall. Coho salmon spend a year in freshwater and then migrate out to the ocean to spend about 1.5 years feeding before returning to spawn, generally in fall or early winter. Sockeye salmon rear in freshwater for one to three years, after which they reach the smolt stage and migrate to the ocean to feed and grow. They typically mature and return to freshwater to spawn in the summer or fall after two to three years at sea, but some return earlier or stay at sea longer, between four and five years. Steelhead trout typically migrate to open marine waters after spending two years in freshwater. They reside in marine waters for typically two or three years prior to returning to their natal stream as four- or five-year-olds to spawn shortly after river entry from December through April. Young chum salmon (fry) typically migrate directly to estuarine and marine waters soon after they are born and do not reside in freshwater for an extended period. As chum salmon grow larger, they migrate offshore and as they approach maturity, typically between the ages of three and six, they migrate back to spawn in late summer through March.
The eulachon is an anadromous fish, smaller than salmonids (8.5 inches, 21.5 centimeters), that can be found in the continental shelf waters of the eastern Pacific Ocean. Adult and juvenile Southern DPS eulachon typically occupy waters 50 to 200 m deep (Gustafson 2016), and up to depths of about 300 m, from California to the Bering Sea. Southern DPS eulachon are those that return to spawn in rivers south of the Nass River in British Columbia to the Mad River in California.

The giant manta ray occupies tropical, subtropical, and temperate oceanic waters and productive coastlines where they feed on zooplankton. Giant manta rays are commonly offshore in oceanic waters, but are sometimes found feeding in shallow waters (less than 10 m [32.8 ft]) during the day. Giant manta rays can dive to depths of over 1,000 m (3,280.8 ft), and also conduct night descents to between 200 and 450 m (656.2 to 1,476.4 ft) deep.

The green sturgeon is an anadromous fish that occurs in the nearshore coastal waters to a depth of 110 m from Baja California, Mexico to the Bering Sea, Alaska (Hightower 2007). Adult Southern DPS green sturgeon enter San Francisco Bay and migrate up the Sacramento River to spawn (Heublin et al. 2009).

The current range of the Gulf sturgeon extends from Lake Pontchartrain in Louisiana east to the Suwannee river system in Florida. Young-of-the-year slowly work their way downstream from where they hatched and arrive in estuaries and river mouths where they will spend their next six years developing (Sulak and Clugston 1999). After six years, Gulf sturgeon enter the marine environment to forage on benthic (bottom dwelling) invertebrates along the shallow nearshore (2-4 m depth), barrier island passes, and in unknown offshore locations in the Gulf of Mexico (Huff 1975, Carr et al. 1996, Fox et al. 2002, Ross et al. 2009).

The Nassau grouper is distributed from south Florida throughout the Caribbean, and Bermuda. Juveniles inhabit macroalgae, coral clumps, and seagrass beds, and are relatively solitary. As they grow, they occupy progressively deeper areas and offshore reefs, and can be in schools of up to forty individuals. When not spawning, adults are most common in waters less than 100 m deep.

The oceanic whitetip shark is a large pelagic shark distributed globally throughout open ocean waters, outer continental shelves, and around oceanic islands, primarily from 10 degrees North to 10 degrees South, but up to 30 degrees North and 35 degrees South (Young 2016). They occur from the surface to at least 152 m (498.7 ft) deep, and display a preference for water temperatures above 20 degrees Celsius (°C).

Shortnose sturgeon occur in estuaries, rivers, and the sea along the east coast of North America (Vladykov and Greeley 1963). Their northerly distribution extends north of the action area to the Saint John River, New Brunswick, Canada, and their southerly distribution historically extended to the Indian River, Florida (Evermann and Bean 1898, Scott and Scott 1988). Some populations rarely leave freshwater while others are known to migrate along the coast between river systems (Quattro et al. 2002, Wirgin et al. 2005, Dionne et al. 2013, Altenritter et al. 2015).

The scalloped hammerhead shark is found throughout the world and the Central and Southwest Atlantic DPS, Eastern Pacific DPS, and Indo-West Pacific DPSs live in coastal warm temperate and tropical seas. The species occurs over continental shelves and the shelves surrounding islands, as well as adjacent deep waters, but is seldom found in waters cooler than 22 (°C) (Compagno 1984; Schulze-Haugen and Kohler 2003). It ranges from the intertidal and surface to depths of up to 450 to 512 m (1,476.4 to 1,679.8 ft), with occasional dives to even deeper waters. It has also been documented entering enclosed bays and estuaries. The Central and Southwest Atlantic DPS of scalloped hammerhead shark's range extends from the southeast coast of Florida to outside the action area, down to Brazil, including the Caribbean Sea, but not the Gulf of Mexico. The Eastern Pacific DPS of scalloped hammerhead shark's range extends from the coast of southern California, down south past the action area, to Ecuador and possibly Peru, and waters off Tahiti. The Indo-West Pacific DPS of scalloped hammerhead shark ranges from Japan down to Australia, including tropical Pacific islands in the action area. The central Pacific Ocean waters near Hawaii are not included within the range of listed DPSs.

Historically within the United States, smalltooth sawfish have been captured in estuarine and coastal waters from New York southward through Texas, with the largest number of recorded captures in Florida (NMFS 2010). Recent capture and encounter data suggest that the current distribution is primarily south and southwest Florida from Charlotte Harbor through the Dry Tortugas (Seitz and Poulakis 2002, Poulakis and Seitz 2004). Water temperatures (no lower than 16-18°C) and the availability of appropriate coastal habitat (shallow, euryhaline waters and red mangroves) are the major environmental constraints limiting the distribution of smalltooth sawfish (Bigalow and Schroeder 1953). Juvenile sawfish spend the first 2-3 years of their lives in the shallow waters provided in the lower reaches of rivers, estuaries, and coastal bays (Simpfendorfer et al. 2008 and 2011). As smalltooth sawfish approach 250 centimeters (cm), they become less sensitive to salinity changes and begin to move out of the protected shallow water embayments and into the shorelines of barrier islands (Poulakis et al. 2011). Adult sawfish typically occur in more open water, marine habitats (Poulakis and Seitz 2004).

Critical Habitat in the Action Area

This section discusses designated critical habitat that is either completely encompassed by the action area or is partially within the action area.

Green Sturgeon

The action area includes critical habitat for Southern DPS green sturgeon (Figure 6). In marine waters, the designated critical habitat is up to the 110 m depth isobath from Monterey Bay to the U.S.-Canada border.

The physical and biological features (PBFs) essential for the conservation of the Southern DPS green sturgeon are:

1. **Migratory corridor:** A migratory pathway necessary for the safe and timely passage within marine and between estuarine and marine habitats.
2. **Water quality:** Nearshore marine waters with adequate dissolved oxygen levels and acceptably low levels of contaminants (e.g., pesticides, organochlorines, elevated levels of heavy metals) that may disrupt the normal behavior, growth, and viability of subadults and adults.
3. **Food resources:** Abundant prey items for subadults and adults, which may include benthic invertebrates and fishes.

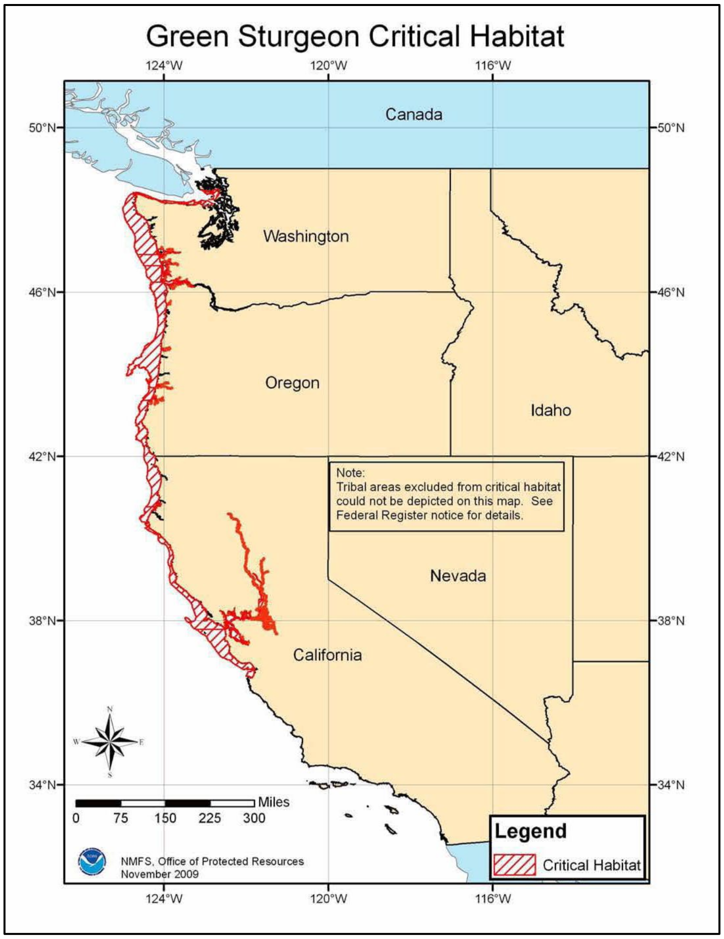


Figure 6. Green Sturgeon Critical Habitat

Gulf Sturgeon

Most of the Gulf sturgeon critical habitat is outside the action area, except for a boundary portion near Cedar Key, Florida, in the Gulf of Mexico (Figure 7). Most subadult and adult Gulf sturgeon spend cool months (October or November through March or April) in estuarine areas, bays, or in the Gulf of Mexico.

The PBFs relevant to the conservation of gulf sturgeon in estuarine and marine areas are:

1. Abundant prey items within estuarine and marine habitats and substrates for juvenile, subadult, and adult life stages;
2. Water quality, including temperature, salinity, pH, hardness, turbidity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages;
3. Sediment quality, including texture and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages; and
4. Safe and unobstructed migratory pathways necessary for passage within and between riverine, estuarine, and marine habitats (e.g., a river unobstructed by any permanent structure, or a dammed river that still allows for passage).

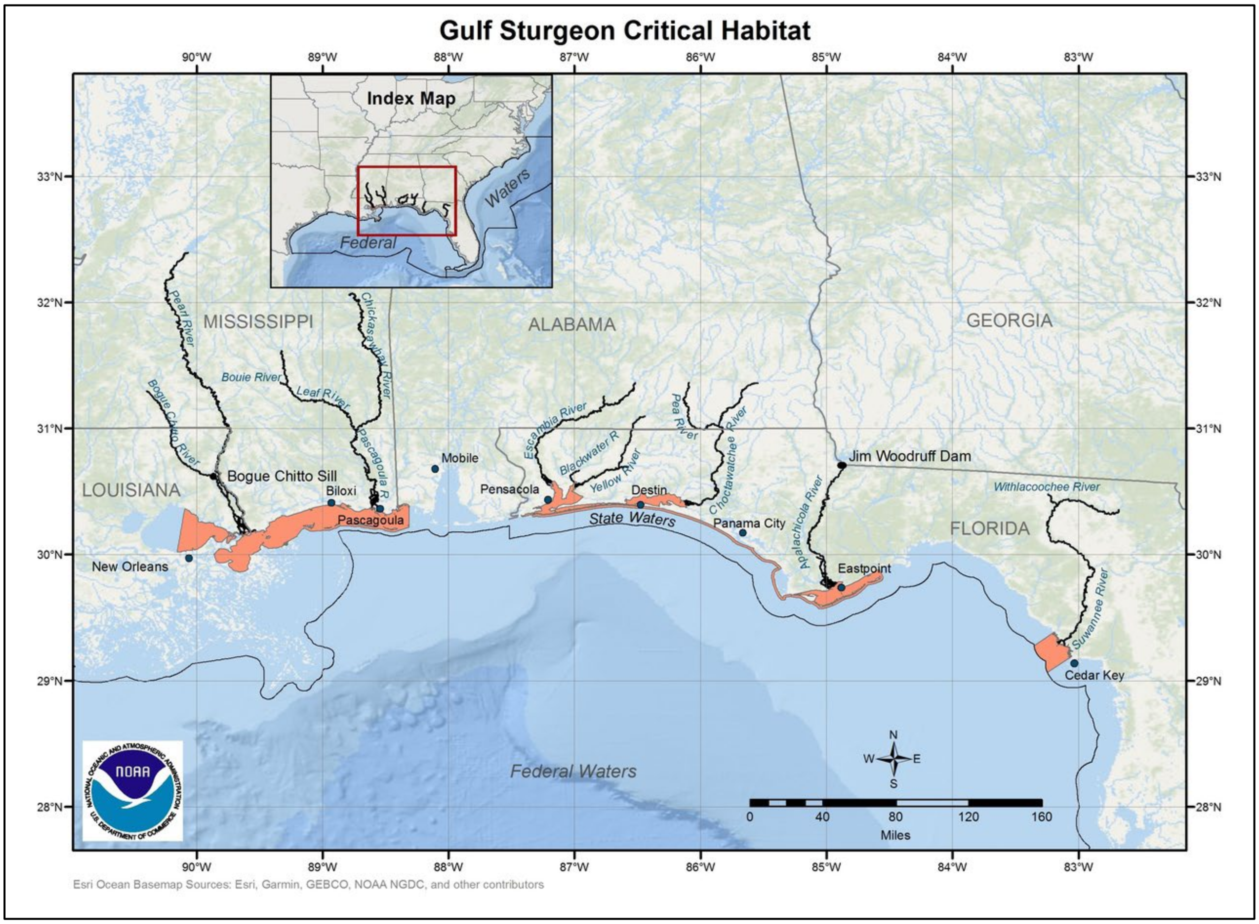


Figure 7. Gulf Sturgeon Critical Habitat

Pacific Leatherback Sea Turtle

The action area includes leatherback sea turtle critical habitat along the U.S. West Coast (Figure 8). This designation includes approximately 43,798 square kilometers stretching along the California coast from Point Arena to Point Arguello east of the 3000 m depth contour; and 64,760 square kilometers stretching from Cape Flattery, Washington to Cape Blanco, Oregon east of the 2,000 m depth contour. The designation includes waters from the ocean surface down to a maximum depth of 80 m. These waters were designated specifically because of the occurrence of prey species, primarily Scyphomedusae of the order Semaeostomeae (i.e., jellyfish), of sufficient condition, distribution, diversity, abundance and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks.

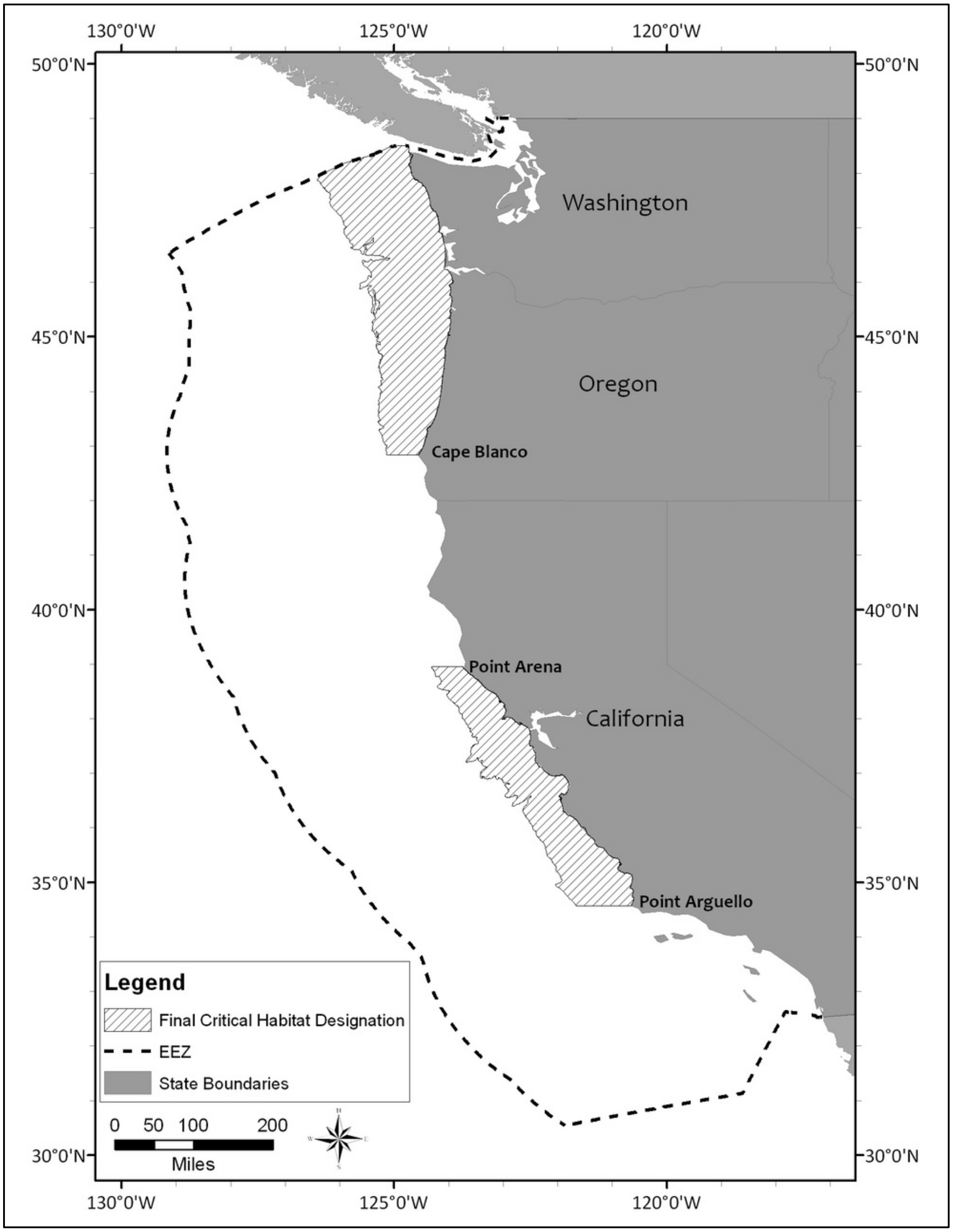


Figure 8. Pacific Leatherback Sea Turtle Critical Habitat

Loggerhead Sea Turtle

The action area includes Northwest Atlantic Ocean DPS loggerhead sea turtle critical habitat in the Gulf of Mexico and Atlantic Ocean (Figure 9). The designated critical habitat includes overlapping areas of nearshore reproductive habitat, constricted migratory habitat, breeding habitat, and *Sargassum* habitat (descriptions below). The FAA determined that approximately 13 miles of nearshore reproductive habitat is within the action area around Cape Canaveral and Port

Canaveral, but the remaining nearshore reproductive habitat areas are outside the action area because the landing/splashdown area begins 5 NM offshore.

- **Nearshore reproductive habitat:** The PBFs of nearshore reproductive habitat as a portion of the nearshore waters adjacent to nesting beaches that are used by hatchlings to egress to the open-water environment as well as by nesting females to transit between beach and open water during the nesting season. The following primary constituent elements support this habitat: (i) nearshore waters directly off the highest density nesting beaches and their adjacent beaches, as identified in 50 CFR § 17.95(c), to 1.6 kilometers offshore; (ii) waters sufficiently free of obstructions or artificial lighting to allow transit through the surf zone and outward toward open water; and (iii) waters with minimal manmade structures that could promote predators (i.e., nearshore predator concentration caused by submerged and emergent offshore structures), disrupt wave patterns necessary for orientation, and/or create excessive longshore currents.
- **Constricted migratory habitat:** The PBFs of constricted migratory habitat as high use migratory corridors that are constricted (limited in width) by land on one side and the edge of the continental shelf and Gulf Stream on the other side. Primary constituent elements that support this habitat are the following: (i) constricted continental shelf area relative to nearby continental shelf waters that concentrate migratory pathways; and (ii) passage conditions to allow for migration to and from nesting, breeding, and/or foraging areas.
- **Breeding habitat:** The PBFs of concentrated breeding habitat as those sites with high densities of both male and female adult individuals during the breeding season. Primary constituent elements that support this habitat are the following: (i) high densities of reproductive male and female loggerheads; (ii) proximity to primary Florida migratory corridor; and (iii) proximity to Florida nesting grounds.
- ***Sargassum* habitat:** The PBFs of loggerhead *Sargassum* habitat as developmental and foraging habitat for young loggerheads where surface waters form accumulations of floating material, especially *Sargassum*. Primary constituent elements that support this habitat are the following: (i) convergence zones, surface-water downwelling areas, the margins of major boundary currents (Gulf Stream), and other locations where there are concentrated components of the *Sargassum* community in water temperatures suitable for the optimal growth of *Sargassum* and inhabitance of loggerheads; (ii) *Sargassum* in concentrations that support adequate prey abundance and cover; (iii) available prey and other material associated with *Sargassum* habitat including, but not limited to, plants and cyanobacteria and animals native to the *Sargassum* community such as hydroids and copepods; and (iv) sufficient water depth and proximity to available currents to ensure offshore transport (out of the surf zone), and foraging and cover requirements by *Sargassum* for post-hatchling loggerheads, i.e., >10 m in depth.

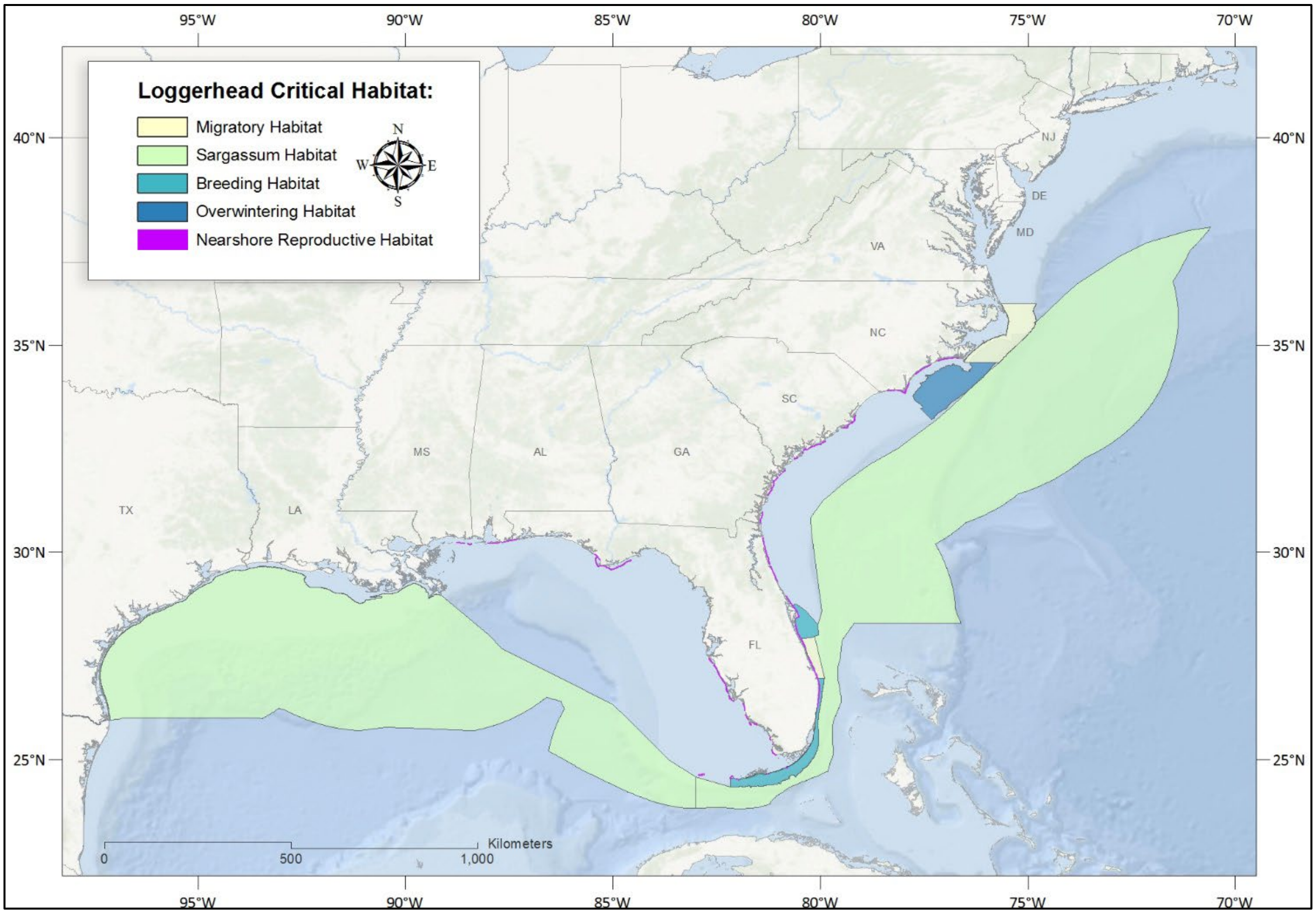


Figure 9. Loggerhead Sea Turtle Critical Habitat

North Atlantic Right Whale

NMFS designated two units of critical habitat for the North Atlantic right whale. Unit 1 is for foraging habitat in the Gulf of Maine and Georges Bank region, and is not in the action area. Unit 2 is for calving and is in the action area, consisting of all marine waters from Cape Fear, North Carolina, southward to approximately 27 NM below Cape Canaveral, Florida (Figure 10). Unit 2 occurs off the coast of CCSFS and extends seaward approximately 5 NM off the coast north of CCSFS. The following PBFs are present in Unit 2:

- Sea surface conditions associated with Force 4 or less on the Beaufort Scale.
- Sea surface temperatures of 7°C to 17°C.
- Water depths of 6-28 m, where these features simultaneously co-occur over contiguous areas of at least 231 square NM of ocean waters during the months of November through April. When these features are available, they are selected by right whale cows and calves in dynamic combinations that are suitable for calving, nursing, and rearing, and which vary, within the ranges specified, depending on factors such as weather and age of the calves.

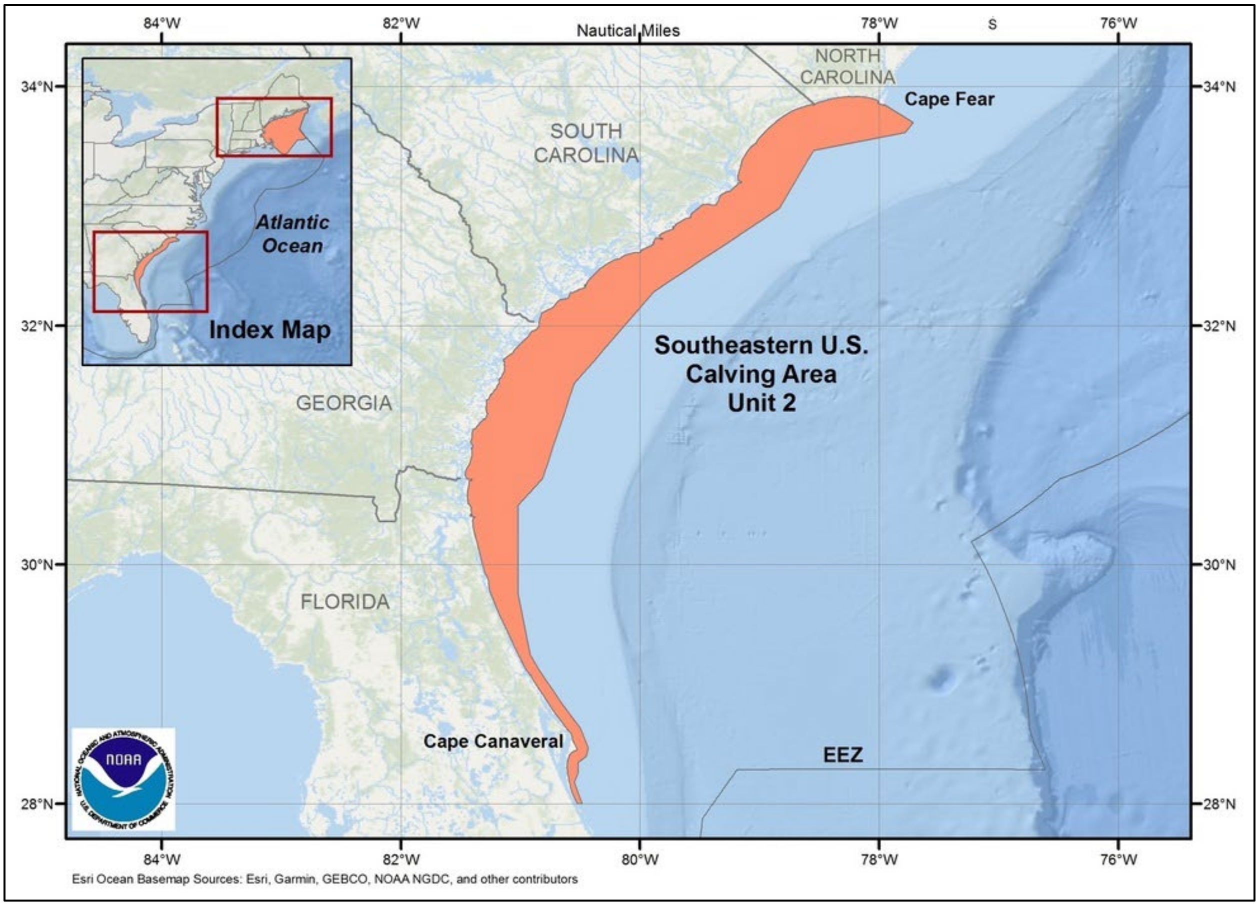


Figure 10. North Atlantic Right Whale Critical Habitat Unit 2

North Pacific Right Whale

Designated critical habitat for the North Pacific right whale includes an area in the Southeast Bering Sea, which is not in the action area, and an area south of Kodiak Island in the Gulf of Alaska (Figure 11), which is in the northern boundary of the action area in the Pacific. Both critical habitat areas support feeding by North Pacific right whales because they contain the designated PBFs, which include: nutrients, physical oceanographic processes, certain species of zooplankton (e.g. copepods *Calanus marshallae*, *Neocalanus cristatus*, and *N. plumchris*, and the euphausiid *Thysanoëssa raschii*), and a long photoperiod due to the high latitude (73 FR 19000).

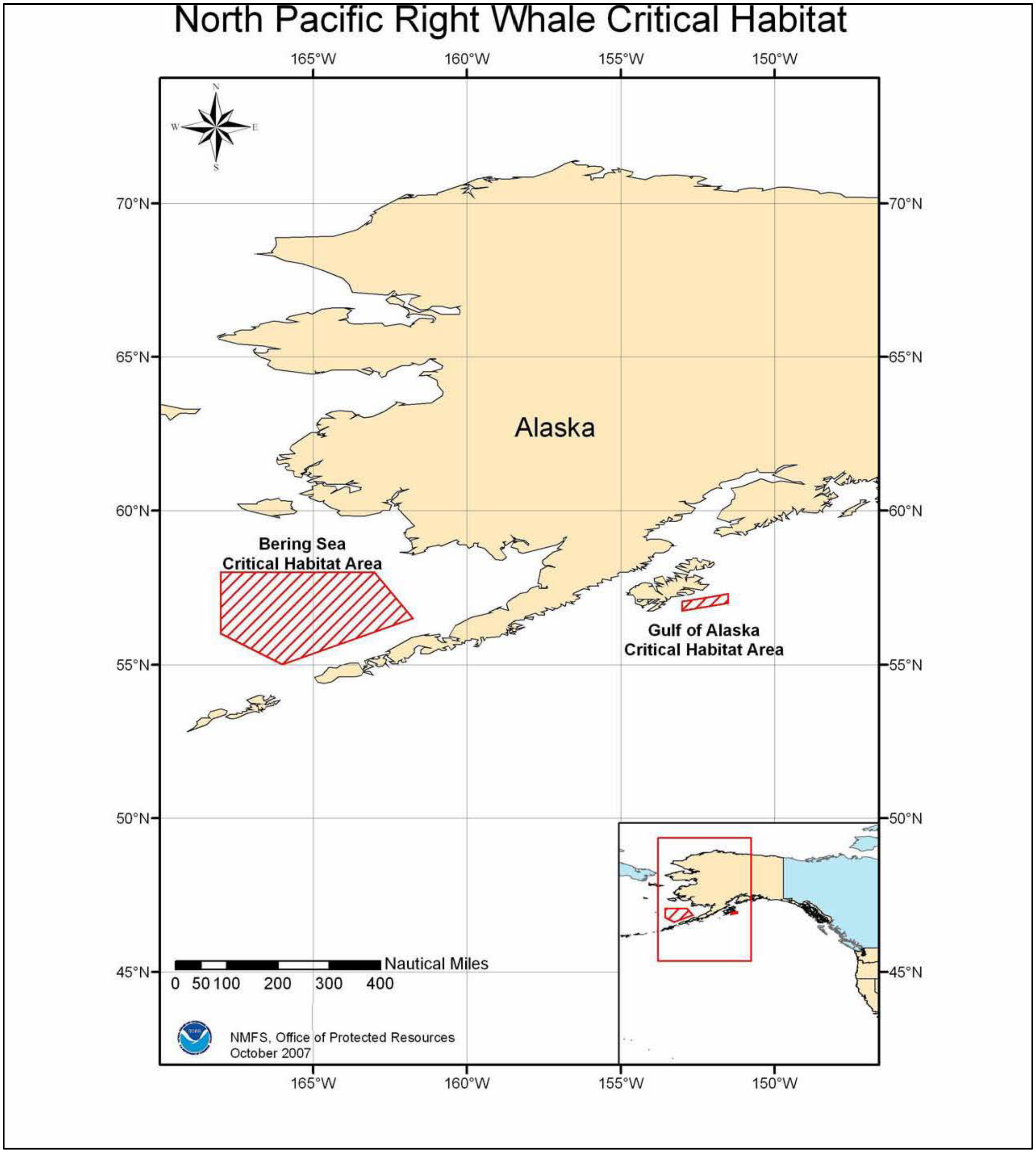


Figure 11. North Pacific Right Whale Critical Habitat

Humpback Whale

NOAA Fisheries designated critical habitat for the endangered Western North Pacific DPS, the endangered Central America DPS, and the threatened Mexico DPS of humpback whales on May 21, 2021 (86 FR 21082; Figures 12-14). The area designated as critical habitat for the Central America DPS contain approximately 48,521 square NM of marine habitat in the Pacific Ocean within the portions of the California Current Ecosystem off the coasts of Washington, Oregon, and California (Figure 12). Areas designated as critical habitat for the Mexico DPS contain approximately 116,098 square NM of marine habitat in the North Pacific Ocean, including areas within portions of the eastern Bering Sea, Gulf of Alaska, and California Current Ecosystem (Figure 13). Areas designated as critical habitat for Western North Pacific DPS contain approximately 59, 411 square NM of marine habitat in the North Pacific Ocean, including areas within the eastern Bering Sea and Gulf of Alaska (Figure 14).

The following PBFs were identified as essential to the conservation of the DPSs as follows:

1. **Central American DPS:** prey species, primarily euphausiids and small pelagic schooling fishes, such as Pacific sardine, northern anchovy, and Pacific herring, of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth.
2. **Mexico DPS:** prey species, primarily euphausiids and small pelagic schooling fishes, such as Pacific sardine, northern anchovy, Pacific herring, capelin, juvenile walleye pollock, and Pacific sand lance of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth.
3. **Western North Pacific DPS:** prey species, primarily euphausiids and small pelagic schooling fishes, such as Pacific herring, capelin, juvenile walleye pollock, and Pacific sand lance of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth.

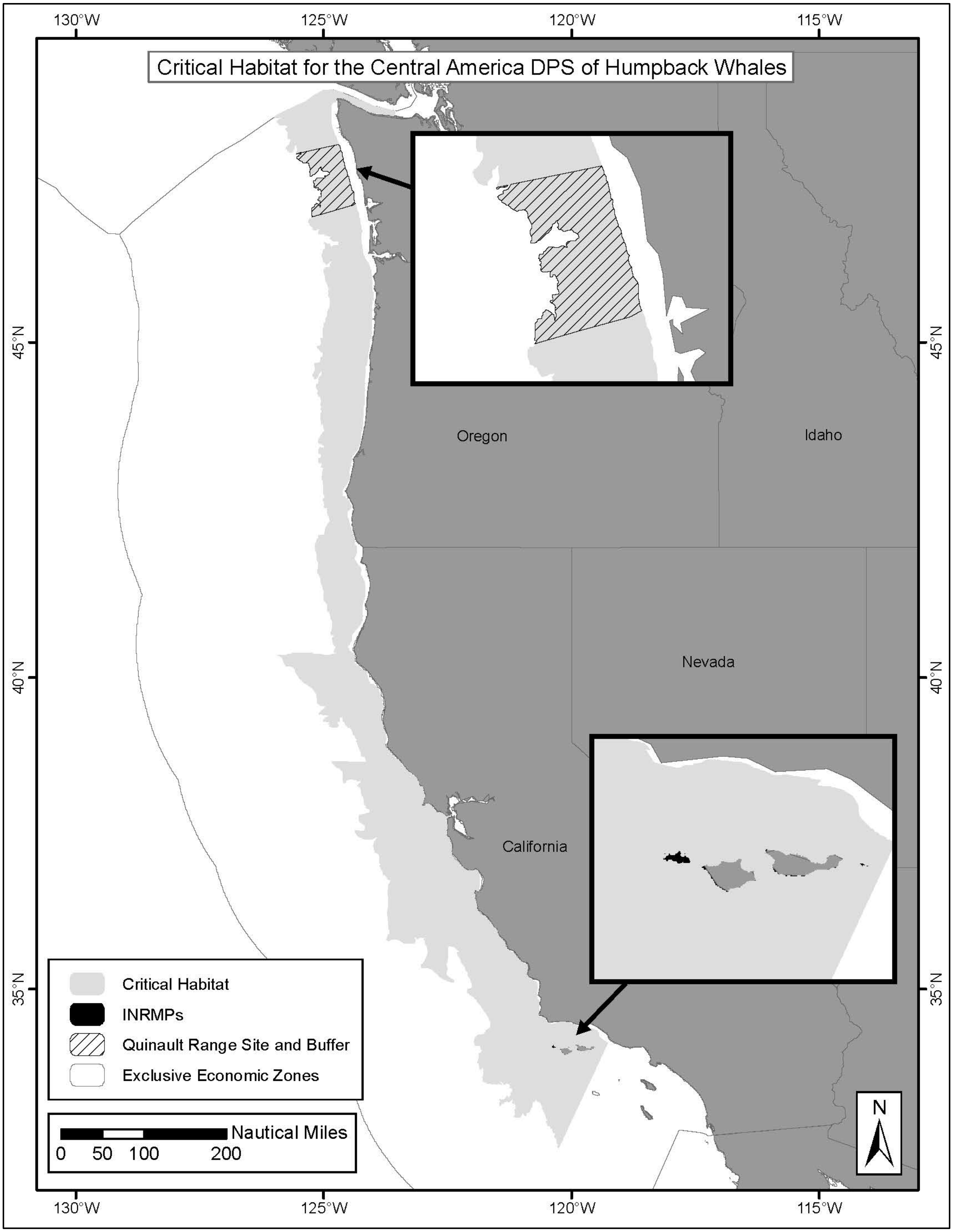


Figure 12. Critical Habitat for Central America DPS humpback whales

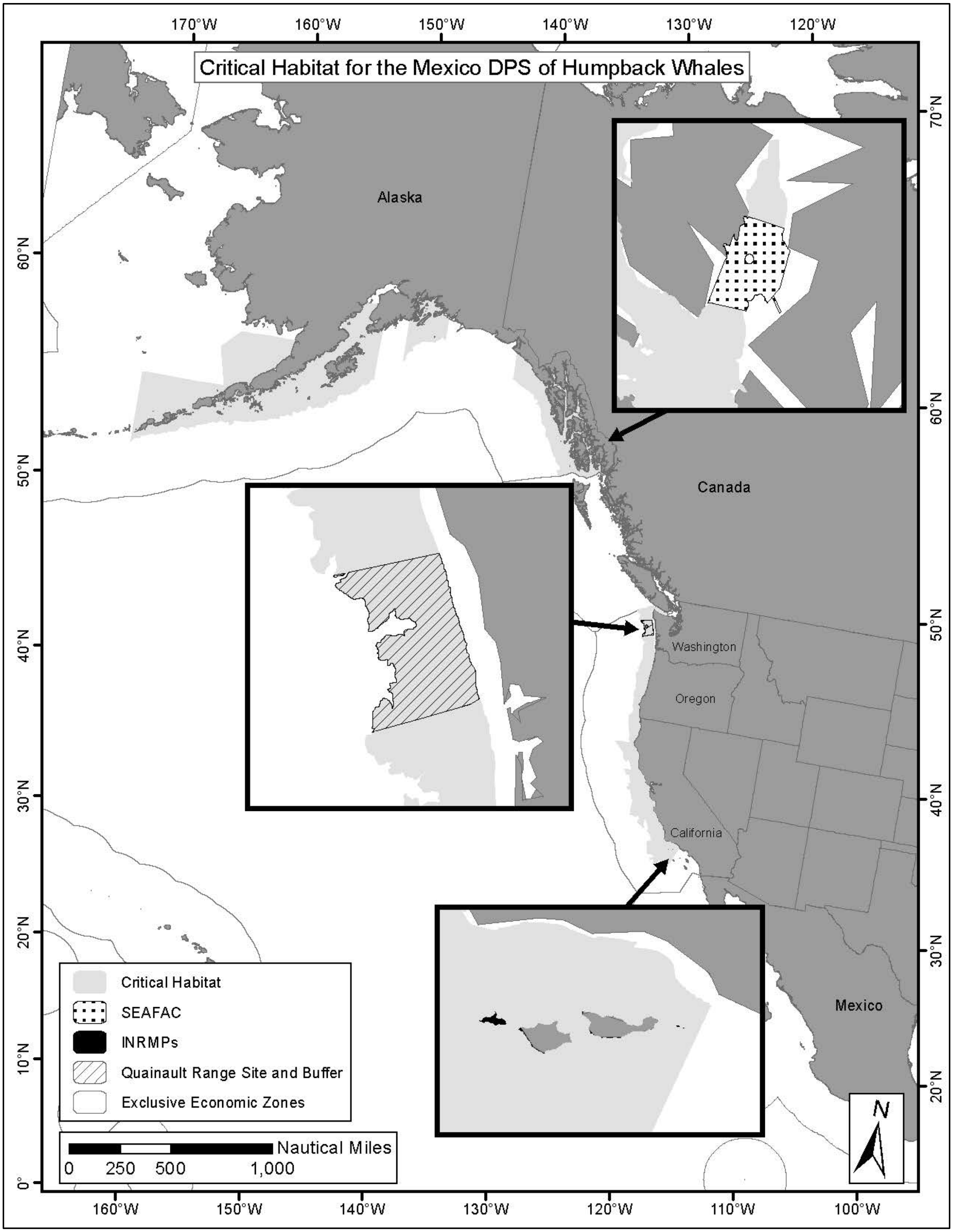


Figure 13. Critical Habitat for Mexico DPS humpback whales

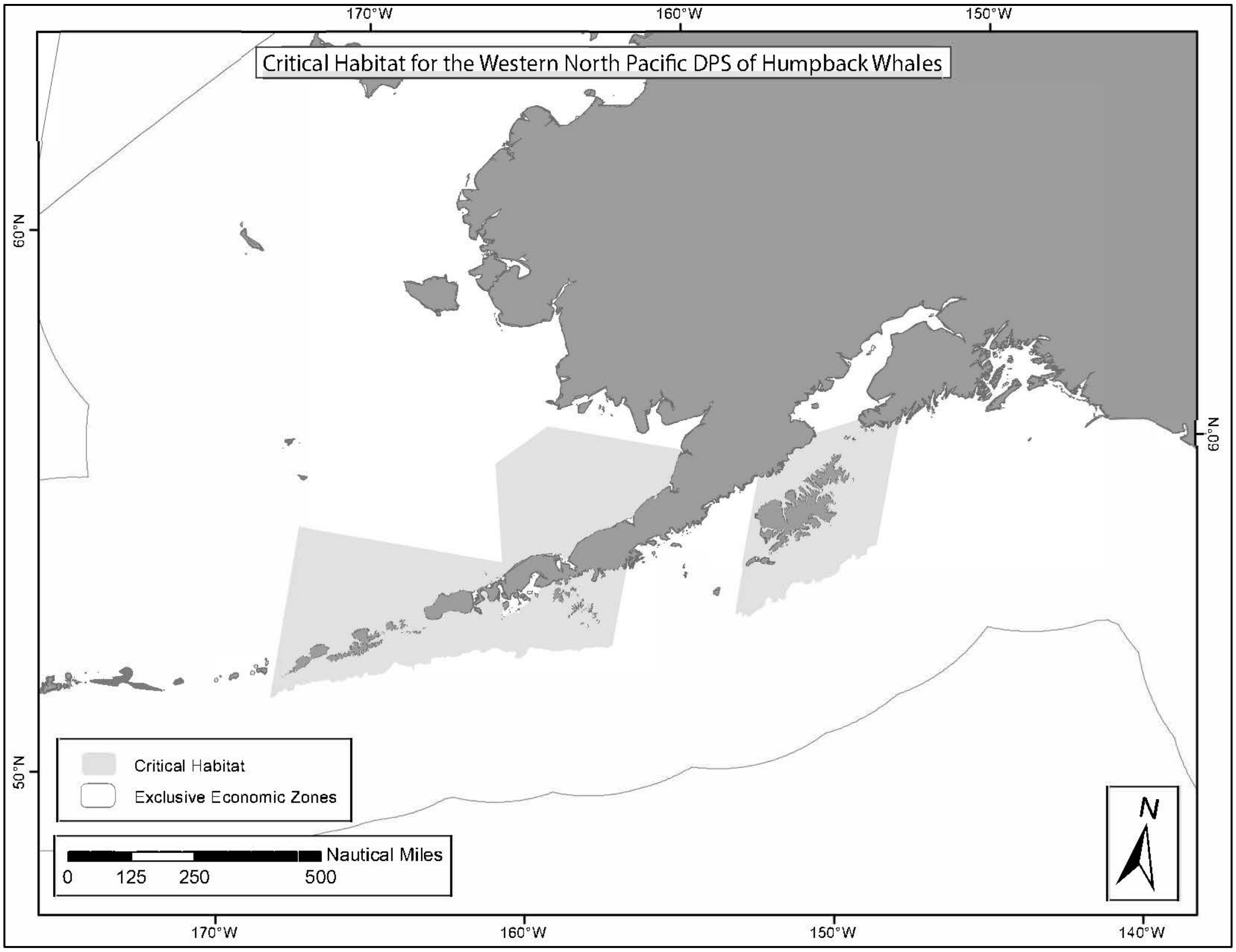


Figure 14. Critical Habitat for Western North Pacific DPS humpback whales

Killer Whale

In 2006, NMFS issued a final rule designating approximately 2,560 square miles of inland waters of Washington State as critical habitat for the Southern Resident DPS killer whale. In August of 2021, NMFS issued a revised rule to the critical habitat designation by expanding it to include six new areas along the U.S. West Coast, while maintaining the whales' currently designated critical habitat in inland waters of Washington (Figure 15). The expanded critical habitat includes marine waters between the 6.1 m depth contour and the 200 m depth contour from the U.S. international border with Canada south to Point Sur, California. Critical habitat within the action area contains PBFs associated with water quality to support growth and development, prey availability for growth, reproduction and development, and overall population growth; and passage conditions to allow for migration, resting, and foraging.

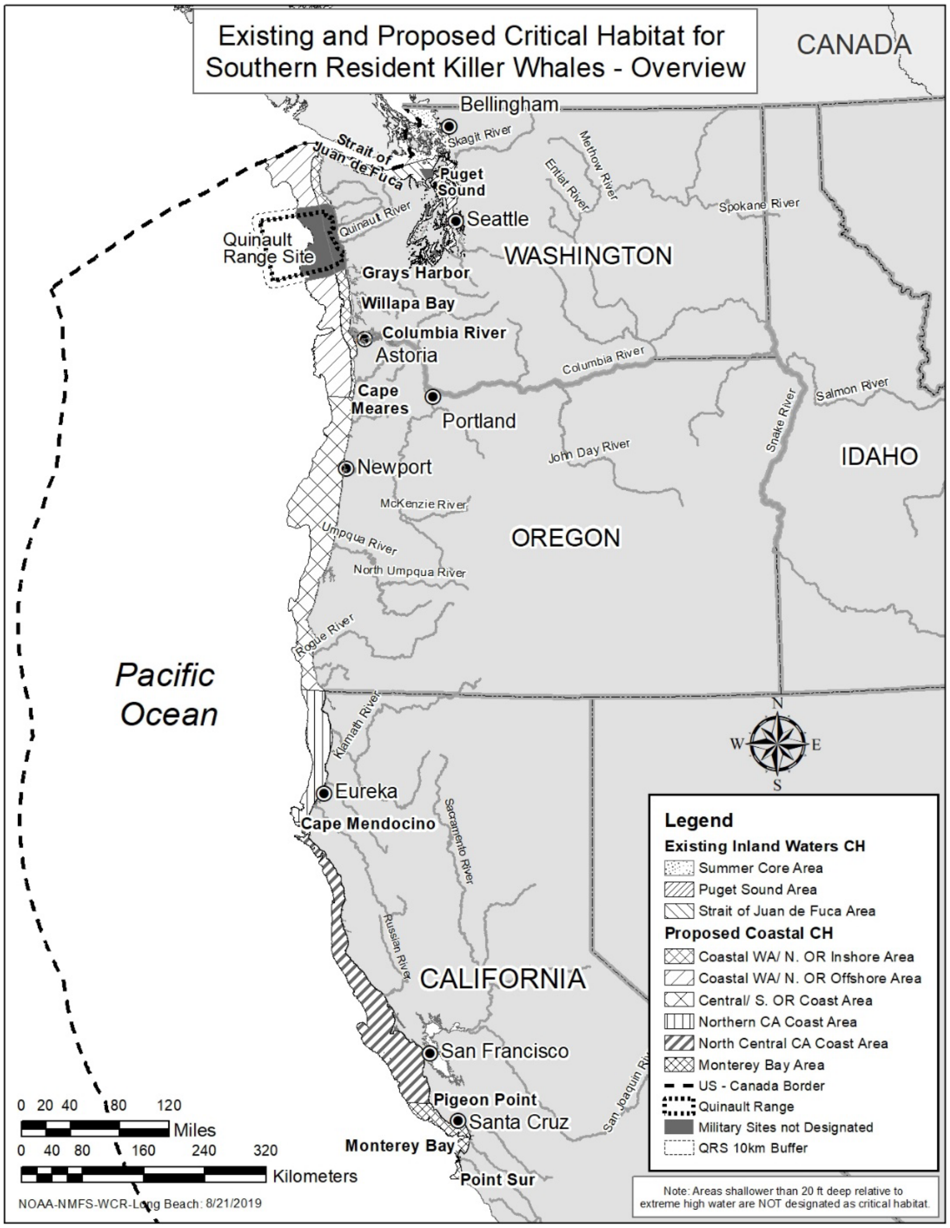


Figure 15. Southern Resident Killer Whale Critical Habitat

False Killer Whale

On July 24 2018, NOAA Fisheries designated critical habitat for the main Hawaiian Islands insular false killer whale DPS by designating waters from the 45-m depth contour to the 3,200-m depth contour around the main Hawaiian Islands from Ni'ihau east to Hawai'i (Figure 16). Island-associated marine habitat is an essential feature for the conservation of the main Hawaiian Islands insular false killer whale. Main Hawaiian Islands insular false killer whales are island-associated whales that rely entirely on the productive submerged habitat of the main Hawaiian Islands to support all of their life-history stages. The following characteristics of this habitat support insular false killer whales' ability to travel, forage, communicate, and move freely around and among the waters surrounding the main Hawaiian Islands:

1. Adequate space for movement and use within shelf and slope habitat;
2. Prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth;
3. Waters free of pollutants of a type and amount harmful to main Hawaiian Islands insular false killer whales; and
4. Sound levels that would not significantly impair false killer whales' use or occupancy.

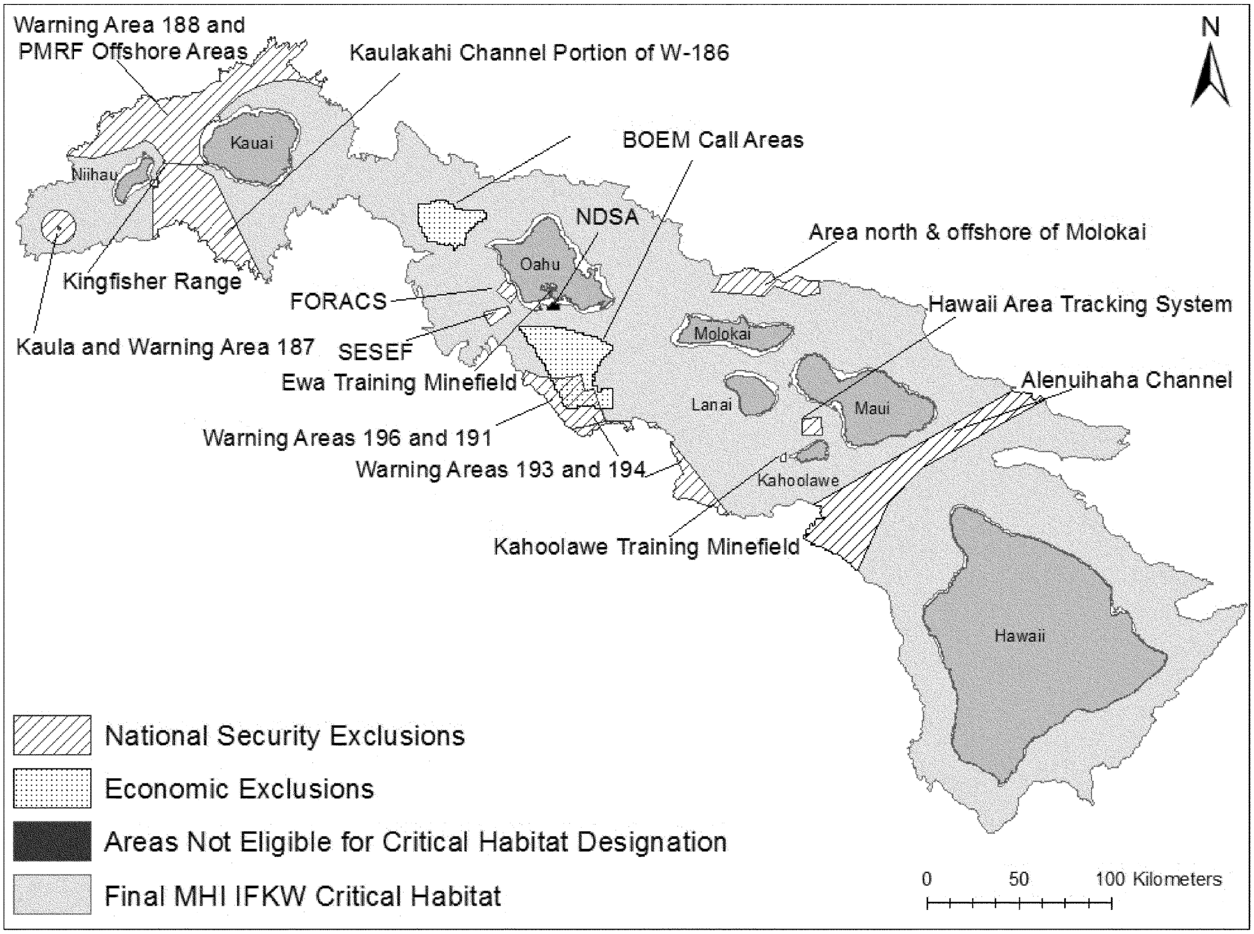


Figure 16. Main Hawaiian Islands insular DPS false killer whale critical habitat.

Hawaiian Monk Seal

NOAA Fisheries designated Critical Habitat for the Hawaiian monk seal in sixteen occupied areas within the range of the species (See series of Critical Habitat maps at: https://www.fisheries.noaa.gov/resource/map/hawaiian-monk-seal-critical-habitat-map), These areas contain one or more PBFs essential to Hawaiian monk seal conservation, including: preferred pupping and nursing areas, significant haul-out areas, and/or marine foraging areas out to 200 m in depth.

Northwestern Hawaiian Islands (Hawaiian names in parenthesis)

There are ten designated Hawaiian monk seal critical habitat areas in the Northwestern Hawaiian Islands that include all beach areas, sand spits, and islets, including all beach crest vegetation to its deepest extent inland, as well as the seafloor and marine habitat 10 m in height above the seafloor from the shoreline out to the 200 m depth contour around:

- Kure Atoll (Hōlanikū)
- Midway Atoll (Kuaihelani)
- Pearl and Hermes Reef (Manawai)
- Lisianski Island (Kapou)
- Laysan Island (Kamole)
- Maro Reef (Kamokuokamohoali‘i)
- Gardner Pinnacles (‘Ōnūnui)
- French Frigate Shoals (Lalo)
- Necker Island (Mokumanamana)
- Nihoa Island

<u>Main Hawaiian Islands</u>

There are six designated Hawaiian monk seal critical habitat areas in the main Hawaiian Islands that include the seafloor and marine habitat to 10 m above the seafloor from the 200-m depth contour through the shoreline and extending into terrestrial habitat 5 m inland from the shoreline between identified boundary points around the following islands:

- Kaula Island (includes marine habitat only)
- Ni‘ihau (includes marine habitat from 10 to 200 m in depth)
- Kaua‘i
- O‘ahu
- Maui Nui (including Kaho‘olawe, Lāna‘i, Maui, and Moloka‘i)
- Hawai‘i Island

Steller Sea Lion

Critical habitat for designated for the Steller sea lion includes specific rookeries, haul-outs, and associated areas, as well as three foraging areas that are considered to be essential for the health, continued survival, and recovery of the species. Critical habitat includes terrestrial, air and aquatic areas that support reproduction, foraging, resting, and refuge.
Critical habitat in Alaska includes a terrestrial zone extending 3,000 ft (0.9 km) landward from each major rookery and haul-out; it also includes air zones extending 3,000 ft (0.9 km) above these terrestrial zones and aquatic zones. Aquatic zones extend 3,000 ft (0.9 km) seaward from the major rookeries and haul-outs east of 144°W (Figure 17). West of 144° W, where the Western DPS is located, the aquatic zone extends 20 NM (37 km) seaward from the baseline or basepoint of each major rookery and major haul-out (Figure 18). In addition, NMFS designated special aquatic foraging areas as critical habitat for the Steller sea lion. These areas include the Shelikof Strait (in the Gulf of Alaska), Bogoslof Island, and Seguam Pass (the latter two are in the Aleutians). These sites are located near Steller sea lion abundance centers and include important foraging areas with large concentrations of prey.

Although within the range of the now delisted Eastern DPS, the designated critical habitat in California and Oregon remains in effect (Figure 19). In California and Oregon, major Steller sea lion rookeries and associated air and aquatic zones are designated as critical habitat. Critical habitat includes an air zone extending 3,000 ft (0.9 km) above rookery areas historically occupied by sea lions. Critical habitat also includes an aquatic zone extending 3,000 ft (0.9 km) seaward.

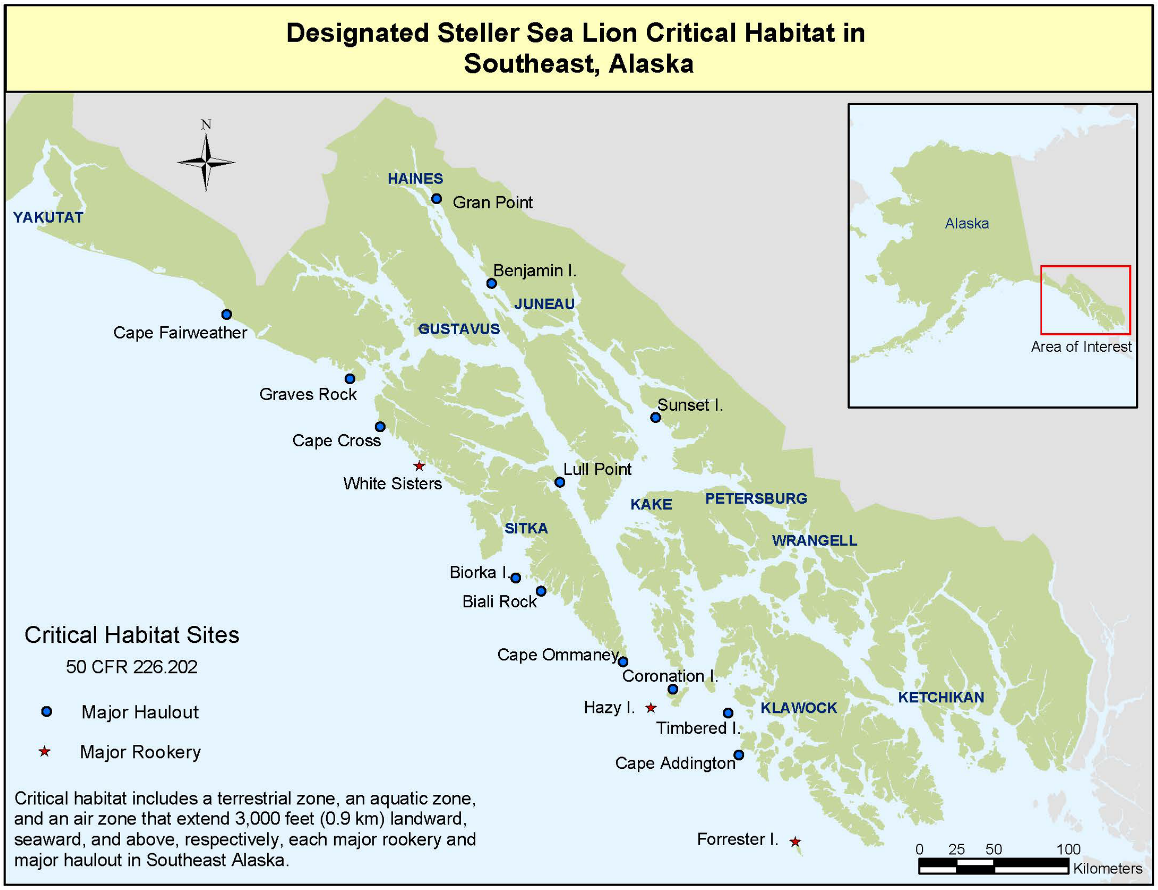


Figure 17. Steller Sea Lion Critical Habitat – Southeast Alaska

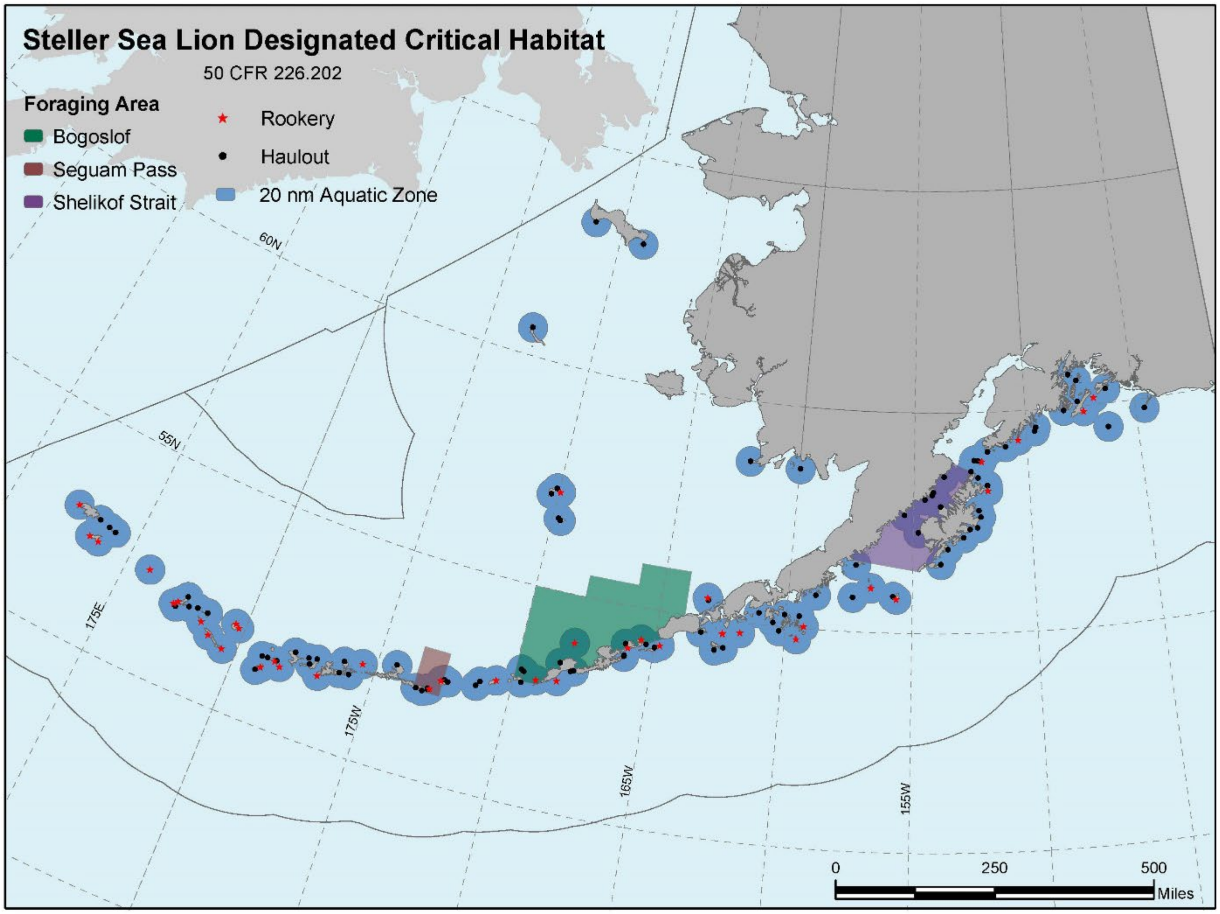


Figure 18. Steller Sea Lion Critical Habitat – Western Alaska

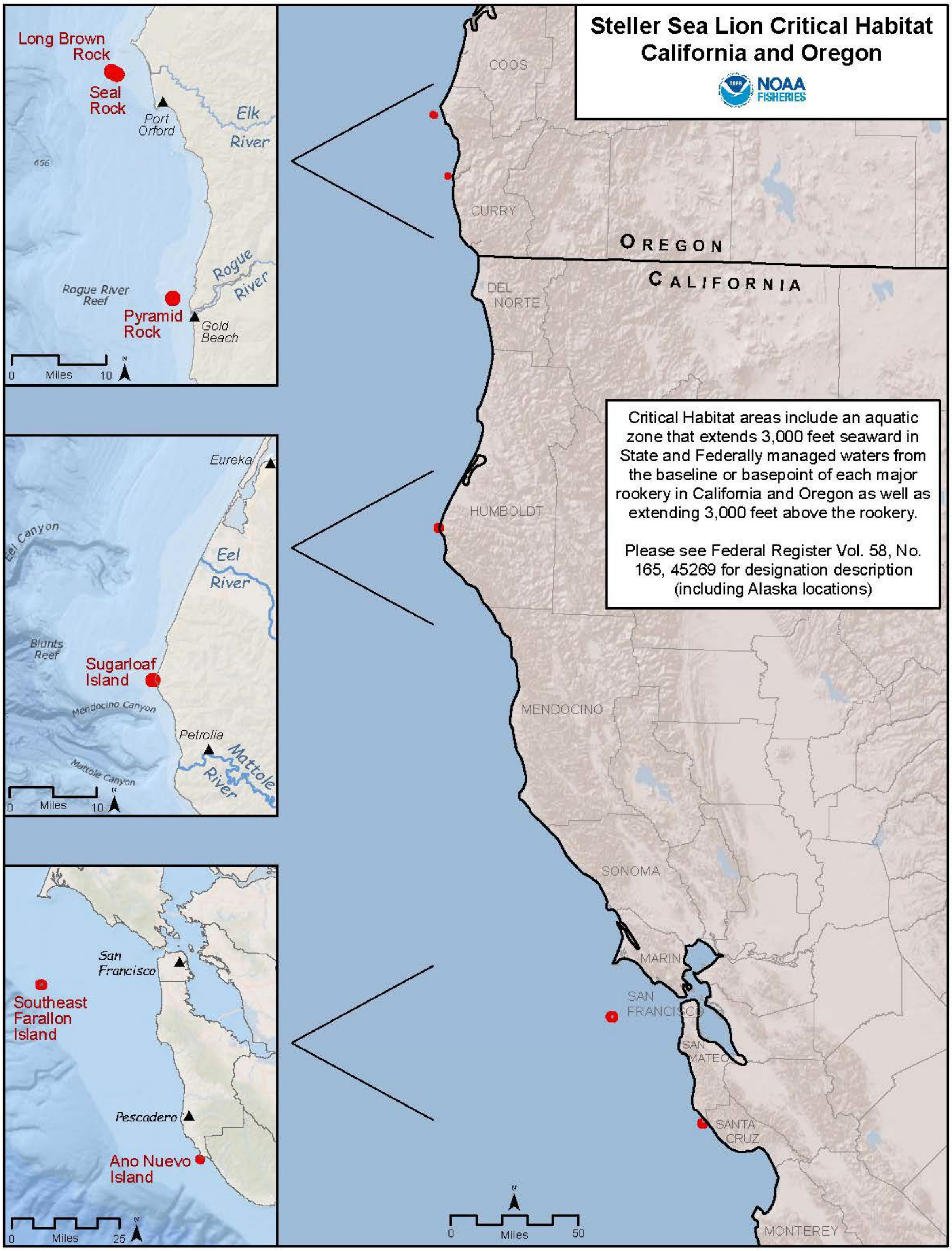


Figure 19. Steller Sea Lion Critical Habitat – Oregon and California

EFFECTS ANALYSIS

"Effects of the action" means all consequences to ESA-listed species or designated critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 C.F.R. §402.2).

The applicable standard to find that a proposed action is not likely to adversely affect ESA-listed species or designated critical habitat is that all of the effects of the action are expected to be discountable, insignificant, or wholly beneficial. Beneficial effects have an immediate positive effect without any adverse effects to the species or habitat. Insignificant effects relate to the size or severity of the impact and include those effects that are undetectable, not measurable, or so minor that they cannot be meaningfully evaluated. Insignificant is the appropriate effect conclusion when plausible effects are going to happen, but will not rise to the level of constituting an adverse effect. For an effect to be discountable, there must be a plausible adverse effect (i.e., a credible effect that could result from the action that would be an adverse effect if it did affect an ESA-listed species), but it is very unlikely to occur.
The following subsections identify the potential stressors and analyze the potential effects of the proposed launch and reentry vehicle operations on the ESA-listed species and critical habitat in the action area.

Potential Stressors to ESA-Listed Species

Stressors are any physical, chemical, or biological agent, environmental condition, external stimulus, or event that may induce an adverse response in either an ESA-listed species or its designated critical habitat. Potential stressors to ESA-listed species from the proposed activities include the following:

- Impact by fallen objects: spacecraft, rocket parts, radiosonde;
- Entanglement in unrecovered parachutes and parafoils;
- Ingestion of material from unrecovered parachutes, parafoils, and weather balloon fragments;
- Exposure to hazardous materials;
- Exposure to sonic booms (overpressure) and impulse noise generated during spacecraft reentry or stage landings in the ocean;
- Ship strike; and
- Harassment by aircraft overflight.

Fallen objects, unrecovered parachutes/parafoils, and hazardous materials could also impact designated critical habitat. Potential effects to the ESA-listed species from these stressors are discussed in the following sections, followed by potential effects to the PBFs of designated critical habitat.

Impact by Fallen Objects

Boosters, fairings, spacecraft, and radiosondes from weather balloons falling through the atmosphere to Earth's surface have the potential to affect ESA-listed species marine species. Debris from a launch abort test or any launch failure anomalies could also have an effect. The primary concern is a direct impact from an object landing on an ESA-listed marine mammal, sea turtle or fish.

The action area where objects could splashdown encompasses vast expanses of ocean. ESA-listed species are sparsely distributed across these ocean expanses, resulting in very low densities of species overall. The probability of a direct impact to an ESA-listed species is thus extremely unlikely.

The same conclusion was reached when analyzing the Joint Flight Campaign missile testing from some of the same launch sites and overlapping areas of the Atlantic and Pacific Oceans (OPR-2021-02470). The BE for the Joint Flight Campaign utilized the best available density data for ESA-listed marine mammals and sea turtles, which is from the U.S. Navy's Marine Species Density Databases for training and testing areas in the Pacific and Atlantic (U.S. Navy 2017a and b, U.S. Navy 2018). Species densities were averaged across study areas within a proposed drop zone and the highest estimated densities across seasons were used to represent animal densities in the entire drop zone. For a flight test from VSFB, the maximum number of estimated animal exposures for any ESA-listed species in the broad ocean area is for fin whales at 0.00002 individuals, corresponding to a one in 50,000 chance of contacting a fin whale during a single test from VSFB. For a flight test from WFF, the maximum number of estimated animal exposures for any ESA-listed species in the broad ocean area is 0.000008 individuals for marine mammals (fin whales) and 0.00005 for sea turtles (loggerheads). This corresponds to a one in 121,000 chance of contacting a fin whale and a one in 22,000 chance of contacting a loggerhead turtle during a single test from WFF.

The very low probabilities of direct contact further illustrate the likelihood of ESA-listed mammals or sea turtles being in the same spot where these materials happen to land in vast open ocean areas is very low. Similar density data for ESA-listed fish species is not available, but most of the fish species that may be present in the action area do not spend much time near the surface where direct strikes could occur and often prefer deeper waters (e.g., eulachon, grouper, sawfish, sturgeons, salmonids). Additionally, a physical strike affecting a fish depends on the relative size of the object potentially striking the fish and the location of the fish in the water column. Because fish are likely able to detect an object descending in the water column (e.g., sensing the pressure wave or displacement of water) and are highly mobile, fish would likely swim away from an oncoming object. The oceanic whitetip shark, scalloped hammerheads and giant manta ray are known to spend time near the surface, likely to utilize sunlight-warmed waters, but are also known to dive to greater depths. However, the chance of any ESA-listed fish species being in the same spot where launch materials happen to land is highly unlikely, and therefore, the risk of being directly hit by any falling objects from launch operations is extremely low.

It is worth noting that materials have been expended from rocket launches for decades with no known interactions with any of the ESA-listed species considered in this programmatic. In summary, because it would be extremely unlikely for an ESA-listed species to be directly struck by launch vehicle components, spacecraft, radiosondes, and any launching or landing-related debris, the potential for effects to ESA-listed species from a direct impact by those fallen objects are discountable. Therefore, we conclude that direct impacts from fallen objects to ESA-listed marine mammals, sea turtles, and fish in the action area because of activities covered under this programmatic may affect, but are not likely to adversely affect these animals.

Entanglement

Spacecraft reentry and recovery operations and fairing recovery involve the use of parachutes and/or parafoils, which introduces the possibility of marine species becoming entangled in the parachute/parafoil material and attached lines, particularly if the material is not recovered by the launch operator. Entanglement can impact a marine animal by limiting its ability to move through the water for feeding, reproductive, or migratory purposes (Laist 1997). Materials entangled tightly around a body part may cut into tissues, enable infection, and severely compromise an individual's health, and may lead to death. A compromised individual is also less likely to be able to escape predation.

Drogue parachutes are the smallest and are cut away at altitude, which separates it from the spacecraft or fairing before the point of splashdown and so are more likely not to be recovered than the other parachutes and parafoils. The drogue parachute's primary material (nylon) is in the family of high molecular weight polymers, which are not easily degraded by abiotic (physical or chemical) or biotic processes (Haines and Alexander 1974). Photooxidative degradation, the process of decomposition of the material by light (most effectively by near-ultraviolet [UV] and UV wavelengths) would be the most effective source of damage exerted on the nylon parachute. However, the drogue parachute assembly becomes saturated within approximately one minute of splashing down and begins to sink. The drogue parachutes are expected to sink at a rate of approximately 1,000 ft in 46 minutes (or approximately 22 ft per minute; see Appendix A), rapidly sinking below the depths to which UV radiation penetrates in the oceans, eventually resting on the ocean floor where exposure to UV light would not occur, making photo-oxidation improbable. Once on the ocean floor, the relatively constant temperatures and lower oxygen concentration (as compared to the atmosphere) would slow the degradation process (Andrady 1990).

If the larger main parachutes or parafoils are not recovered, they will take longer than the drogue parachutes to become saturated and will sink more slowly, but even the largest parafoil is expected to sink at a rate of approximately 1,000 ft in 145.5 minutes (or approximately 7 ft per minute; see Appendix A). This still is a relatively short amount of time to pass through the water column, likely reaching the ocean floor within a matter of hours.

All parachutes and parafoils are meant to be recovered and they have been recovered during the majority of operations. Even if the parachutes or a parafoil are not recovered, they sink rather quickly and spend a short time passing through the water column. Fairing recovery typically takes place between 300-500 NM offshore and if any drogue parachutes or parafoils are not recovered, they are expected to settle (> 3,000 m [9,800 ft]). None of the ESA-listed species considered in this programmatic forage that deep, and therefore are not expected to encounter the settled parachutes or parafoils. SpaceX's Dragon spacecraft parachutes (drogue and main) are the only spacecraft parachutes that have been deployed to date for spacecraft re-entries. Missions use the Dragon spacecraft during contract support for NASA, delivering cargo to the International Space Station. Recovery of Dragon spacecraft reentering from resupply missions occurs offshore over deep waters (> 3,000 m [9,800 ft]), similar to the fairings. SpaceX has typically recovered the Dragon spacecraft within one hour of splashdown and subsequently recover parachutes.

However, there have two instances where sea and weather conditions during Dragon cargo spacecraft recovery created complications and SpaceX did not recover the parachutes. In 2020, a crewed test flight of Dragon-2 was conducted and the recovery operation was not as far offshore (approximately 27 NM), for human crew safety logistics, and therefore occurred over shallower water. The crewed Dragon test flight recovered both drogue parachutes and 3 of the 4 main parachutes. As the crewed Dragon flights become operational, procedures should become more efficient, including parachute retrieval. Crewed Dragon spacecraft missions will be less frequent than cargo missions and only expected to happen once or twice a year.

Considering the low occurrence of parachutes or parafoils not being recovered, the limited time they would spend in the water column and settling typically in the deep ocean, exposure of ESA-listed mammals, sea turtles, or fishes to the parachutes or parafoils is extremely unlikely and therefore the risk of entanglement is discountable.

Ingestion

Foraging individuals of ESA-listed species could be exposed and therefore risk ingesting, pieces of weather balloons, parachutes or parafoils.

Latex weather balloons typically have a diameter at launch of approximately 4 ft, but then rise to approximately 20–30 km where the volume increases to the point where the elastic limit is reached and the balloon bursts. The temperature at this altitude range can reach negative 40 degrees Fahrenheit (°F) and even colder. Under these conditions of extreme elongation and low temperature, the balloon undergoes "brittle fracture" where the rubber actually shatters along grain boundaries of crystallized segments. The resultant pieces of rubber are small strands comparable to the size of a quarter (Burchette 1989). This was confirmed by researchers at the University of Colorado and NOAA (University of Colorado and NOAA 2017). The small shreds then make their way back to the surface of the Earth and are expected to land in the ocean. Along the way, the pieces can be subject to movements in atmospheric pressure and wind as they sink through the air. This can cause the fragments to become scattered and disperse before landing on the surface of the ocean where they are subject to movement of surface currents, which can cause additional dispersion.

The balloon fragments would be positively buoyant, float on the surface, and begin to photo-oxidize due to UV light exposure. Studies have shown latex in water will degrade, losing tensile strength and integrity, though this process can require multiple months of exposure time (Pegram and Andrady 1989; Andrady 1990; Irwin 2012). Field tests conducted by Burchette (1989) showed latex rubber balloons are very degradable in the environment under a broad range of exposure conditions, including exposure to sunlight and weathering and exposure to water. The balloon samples showed significant degradation after six weeks of exposure (Burchette 1989).

The floating latex balloon fragments would provide substrate for algae and eventually be weighed down with growth of heavier epifauna, such as tunicates (Foley 1990). The degree to which such colonization may occur will correspond to the amount of time the balloon remains at or near the ocean's surface. Additionally, an area's geographic latitude (and corresponding climatic conditions) has a marked effect on the degree of biofouling on marine debris. Fouling of the latex shreds could be confused with organic matter while ESA-listed species are foraging. Green sea turtles are herbivorous and a large study of green sea turtles that stranded in Texas between 1987 and 2019, discovered 48% had ingested plastic, although there was no evidence of mortality related to the ingestion of the plastics (Choi et al. 2021). A study of latex balloon fragment ingestion by freshwater turtles and catfish found no significant impact on survival or blood measured indicators of stress response (Irwin 2012).

In addition to further degradation of the latex material, the embedded fouling organisms would cause the material to become negatively buoyant, making it slowly sink to the ocean floor. Studies in temperate waters have shown that fouling can result in positively buoyant materials (e.g., plastics) becoming neutrally buoyant, sinking below the surface into the water column after only several weeks of exposure (Ye and Andrady 1991; Lobelle and Cunliffe 2011), or descending farther to rest on the seafloor (Thompson et al. 2004).

Given the small balloon shreds are likely to be scattered and not concentrated, and they should only be available in the upper portions of the water column on the order of weeks, the potential for exposure of ESA-listed marine species to these shreds is extremely low and therefore discountable.

As stated previously, operators expect to recover parachutes/parafoils soon after splashdown and in the rare occasion they are not recovered (a few each year, see Appendix A), the parachutes/parafoils will sink to the seafloor within a matter of hours. As discussed previously, the degradation of parachute and parafoil materials will be a slow process that takes place after the materials have settled on the sea floor. It is possible that small fragments could temporarily resuspend in the water column, but the potential for this depends on local ocean floor conditions and the fragments are not expected to resuspend high in the water column where they would likely be encountered by ESA-listed species. As previously discussed recovery operations typically take place far offshore (e.g. 300-500 NM) and any drogue parachutes or parafoils not recovered are expected to settle (> 3,000 m [9,800 ft]). None of the ESA-listed species considered in this programmatic forage that deep, therefore, the likelihood of them encountering ingestible material once it has settled over the long-term is expected to be extremely unlikely to occur and thus discountable.

We conclude that the risk of ingesting pieces of weather balloons, parachutes or parafoils to ESA-listed marine mammals, sea turtles, and fish in the action area because of activities covered under this programmatic may affect, but are not likely to adversely affect these animals.

Exposure to Hazardous Materials

Hypergolic fuels (e.g., NTO and MMH) may be on the spacecraft during a splashdown. A spacecraft's propellant storage is designed to retain residual propellant, so any propellant remaining in the spacecraft is not expected to be released into the ocean. In an event the propellant tank actually ruptures on impact, the propellant would evaporate or be quickly diluted.

In the event of a failed launch operation, launch operators will follow the emergency response and cleanup procedures outlined in their Hazardous Material Emergency Response Plan (or similar plan). Procedures may include containing the spill using disposable containment materials and cleaning the area with absorbents or other materials to reduce the magnitude and duration of any impacts. In most launch failure scenarios, at least a portion of the propellant will be consumed by the launch/failure, and any remaining propellant will evaporate within hours or be diluted by seawater and degrade over time (timeframes are variable based on environmental conditions, but generally hours to days).

Launch vehicles and spacecraft are designed to retain propellants and even if there is a rare launch failure (> 93% success rate over 30 years), propellants will evaporate and be diluted within hours. The chance for ESA-listed marine species to be exposed to the residual propellants from a splashdown or launch failure is extremely low and therefore discountable. Therefore, we conclude that hazardous material exposure to ESA-listed marine mammals, sea turtles, and fish in the action area because of activities covered under this programmatic may affect, but are not likely to adversely affect these animals.

Exposure to Sonic Booms and Impulse Noise

A sonic boom will be generated during spacecraft reentry and stage landings in the ocean. Due to the shape and size of existing spacecraft and spacecraft in development, as well as the altitude at which reentering spacecraft generate a sonic boom, the FAA, USSF, and NASA do not expect the overpressure from reentering spacecraft to exceed 1 psf. An overpressure of 1 psf is similar to a thunderclap. For boosters that can currently land on a barge in the ocean (e.g., SpaceX Falcon series), overpressures at the ocean's surface could be up to 8 psf. For the Super Heavy, which is currently in developmental stages and expected to be operational soon, overpressures at the ocean's surface could be up to 15 psf from ocean barge landings. Boom intensity, in terms of psf, is greatest under the flight path and progressively weakens with horizontal distance away from the flight track. Based on modeling for landings at the Boca Chica Launch Site, the area beneath the stage receiving the maximum overpressure (up to 15 psf) as it is landing could be up to 1.28 km in diameter.

Overpressure from sonic booms are not expected to affect marine species underwater. Acoustic energy in the air does not effectively cross the air/water interface and most of the noise is reflected off the water surface (Richardson et al. 1995). The landing platform barge will also act as a barrier to the most intense portion of overpressure from landings. In addition, underwater sound pressure levels from in-air noise are not expected to reach or exceed threshold levels for injury or harassment to ESA-listed species.

Previous research conducted by the USAF supports this conclusion with respect to sonic booms, indicating the lack of harassment risk for protected marine species in water (U.S. Air Force Research Laboratory 2000). The researchers were using a threshold for harassment of marine mammals and sea turtles by impulsive noise of 12 pound per square inch (psi) peak pressure and/or 182 decibels (dB) referenced (re) to the standard unit of acoustic pressure underwater, 1 micro Pascal (µPa), which is an older threshold used by NMFS and DoD at the time. The researchers pointed out that, to produce the 12 psi in the water, there needs to be nearly 900 psf at the water surface, assuming excellent coupling conditions. They also noted that it is very difficult to create sonic booms that even approach 50 psf. Current thresholds utilized by NMFS for behavioral disturbance from impulsive acoustic sources are lower (in water, re 1 µPa: 175 dB sea turtles, 160 dB marine mammals, 150 dB fishes) but these are root mean square (rms) values and not peak pressure values.. The rms is a square root of the average of sound signal pressures that have been squared over a given duration. Due to the squaring and averaging of sound pressure values (which tends to level out large values), the rms, results in a more conservative value than just a peak value. Still, what the USAF research report illustrates is that it would take a tremendously greater sonic boom than what is generated by the booster stage landings to create an acoustic impact underwater that could approach disturbing ESA-listed marine mammals, sea turtles or fish. Therefore, any effect from the sonic booms on ESA-listed species while under water would be insignificant.

ESA-listed marine mammals and sea turtles could be exposed to the overpressures from sonic booms in the air when they are surfacing for air; however, the chances of both events happening at same time (i.e., species surfacing and a sonic boom occurring) is extremely unlikely, especially considering the length of a sonic boom is less than one second. The Guadalupe fur seal, Hawaiian monk seal, and Steller sea lion can spend time hauled out of the water and therefore may be affected by an in-air sonic boom. The potential for effect would only be present during spacecraft reentry missions occurring in the Pacific Ocean and rocket booster landing are not planned near areas where these species haul out. Spacecraft reentry in the Pacific Ocean would generate sonic booms at high altitudes (approximately 50,000 ft). The magnitude of the high altitude sonic boom overpressure that has the potential to impact land areas where Guadalupe fur seals, Hawaiian monk seals, and Steller sea lions may be present is low (1 psf or lower). Therefore, the effect of these sonic booms is unlikely to create any meaningful disturbance for these ESA-listed pinnipeds when they are out of the water.

The 2019 MMPA Letter of Authority for VSFB launch operations arrived at a similar conclusion (84 FR 14314). Over 20 years of monitoring data for species including harbor seals (*Phoca vitulina*), elephant seals (*Mirounga angustirostris*), and California sea lions (*Zalophus californianus*) at VSFB and the North Channel Islands (CA), show reactions to sonic booms tend to be insignificant when not above 1.0 psf. Observational data do not include the ESA-listed pinnipeds considered in this programmatic, but the long time series data for other species serve as a proxy indicating this category of sonic booms for marine mammals that haul out of water do not result in disturbance at low overpressures.

In summary, it is extremely unlikely that an ESA-listed sea turtle or marine mammal would surface close to a landing booster at the exact moment to be exposed to a sonic boom (greater than 1 psf) in the air, therefore the effects are discountable. Any ESA-listed sea turtles, marine mammals or fishes underwater are not expected to be exposed to measurable acoustic effects from a sonic boom therefore, the effects are insignificant. The low level sonic boom (not above 1 psf) resulting from spacecraft reentry at high altitude in the Pacific, is not expected to create any significant disturbance to hauled out ESA-listed pinnipeds and the effects are therefore insignificant.

Ship Strike

Ships and other watercraft vessels are used to recover launch vehicle stages that land on a platform in the ocean, as well as to recover spacecraft and payload fairings. Vessels may also be used for surveillance to ensure that designated hazard areas are clear of non-participating crafts. These watercraft operations have potential to result in a ship strike of ESA-listed species that spend time at or near the surface of the water (e.g., marine mammals, sea turtles, giant manta ray, oceanic whitetip shark, and scalloped hammerhead). ESA-listed marine mammals and sea turtles can spend time at the surface, but most of their time is spent submerged. Giant manta ray, oceanic whitetip and scalloped hammerhead sharks can also spend time at or near the ocean surface and be subject to potential ship strikes, but they also dive to great depths. All vessels would be required to comply with the *Environmental Protection Measures* for vessel operations. All watercraft would have a dedicated observer on board, adhere to maintaining minimum safety distances between ESA-listed species and vessels, and reduce speed as required.

During the portion of time that ESA-listed marine mammals, sea turtles, and some elasmobranch fish species may spend near the ocean surface, ship strikes are considered extremely unlikely to occur and therefore discountable, due to the use of dedicated observation personnel and safety procedures for avoidance. Based on previous operation reports provided as part of ESA section 7 consultations for similar operations, there have not been reported vessel collisions with ESA-listed marine species.

Rice's whale requires additional consideration due to its very low population size (likely < 50) and its ecology. The Rice's whale dives deep during the day to forage but at night tends to stay just below the surface, increasing the chance of the animal being struck at night. The *Vessel Operations* measures in the PDCs for this programmatic consultation include the condition that recovery and vessel transit will not occur at night in the Rice's whale core distribution area. The PDCs for this programmatic consultation stipulate only one splashdown, a reentry and recovery of the Dragon capsule, may occur in Rice's whale core habitat distribution area per year. These restrictions will ensure the effects of vessel strike due to recovery vessel operations are discountable.

We conclude that the risk of ship strike to ESA-listed marine mammals, sea turtles, and fish in the action area because of activities covered under this programmatic may affect, but are not likely to adversely affect these animals.

Aircraft Overflight

Noise from aircraft overflight may enter the water, but, as stated in relation to sonic booms, 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. Individual ESA-listed species that occur at or very near the surface (e.g., marine mammals, sea turtles, giant manta ray and sharks) at the time of an overflight could be exposed to some level of elevated sound. There could also be a visual stimulus from overflight that could potentially lead to a change in behavior. Both noise and visual stimulus impacts would be temporary and only occur if an individual is surfacing or very close to the surface and an aircraft happens to be flying over at the same time.

Studies in the Gulf of Mexico found that most sperm whales dive when overflown by fixed wing aircraft (Wursig et al. 1998). Richter et al. (2006) documented only minor behavioral effects (i.e., both longer surface time and time to first vocalization) of whale-watching aircraft on New Zealand sperm whales. However, details on flight altitude were not provided. Smultea et al. (2008) studied sperm whales in Hawaiʻi, documenting that diving responses to fixed winged overflights occurred at approximately 820 ft above ground level (AGL).

Patenaude et al. (2002) observed bowhead whales, which are not a species considered in this consultation but serve as an example for mysticetes, during spring migration in Alaska and recorded short-term responses to fixed-wing aircraft activity. Few (approximately 2%) of the observed bowheads reacted to overflights (between 200 and 1,500 AGL), with the most common behavioral responses being abrupt dives, short surfacing episodes, breaching, and tail slaps (Patenaude et al. 2002). Most of these responses occurred when the aircraft was below altitudes of 600 ft (Patenaude et al. 2002), which is below the altitude expected to be flown by fixed wing aircraft during project-related surveillance for the activities considered in this consultation.

Species-specific studies on the reaction of sea turtles to fixed wing aircraft overflight are lacking. Based on sea turtle sensory biology (Bartol and Musick 2003), sound from low-flying aircraft could likely be heard by a sea turtle at or near the ocean surface. Sea turtles might be able to detect low-flying aircraft via visual cues such as the aircraft's shadow, similar to the findings of Hazel et al. (2007) regarding watercraft, potentially eliciting a brief reaction such as a dive or lateral movement. However, considering that sea turtles spend a significant portion of their time below the sea surface (Lutcavage and Lutz 1997) and the low frequency and short duration of surveillance flights, the probability of exposing an individual to an acoustically or visually-induced stressor from aircraft momentarily flying overhead would be very low. The same is relevant for giant manta rays and the ESA-listed shark species in the action area, considering their limited time near the surface and brief aircraft overflight.

As stated in the *Environmental Protection Measures*, spotter aircraft will maintain a minimum of 1,000 ft over ESA-listed or MMPA-protected species and 1,500 ft over North Atlantic right whales. Additionally, aircraft will avoid flying in circles if marine mammals or sea turtles are spotted to avoid any type of harassing behavior. The chances of an individual ESA-listed species being exposed to the proposed aircraft overflights are extremely low. Given the limited and temporary behavioral responses documented in available research, it is expected that potential effects on ESA-listed species, should they even occur, would be insignificant. We conclude that effects from aircraft overflight to ESA-listed marine mammals, sea turtles, and fish in the action area because of activities covered under this programmatic may affect, but are not likely to adversely affect these animals.

Critical Habitat

A common element across several of the designated critical habitats in the action area that may be affected by the proposed action is water quality: green sturgeon, Gulf sturgeon, Southern Resident DPS killer whale, and Main Hawaiian Islands Insular DPS false killer whale critical habitat include PBFs for water quality. Water quality may be temporarily degraded as a result of a launch failure. Potential effects to water quality could result from debris and propellants. Recovery activities and any emergency response and cleanup procedures would reduce the magnitude and duration of any impacts. As previously discussed, propellants are expected to evaporate and quickly become diluted, limiting any impacts to a temporary duration. Given the unlikely scenario of a launch failure and the brief exposure of residual propellants from splashdowns, it is highly unlikely that water quality features would become degraded to the extent the conservation value of the critical habitats are impacted.

Most of the proposed operations would occur well offshore in deep waters. Landing and recovery operations would not occur within 5 NM of the coast where most of the critical habitat for green sturgeon is located. The same is true for Gulf sturgeon, except for Cedar Key, Florida, but it is far away from flight trajectories from the Boca Chica Launch Site. It is very unlikely that any launch or reentry operations would occur within that portion of Gulf sturgeon critical habitat. Unit 2 of the North Atlantic right whale critical habitat occurs off the coast of CCSFS and extends seaward approximately 5 NM off the coast. Keeping operations out of the first 5 NM from shore helps avoid this critical calving area. Operations are not expected to have any impact on the oceanic features near the Unit 2 calving area such as sea temperature, sea state or depth. PBFs for Hawaiian monk seal conservation include significant haul-outs and preferred pupping/nursing areas. Operations will not occur in or near those areas. Critical habitat for Steller sea lions includes major rookeries, haul-outs, and associated zones extending 3,000 ft (0.9 km) landward, in the air above, or into the water from those major rookeries and haul-outs, that support reproduction, foraging, resting, and refuge. Operations will not occur in those zones. West of 144° W, where the Western DPS Steller sea lion is located, the critical habitat aquatic zone extends 20 NM (37 km) seaward from the baseline or basepoint of each major rookery and major haul-out. If operations cannot comply with the PDC that landings will not occur in those 20 NM aquatic zones, they will require a project-specific review.

Migratory passage and adequate space for movement are features common to Southern Resident DPS killer whale, Main Hawaiian Islands Insular DPS false killer whale, and Northwest Atlantic Ocean DPS loggerhead sea turtle critical habitats. As stated previously, no operations will occur in the immediate nearshore environment (< 5 NM), resulting in a considerable amount of those critical habitats not being affected by the proposed action. Landing and reentry operations will typically be much farther out but, even if they were to occur close to the 5 NM limit, they are temporary with no long-term occupation or structures creating obstructions to movement, thus any potential effects are likely to be insignificant.

Prey and foraging areas are other common elements across several of the designated critical habitats in this consultation: leatherback, Southern Resident DPS killer whale, Main Hawaiian Islands Insular DPS false killer whale, North Pacific right whale; Western North Pacific, Central America, and Mexico DPSs of humpback whales; and Hawaiian monk seal and Steller sea lion foraging areas. As previously stated, sound from sonic booms is not expected to enter the water with enough intensity to create any significant disturbances to ESA-listed species and the effects of this sound is also expected to be insignificant for zooplankton or small pelagic schooling fishes that are the important prey species for these critical habitats. Pieces of weather balloons or parachutes/parafoils are not expected to be available to prey species in sufficient concentrations to measurably affect prey populations. Considering the rare occurrence of not recovering parachutes/parafoils, as the parachutes/parafoils begin to become saturated with seawater and begin to sink, prey fish species should be able to detect the object and move out of the way (as previously discussed for fishes) and the chance of entanglement is extremely unlikely to occur and thus discountable. Prey zooplankton species may have less of an ability to move out of the way and therefore some could get entrapped in the parachute/parafoil. The removal of a small amount of zooplankton is not expected to reduce the conservation value of that PBF in any designated critical habitats and therefore the effect will be insignificant.

A unique PBF for Main Hawaiian Islands Insular DPS false killer whale critical habitat is sound levels that would not significantly impair false killer whales' use or occupancy. As previously stated, sound of any intensity that would create meaningful disturbance underwater is not an expected effect from proposed operations.

Oceanographic conditions supporting *Sargassum* habitat having adequate abundance and cover for post hatchlings and prey is a PBF for Northwest Atlantic Ocean DPS loggerhead sea turtle critical habitat. The scale of operations are not large enough to affect boundary currents or areas of convergence that promote the aggregation of *Sargassum*. Any potential impacts to these features are expected to be very small and temporary, and therefore insignificant.

In summary, the effects associated with stressors from launch and reentry operations that are part of the proposed action may affect, but are not expected to adversely affect any of the designated critical habitats in the action area.

Additive Effects

We have concluded the proposed launch and reentry vehicle operations in the marine environment, when in compliance with the requirements of this programmatic, are not likely to adversely affect ESA-listed marine mammals, sea turtles, and fishes or designated critical habitat for green sturgeon, Gulf sturgeon, leatherback sea turtle, Northwest Atlantic Ocean DPS loggerhead sea turtle, North Atlantic right whale, North Pacific right whale; Western North Pacific DPS, Central America DPS, and Mexico DPS of humpback whales; Southern Resident DPS killer whale, Main Hawaiian Islands Insular DPS false killer whale, Hawaiian monk seal, and the Western DPS Steller sea lion. Programmatic consultations often involve actions that may occur with some frequency over many years and possibly continue for an indefinite time. As a result, we evaluate the potential for the effects of the stressors to ESA-listed species and designated critical habitat over the lifetime of the proposed action to result in additive effects due to chronic stress or cumulative effects. Therefore, we determine if, when considered additively, the effects of stressors associated with the launch and reentry vehicle operations in the marine environment that are part of the proposed action are likely to adversely affect the aforementioned ESA-listed species and designated critical habitat.

The USSF (and previously USAF), NASA, and commercial space operations with authorization from the FAA have been conducting launch and reentry vehicle operations for decades with little documented impact to the marine environment as a whole, including a lack of reported incidences affecting ESA-listed species and designated critical habitats in the action area. The activities considered in this programmatic consultation will occur across large expanses of open water in the Atlantic and Pacific Oceans, and the Gulf of Mexico. Each of the stressor categories (see *Effects of the Action*) were determined to have effects that are extremely unlikely to occur and therefore discountable, or to result in effects that are so small as to be insignificant. The possibility of the discountable effects overlapping in time and space and having a cumulative effect to ESA-listed species and designated critical habitat in the action area does not seem plausible considering the limited time operations occur in a small portion of the vast action areas. Within the same reasoning, chronic stress from activities whose effects are considered insignificant also does not seem plausible. Therefore, additive effects from the activities considered in this consultation are extremely unlikely and thus discountable.

CONCLUSION

Based on this analysis, NMFS ESA Interagency Cooperation Division concurs with the FAA, NASA and the USSF, that the proposed action may affect, but is not likely to adversely affect ESA-listed species and designated critical habitat.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on ESA-listed species or critical habitat, to help implement recovery plans or develop information (50 C.F.R. §402.02).

As previously stated, the Rice's whale population is likely less than 50 individuals and therefore at high risk from threats that could reduce their numbers. Vessel strike is one of those threats. As discussed in the *Effects Analysis*, spacecraft recovery vessel activities are not likely to adversely affect ESA-listed marine mammals such as the Rice's whale. Even though one Dragon capsule splashdown and recovery per year in the Rice's whale core distribution area is not considered a significant threat, we are using this opportunity within this programmatic consultation to emphasize the conservation priority of avoiding the area, especially depths greater than 100 m deep. We also want to take this opportunity to address debris that originates from space launch and reentry operations, even though it is mostly expected to sink and settle in deep water, any reduction of debris in the marine environment could benefit all marine wildlife, including ESA-listed species.

The following conservation recommendations are discretionary measures that NMFS believes are consistent with the Federal action agencies' obligation under section 7(a)(1) and therefore should be carried out where applicable:

- Every effort should be made to move spacecraft capsule splashdowns closer to shallow edges of the Rice's whale core distribution area boundaries. Moving out of the area altogether is preferred.
- No vessel transit should take place in the Rice's whale core distribution area unless to specifically to pick up the capsule and then immediately exit at the nearest boundary edge while staying out of the core habitat area with depths of 100 m to 425 m, where the Rice's whale has been observed (Rosel et al. 2021).
- The action agencies should coordinate with NMFS ESA Interagency Cooperation Division to foster collaboration with the NOAA Marine Debris Program (MDP), in order to evaluate how activities of the MDP may apply to debris that originates from space launch and reentry operations (e.g., expended vehicle components).

In order for NMFS to be kept informed of actions minimizing or avoiding adverse effects on, or benefiting, ESA-listed species or their critical habitat, the FAA, NASA, and/or USSF (as applicable) should notify the ESA Interagency Cooperation Division and SERO of any conservation recommendations implemented as part of activities included in this programmatic consultation. This information can be included in annual reports.

REINITIATION OF CONSULTATION

Reinitiation of consultation is required and shall be requested by the federal agency, where discretionary federal involvement or control over the action has been retained or is authorized by law and:

1. New information reveals effects of the action that may affect an ESA-listed species or designated critical habitat in a manner or to an extent not previously considered;
2. The identified action is subsequently modified in a manner that causes an effect to the ESA-listed species or designated critical habitat that was not considered in this concurrence letter;
3. Take of an ESA-listed species occurs; or
4. A new species is listed or critical habitat designated that may be affected by the identified action (50 C.F.R. §402.16).

Please direct questions regarding this letter to Dr. Soren Dahl, Consulting Biologist, at (301) 427-8495 or soren.dahl@noaa.gov, or me at (301) 427-8495, or by email at cathy.tortorici@noaa.gov.

Sincerely,

Cathryn E. Tortorici
Chief, ESA Interagency Cooperation Division
Office of Protected Resources

Cc: USSF, NASA

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Appendix A – Parachute Information Provided to NMFS by the FAA

A.1 Spacecraft Parachutes

Two sets of parachutes are typically used during spacecraft re-entry: drogue and main parachutes. The drogue parachutes are thin parachutes deployed during reentry to gain control of the spacecraft at speeds that would destroy larger parachutes and therefore are deployed before the larger and thicker main parachutes (see Figure A-1). Spacecraft can be rigged with two drogue parachutes. Each drogue parachute has a diameter of approximately 19 feet with 72 feet of risers/suspension and are made of variable porosity conical ribbon. The drogues typically land within 0.5–1 mile from the spacecraft.

Shortly after the drogue parachutes are deployed, they are released, and the main parachutes are deployed (see Figure A-1). The main parachutes slow the spacecraft to a speed of approximately 13 miles per hour allowing for a "soft" splashdown in the water. The main parachutes are made of Kevlar and nylon and have a diameter of approximately 116 feet with 147 feet of risers/suspension. Spacecraft may be rigged with up four main parachutes.

Figure A-1. Main Parachutes with Released Drogue Parachutes in the Background (SpaceX Dragon)

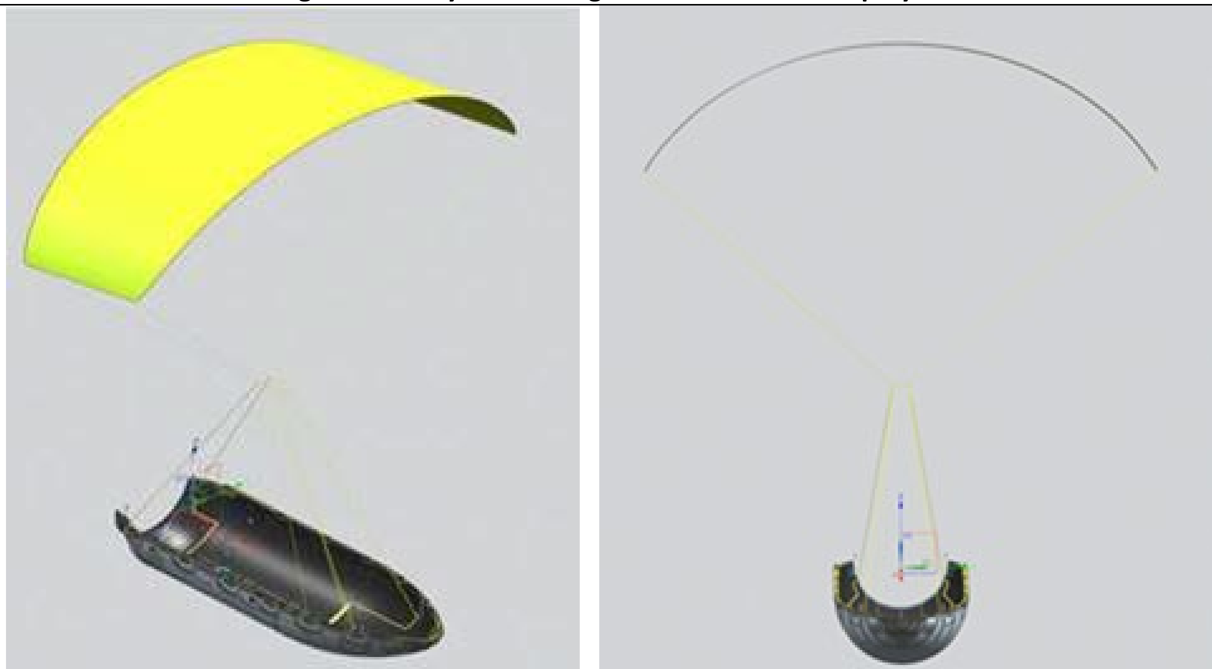
SpaceX's Dragon parachutes (drogue and main) are the only spacecraft parachutes that have been deployed to date for spacecraft re-entries. The parachutes remain floating on the surface enabling the recovery operations. However, due to sea and weather conditions, there have been two instances where SpaceX did not recover Dragon's main parachutes. Similarly, there have been four instances where SpaceX did not recover Dragon’s drogue parachutes. Refer to the FAA’s 2018–2020 annual reports sent to NMFS regarding SpaceX launch recovery efforts.

A.2 Payload Fairing Parachutes

SpaceX has designed a parachute system to enable recovering of payload fairings. Other launch operators may do the same in the future. SpaceX’s parachute system consists of one drogue parachute and one parafoil (see Figures A-2 and A-3).

Figure A-2. Fairing Parafoil

Figure A-3. Payload Fairing Half with Parafoil Deployed



The parachute system slows the decent of the fairing to enable a soft splashdown such that the fairing remains intact. Following re-entry of the fairing into Earth's atmosphere, the drogue parachute is deployed at a high altitude (approximately 50,000 feet) to begin the initial slow down and to extract the parafoil. The drogue parachute is then cut away following the successful deployment of the parafoil. Refer to the FAA's 2018–2020 annual reports sent to NMFS regarding SpaceX launch recovery efforts.

Two parachute systems for the fairing may be used (Type 1 and Type 2). The specifications of each system are noted below (Tables A-1 and A-2). The Type 2 system has a similar drogue parachute as the Type 1 system but a larger and lighter parafoil than Type 1. Type 1 drogue parachute risers are made of Kevlar with nylon overwrap. Type 1 parafoil risers, for which there are four, are made of nylon with Kevlar overwrap. Type 2 drogue parachute risers are made of Kevlar. Type 2 parafoil risers, for which there are four, are made of nylon.

Table A-1. Specifications of Type 1 and Type 2 Fairing Drogue Parachutes

Drogue Type	Canopy Material	Area (ft^2)	Suspension Line Material	Deployment Bag (ft^2)[a]
Type 1	Nylon	63.59	Kevlar	28[b]
Type 2	Nylon	113	Kevlar	28[c]

[a] The deployment bag is part of the drogue parachute assembly; the two components are connected.

[b] Spectra cloth with Kevlar webbing.

[c] Nylon cloth.

ft^2 = square feet

Table A-2. Specifications of Type 1 and Type 2 Fairing Parafoils

Parafoil Type	Canopy Material	Area (ft^2)	Suspension Line Length (ft)
Type 1	Nylon	1,782	42.6
Type 2	Nylon	3,000	50

ft = feet; ft^2 = square feet

The projected sink rates for both types of drogue parachutes and parafoils are shown below (Tables A-3 to A-6 and Figures A-4 to A-7). As indicated in the figures, both types of drogue parachutes are expected to sink at a rate of approximately 1,000 feet in 46 minutes (or approximately 22 feet per minute). The Type 1 parafoil is expected to sink at a rate of approximately 1,000 feet in 63 minutes (or approximately 16 feet per minute). The Type 2 parafoil is expected to sink at a rate of approximately 1,000 feet in 145.5 minutes (or approximately 7 feet per minute). These estimated sink rates were calculated using a NASA method/spreadsheet for estimating sink rates of parachutes and balloons. The spreadsheet provides steady-state sink rates in water for parameters inputted by the user. There are conservative assumptions built in the spreadsheet, such as assuming the parachute remains open during the entire in-water descent, slowing the descent velocity, when, in actuality, the parachute could either collapse or become entangled in the other flight train components. The calculations present the most conservative (slowest) sink rates.

Table A-3. Projected Sink Rate for Type 1 Drogue Parachute

Properties	
Sum of masses:	18.2 pounds
Sum of buoyancy forces:	8.73 pounds
Sum of drag areas:	73 square feet
Sink Rate	
Terminal velocity of system in water:	0.36 feet/second
Sink time per 1,000 ft of depth:	46.2 minutes
Sink time per 100 m of depth:	15.17 minutes

Figure A-4. Sink Rate Chart for Type 1 Drogue Parachute

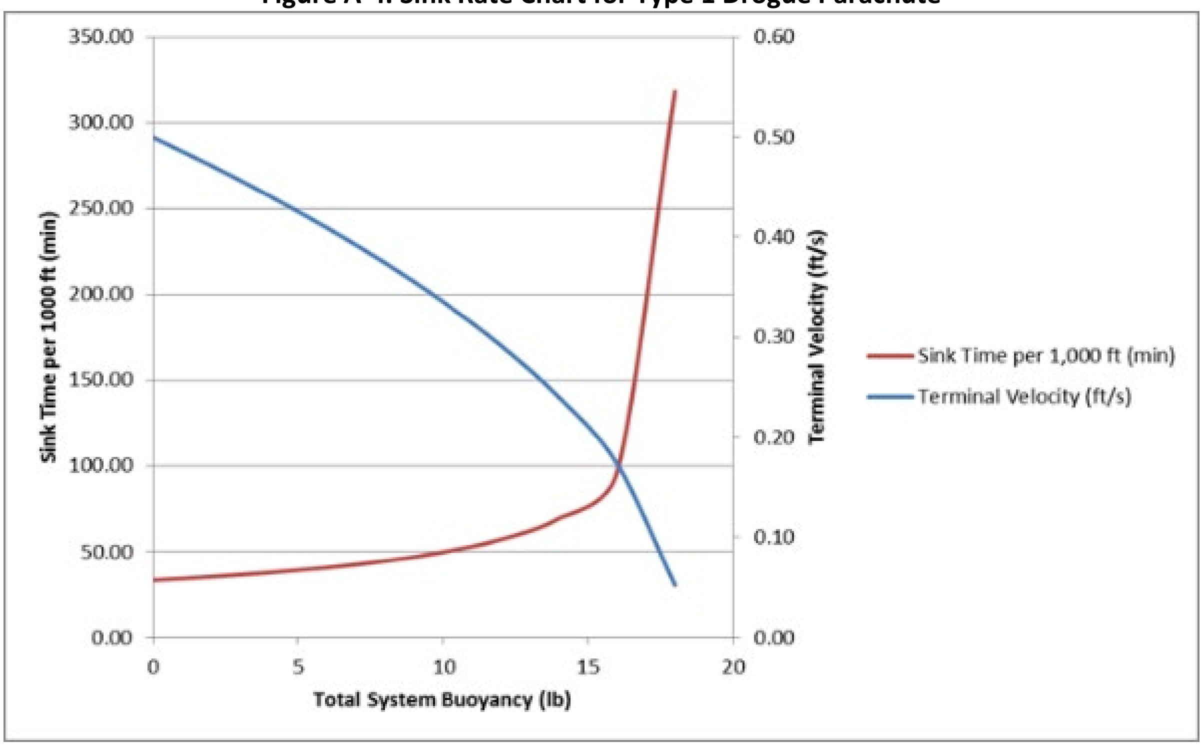


Table A-4. Projected Sink Rate for Type 1 Parafoil

Properties	
Sum of masses:	181 pounds
Sum of buoyancy forces:	84 pounds
Sum of drag areas:	1,426 square feet
Sink Rate	
Terminal velocity of system in water:	0.26 feet/second
Sink time per 1,000 ft of depth:	63.7 minutes
Sink time per 100 m of depth:	20.91 minutes

Figure A-5. Sink Rate Chart for Type 1 Parafoil

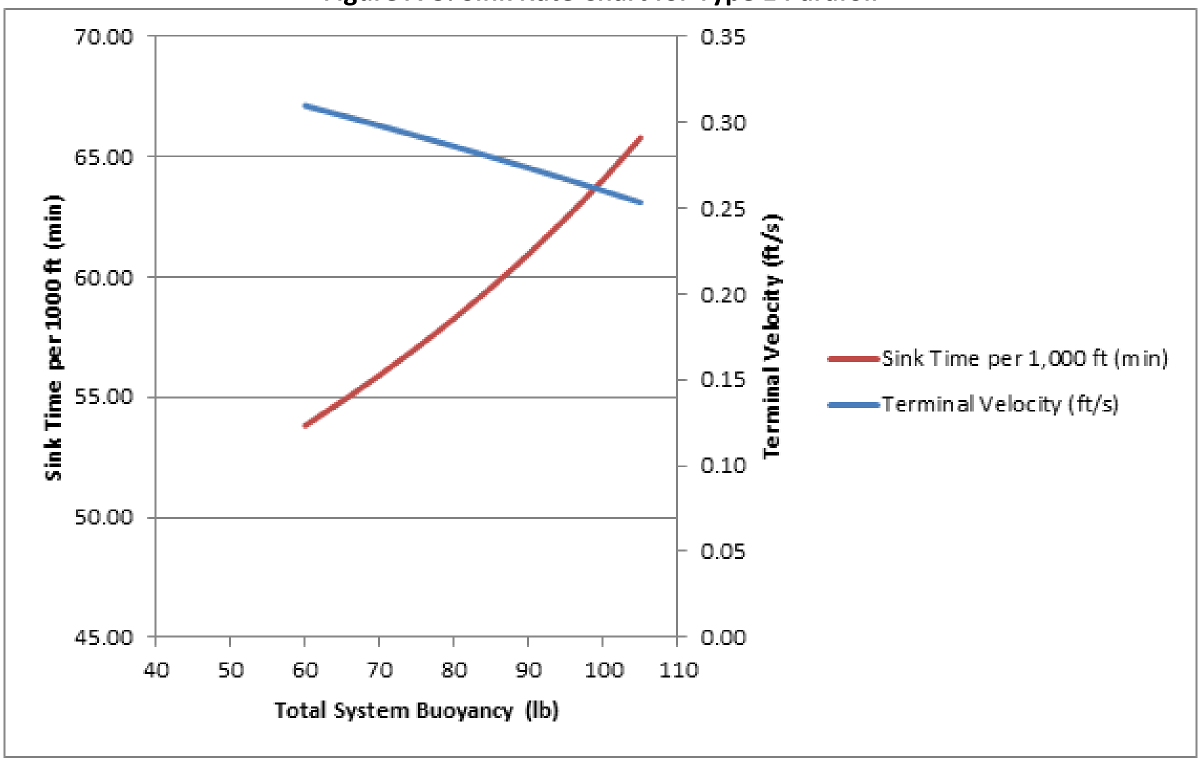


Table A-5. Projected Sink Rate for Type 2 Drogue Parachute

Properties	
Sum of masses:	18.2 pounds
Sum of buoyancy forces:	6.36 pounds
Sum of drag areas:	90 square feet
Sink Rate	
Terminal velocity of system in water:	0.36 feet/second
Sink time per 1,000 ft of depth:	45.9 minutes
Sink time per 100 m of depth:	15.07 minutes

Figure A-6. Sink Rate Chart for Type 2 Drogue Parachute

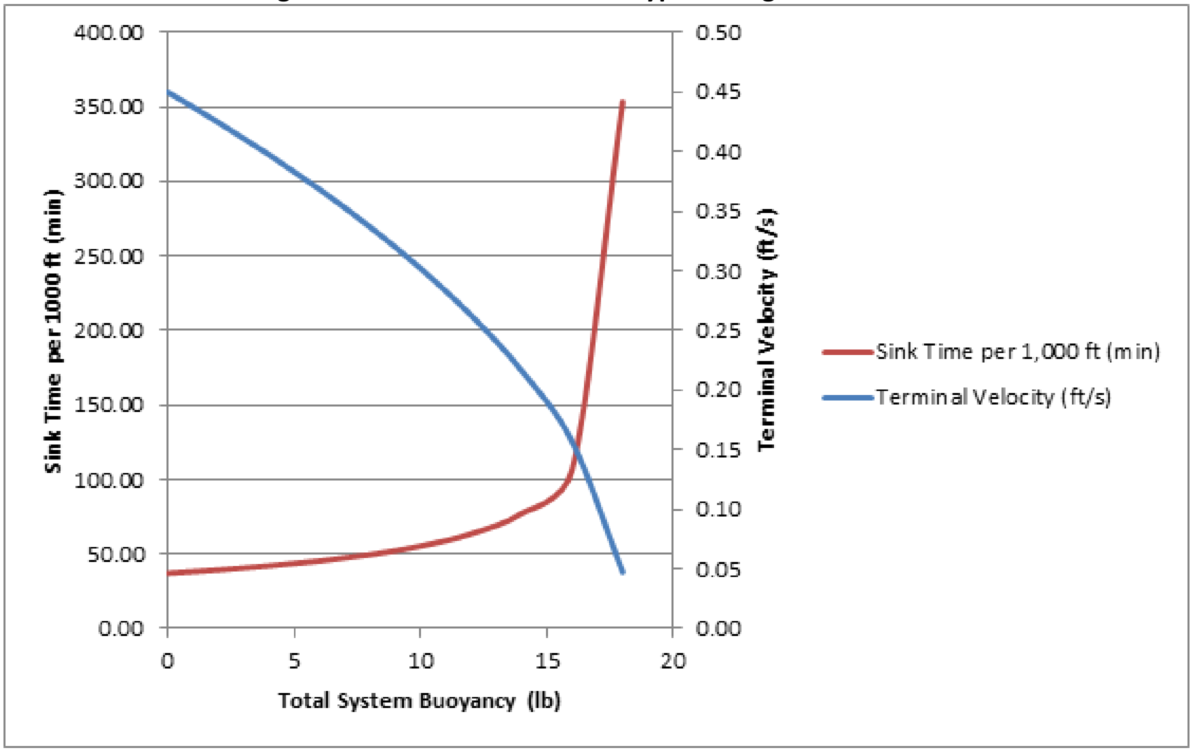


Table A-6. Projected Sink Rate for Type 2 Parafoil

Properties	
Sum of masses:	70 pounds
Sum of buoyancy forces:	39.01 pounds
Sum of drag areas:	2,376 square feet
Sink Rate	
Terminal velocity of system in water:	0.11 feet/second
Sink time per 1,000 ft of depth:	145.5 minutes
Sink time per 100 m of depth:	47.75 minutes

Figure A-7. Sink Rate Chart for Type 2 Parafoil