Federal Aviation Administration

Tiered Environmental Assessment for Updates to Airspace Closures for the Flight 9 Mission Profile of the SpaceX Starship-Super Heavy Vehicle at the SpaceX Boca Chica Launch Site in Cameron County, Texas

May 2025

Tiered Environmental Assessment for Updates to Airspace Closures for the Flight 9 Mission Profile of the SpaceX Starship-Super Heavy Vehicle at the SpaceX Boca Chica Launch Site in Cameron County, Texas

AGENCIES: Federal Aviation Administration (FAA), lead Federal agency.

This final Tiered Environmental Assessment (EA) was prepared in accordance with FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures* (July 16, 2015), to meet the agency's obligations under Section 102(2)(C) of the National Environmental Policy Act of 1969 (NEPA), § § 4321-4336, as amended by the Fiscal Responsibility Act of 2023); Section 4(f) of the Department of Transportation Act of 1966 (49 U.S.C. § 303); Section 106 of the National Historic Preservation Act (16 U.S.C. § 470); and, Executive Order 11988, *Floodplain Management*; DOT Order 5650.2, *Floodplain Management and Protection.*

DEPARTMENT OF TRANSPORTATION, FEDERAL AVIATION ADMINISTRATION: FAA is evaluating the updates to the Aircraft Hazard Area and Notice to Airmen for SpaceX's operation of the Starship-Super Heavy launch program at the Starbase vertical launch area (VLA) in Cameron County, Texas. SpaceX must obtain a new vehicle operator license or modification of its existing license from FAA to operate Starship-Super Heavy for the Flight 9 mission profile. Issuing a license is considered a major Federal action of modifying SpaceX's vehicle operator license (see Section 2.2 for a more detailed description). The completion of the environmental review process does not guarantee that FAA will issue a license modification to SpaceX for the Proposed Action. SpaceX's license application must also meet FAA safety, risk, policy, payload requirements, and financial responsibility requirements per 14 CFR Chapter III. FAA's Federal Action also includes FAA's issuance of temporary airspace closures.

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

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Acronyms & Abbreviations

AHA	Aircraft Hazard Area
ANSP	Air Navigation Service Providers
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
DOD	Department of Defense
DOT	Department of Transportation
EA	Environmental Assessment
EO	Executive Order
FAA	Federal Aviation Administration
FONSI	Finding of No Significant Impact
GHG	Greenhouse Gas
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act of 1969, as amended
NOTAM	Notice to Airmen
PEA	Programmatic Environmental Assessment
ROD	Record of Decision
TCI	Turks & Caicos Islands
U.S.C.	United States Code
VLA	Vertical Launch Area
WR	Written Re-evaluation

1. INTRODUCTION AND BACKGROUND

Space Exploration Technologies Corporation (SpaceX) is seeking to obtain a modification of its existing vehicle operator license from FAA to account for updates to Starship-Super Heavy operations at the Boca Chica Launch Site in Cameron County, Texas. This Tiered EA analyzes these updates, which include new information related to airspace closures for the Flight 9 mission profile operations of the SpaceX Starship-Super Heavy from the Boca Chica Launch Site. The affected environment and environmental impacts of Starship-Super Heavy operations at the Boca Chica Launch Site were analyzed in the 2022 Final Programmatic Environmental Assessment for the SpaceX Starship-Super Heavy Launch Vehicle Program at the SpaceX Boca Chica Launch Site in Cameron County, Texas (2022 PEA; FAA 2022). FAA issued a Mitigated Finding of No Significant Impact (FONSI)/Record of Decision (ROD) based on the 2022 PEA on June 13, 2022.

1.1 Background

FAA prepared the 2022 PEA to analyze the potential environmental impacts of constructing launch-related infrastructure and operating the Starship-Super Heavy launch vehicle at the Boca Chica Launch Site. As documented in FAA's June 13, 2022 Finding of No Significant Impact (FONSI)/ Record of Decision (ROD) and detailed in the 2022 PEA, FAA found that SpaceX's proposed Starship-Super Heavy program, under which SpaceX planned to conduct up to 5 orbital Starship-Super Heavy launches and landings per year and up to 5 suborbital Starship launches per year from the Boca Chica launch site, and implement identified mitigation measures, would not significantly impact the environment.

Subsequent to that decision, FAA issued a written re-evaluation (WR) in April 2023 that evaluated additional information received from SpaceX concerning its Starship-Super Heavy ocean landings and launch pad detonation suppression system (FAA 2023a). In November 2023, FAA issued a WR that evaluated additional information received from SpaceX about the operation of the deluge system, the addition of a forward heat shield to the Starship-Super Heavy vehicle, and the expansion of the area of potential effects for cultural resources (November 2023 WR; FAA 2023b). In March 2024, FAA issued a FONSI based on an EA tiered from the 2022 PEA evaluating the potential environmental impacts of SpaceX's proposal to land the Starship in the Indian Ocean (March 2024 Tiered EA; FAA 2024a). In October 2024, FAA issued a WR that evaluated additional information received from SpaceX about updates to the Forward Heat Shield Interstage Landing Area, Sonic Boom Coverage, Use of the Deluge System During Return to Launch Site Landings, and use of US Coast Guard Safety Zones (October 2024 WR; FAA 2024b). In April 2025, FAA issued a Mitigated FONSI/ROD based on an EA tiered from the 2022 PEA evaluating the potential environmental impacts of SpaceX's proposal to increase the number of Starship-Super Heavy operations at the Boca Chica Launch Site to 25 per year (April 2025 Tiered EA; FAA 2025). This EA tiers from the 2022 Final PEA and the April 2025 Tiered EA.

Based on the safety analysis for Starship-Super Heavy Flight 9, an Aircraft Hazard Area and associated NOTAM would necessitate FAA to close airspace over a portion of the Bahamas and the Turks & Caicos Islands. This is an update to the existing operations involving the Starship-Super Heavy described in the April 2025 Tiered EA as detailed below.

1.2 Federal Agency Roles

1.2.1 Federal Aviation Administration

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

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

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

Regarding potential environmental impacts in the Bahamas and Turks & Caicos Islands, FAA coordinated with the U.S. State Department, Bahamas and the United Kingdom for the Turks & Caicos Islands in accordance with FAA Order 1050.1F, Paragraph 8-6, and Executive Order 12114, *Environmental Effects Abroad of Major Federal Actions*, 44 *Fed. Reg.*1957 (January 9, 1979).

1.3 Purpose and Need

As stated in the April 2025 Tiered EA, the purpose of SpaceX's proposed action is to provide greater mission capability to NASA and the Department of Defense (DOD). SpaceX's activities would continue to fulfill the U.S. expectation that increased capabilities and reduced space transportation costs will enhance exploration (including within the Artemis and Human Landing System programs), support U.S. national security, and make space access more affordable. The Space Transportation section of the National Space Transportation Policy of 1994 addressed the commercial launch sector, stating that "assuring reliable and affordable access to space through U.S. space transportation capabilities is a fundamental goal of the U.S. space program." Additionally, the 2021 Space Priorities Framework's Mission states, "The United States will bolster the health and vitality of our space sectors – civil, commercial, and national security – for the benefit of the American people and leverage that strength to lead the international community in preserving the benefits of space for future generations" (White House 2021).

SpaceX's proposed action is needed to facilitate frequent launch and landing operations to allow iterative development of Starship-Super Heavy vehicles to achieve rapid launch capability and increase operational efficiency, capabilities, and cost effectiveness of the Starship-Super Heavy program. Satisfaction of these needs benefit government and public interests and reduces operational costs. Public interests largely intersect with the government interests identified, including greater mission

capability for space exploration and advancing reliable and affordable access to space which in turn advances the scientific and national security benefits of the U.S. space program as a whole. Demand for launch services has continued to increase over the past 20 years, and the space industry's growth projections indicate this will continue into the foreseeable future. By providing a reusable launch vehicle that returns to its launch site, the proposed action would reduce the cost of launch and increase efficiency, delivering greater access to space and enabling cost-effective delivery of cargo and people to the Moon and Mars. SpaceX's proposed action would satisfy requirements for more efficient and effective space transportation methods and continue the U.S. goal of encouraging activities by the private sector to strengthen and expand U.S. space transportation infrastructure.

2. Description of Proposed Action and Alternatives

NEPA requires that FAA consider the purpose and need for the Proposed Action and from that, "study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources."[1] As discussed in Chapter 3, FAA has not identified any unresolved conflicts concerning alternative uses of available resources associated with SpaceX's proposal. Therefore, in accordance with NEPA and FAA Order 1050.1F, Paragraph 6-2.1(d), this Tiered EA considers the no action alternative and Proposed Action.

2.1 No Action Alternative

Under the No Action Alternative, FAA would not modify SpaceX's license for the Flight 9 mission profile with updates to the airspace closure areas. Without these updates, SpaceX would not be able to continue the iterative development of Starship-Super Heavy and strive towards its goal of providing greater mission capability for the government and commercial space sectors. This alternative provides the basis for comparing the environmental consequences of the Proposed Action.

2.2 Proposed Action

SpaceX is seeking to conduct operations in accordance with its Flight 9 mission profile, which would require FAA to issue a modification of its existing vehicle operator license for updated operations for the Flight 9 mission profile for Starship-Super Heavy operations at the Boca Chica Launch Site. The Federal action also includes FAA's issuance of temporary airspace closures.

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

- Pre-flight Operations (Section 2.1.3.2 of the 2022 PEA)
- Nominal Operational Access Restrictions (Section 2.1.3.5 of the 2022 PEA)
- Personnel Levels (Section 2.1.3.6 of the 2022 PEA)
- Anomalies (Section 2.1.3.7 of the 2022 PEA)
- Launch (Section 2.2 of the April 2025 Tiered EA)

[1] 42 U.S.C. § 4332(2)(E).

- Landings (Section 2.3 of the April 2025 Tiered EA)
- Waterway Closures (Section 2.5 of the April 2025 Tiered EA)

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

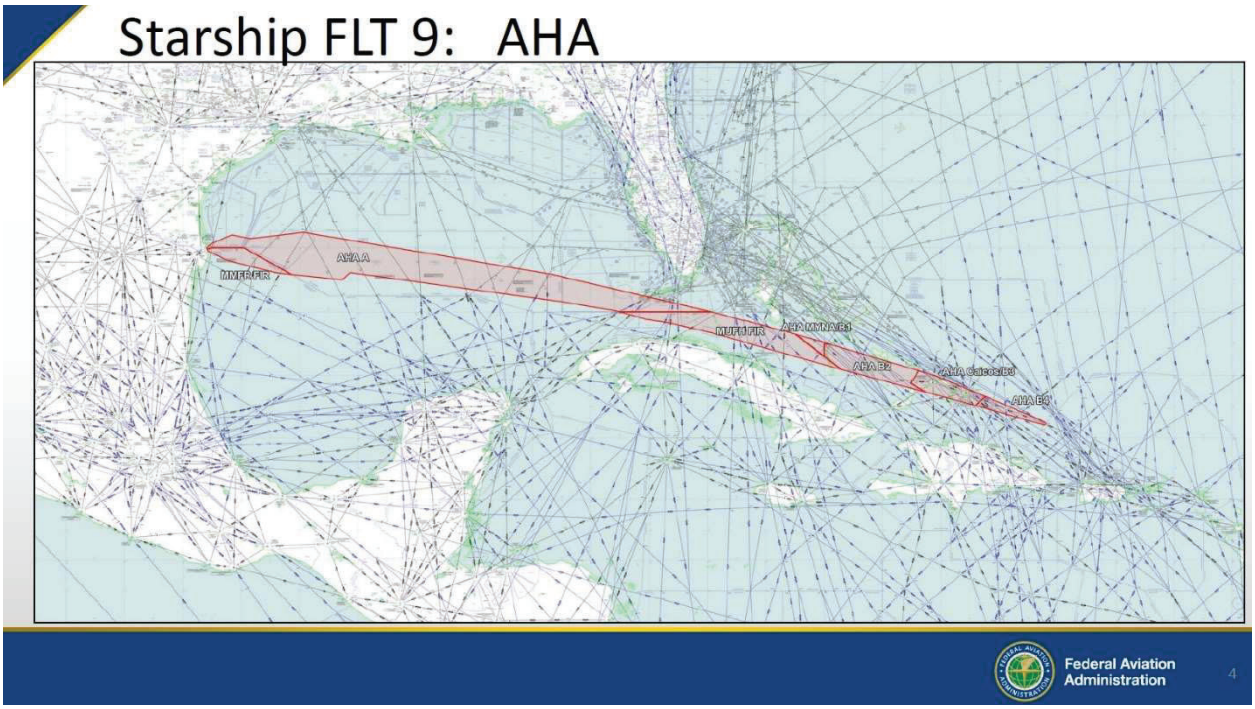
2.2.1 Airspace Closures

As described in the Section 2.1.3.5 of the 2022 Programmatic Environmental Assessment, all launch and reentry operations would comply with necessary notification requirements, including issuance of Notices to Airmen (NOTAM)s, as defined in agreements required for a launch license issued by FAA. A NOTAM provides notice of unanticipated or temporary future closures to components of, or hazards in, the National Airspace System (NAS). FAA issues a NOTAM at least 72 hours prior to a launch or reentry activity in the airspace to notify pilots and other interested parties of temporary conditions. NOTAMS are similarly used by Air Navigation Service Providers (ANSPs) to provide notice of temporary airspace closures in foreign airspace. Advance notice via NOTAMs and the identification of Aircraft Hazard Areas (AHAs)[2] assist pilots in scheduling around any temporary disruption of flight activities in the area of operation.

The location and size of airspace closures for commercial space operations also vary with each mission type and are influenced by multiple factors including prior flight history. The size of airspace closures can grow or shrink as reliability is either decreased or increased with results and analysis from each launch. The Starship vehicle mishaps from Flights 7 and 8 caused a greater probability of failure of the vehicle and, therefore, a larger AHA. SpaceX submitted a preliminary Flight Safety Data Package to FAA in advance of Flight 9. The package included the launch and reentry trajectories and associated AHAs that meet FAA's Part 450 safety criteria. These AHAs define the temporarily closed airspace that would be established and published through a NOTAM prior to the launch/reentry.

Starship-Super Heavy Flight 9 would impact air routes extending eastward from the Boca Chica launch site through the Straits of Florida, covering approximately 1,600 nautical miles. The designated AHA would necessitate the closure of more than 70 airways (established aircraft routes) across the Gulf of America and now, due to vehicle reliability, include the Lucayan Archipelago (Bahamas and Turks & Caicos Islands). Bahamas and Turks & Caicos are expected to close their respective airspace up to 6,000 feet and FAA will close the airspace above that. See the figure below for a depiction of the Flight 9 AHA and affected airways.

[2] Hazard areas are any region of land, sea, or air that must be surveyed, publicized, controlled, or evacuated in order to control the risk to the public. It includes regions of land, sea, and air potentially exposed to hazardous debris generated during normal flight events and all reasonably foreseeable failure modes.



According to the pre-mission NAS assessment, the AHA for Starship Flight 9 is projected to affect over 175 flights, with 99% of the identified aircraft involved in international connecting routes. To minimize disruption to NAS stakeholders, the launch window has been scheduled outside peak transit periods.

Integrating Starship-Super Heavy Flight 9 into the NAS would require ground stops commensurate with the timing of the AHA, miles in trail (distance between aircraft) for spacing and volume control as well as rerouting of aircraft around the AHA. Due to the length of the hazard area, certain flights may elect to delay the departure time due to the inability to accept a reroute due to the size the hazard area. According to the pre-mission NAS assessment, the average expected flight delay would be approximately 40 minutes[3], and could be up to two hours. General Aviation operations would be similarly impacted by the aircraft hazard area.

The aircraft hazard area would affect at least 70 airways within the flight regions of the Bahamas and Turks & Caicos Islands (TCI). Given that the hazard zone nearly encompasses TCI in its entirety, the international airport located within its boundaries (Providenciales International Airport) would be required to close for the duration of the activation of the launch window. According to the pre-mission NAS assessment, the aircraft hazard area for Starship Flight 9 would be expected to affect approximately two international flights to TCI airports.

[3] The delay could be incrementally greater based on any delay of the start of the launch within the two-hour launch window.

3. Affected Environment and Environmental Consequences

The Boca Chica Launch Site is located on SpaceX-owned land in Cameron County, Texas, near the cities of Brownsville and South Padre Island. The larger area around the Boca Chica Launch Site includes several private and public industries, including the SpaceX site known as Starbase, the Port of Brownsville, the City of Port Isabel, San Roman Wind Farm, liquid natural gas facilities, and developments on South Padre Island. Starbase includes infrastructure, such as housing, restaurants, and offices to support SpaceX's production and manufacturing facility near Starbase.

A portion of Crooked Island of the Bahamas, and the Turks & Caicos Islands are within the expanded affected environment for the Flight 9 AHA. The change in the Proposed Action results in a change in the potential impact area for these resources. The analysis in this Tiered EA is focused on the environmental impact categories with the potential to be affected by updates to the airspace closure areas, including: air quality; climate; hazardous materials; land use; noise and noise-compatible land use; and socioeconomics. There are no potential impacts that could affect biological resources (terrestrial and marine wildlife); cultural resources; Department of Transportation Section 4(f); natural resources and energy supply; visual resources; water resources; children's health[4]; farmlands or wild and scenic rivers; therefore, these environmental impact categories are not analyzed in this Tiered EA. If the Flight 9 mission profile is repeated, the effects would be commensurate with each launch.

The 2022 PEA and Mitigated FONSI/ROD and April 2025 Tiered EA and Mitigated FONSI/ROD included mitigation measures to ensure that the potential impacts of SpaceX's launch program would not have significant impacts to the environment. SpaceX maintains ongoing compliance with all mitigation measures.

3.1 Noise and Noise Compatible Land Use

The 2022 PEA and the 2025 Tiered EA determined the Proposed Action would not be expected to result in significant impacts to noise and noise compatible land use, and that sonic boom and other noise would not significantly impact any resources, including biological, cultural, and Section 4(f) resources.

Airspace closures associated with the Proposed Action could result in temporarily grounded aircraft at affected airports and re-routing of en route flights on established alternate flight paths. Aircraft could be temporarily grounded if airspace above or around the airport is closed. Ground delays are also used under some circumstances to avoid airborne reroutes. If aircraft were grounded, noise levels at the airport could temporarily increase if the planes sit idle; some aircraft would likely shut down engines altogether until the closure has lifted. Also, depending on the altitude at which aircraft approach an airport, there could be temporary increases in noise levels in communities around the airports. Aircraft would travel on existing routes and flight paths that are used on a daily basis to account for weather and other temporary restrictions. Any incremental increases in noise levels at individual airports would only

[4] On January 21, 2025, President Trump issued EO 14173, *Ending Illegal Discrimination and Restoring Merit-Based Opportunity*. Due to the rescission of prior executive orders regarding environmental justice, and the recent action by the CEQ to rescind the NEPA implementing regulations, it is no longer the policy of the Federal government to conduct environmental justice analysis and it is no longer a legal requirement to do so. Any prior data gathering, analysis, or discussion regarding environmental justice is not relevant for purposes of evaluating the NEPA significance of this project, nor will it play any role in agency decision-making.

last the duration of the airspace closure and are not expected to meaningfully change existing day-night average sound levels at the affected airports and surrounding areas. Therefore, airspace closures due the Proposed Action are not expected to result in significant noise impacts.

Based on the above findings, the data and analyses are consistent with those discussed in the 2022 PEA and April 2025 Tiered EA, and the Proposed Action would not result in significant impacts to noise and noise compatible land use.

3.2 Air Quality and Climate

Airspace closures associated with the Proposed Action would lead to increased emissions from aircraft. This is mainly because aircraft would need to take pre-established alternative flight routes, which themselves are assessed by FAA under NEPA. This would result in the usage of more fuel. Increases in GHG emissions would result from the additional fuel usage. While rerouting would be a short-lived scenario for affected aircraft, the emissions the launch, considering the number of aircraft impacted, would not be substantial enough to notably influence the climate.

Based on the above findings, the data and analyses are consistent with those discussed in the 2022 PEA and April 2025 Tiered EA, and the Proposed Action would not result in significant impacts to air quality and the climate.

3.3 Hazardous Materials, Solid Waste and Pollution Prevention

A launch anomaly[5] could result in debris and hazardous materials being distributed below the AHAs. , The size of AHAs can grow or shrink as reliability is either decreased or increased with results and analysis from each launch. The Starship vehicle mishaps from Flights 7 and 8 caused a greater probability of failure of the vehicle, with debris landing in the Turks & Caicos Islands and Bahamas, respectively. If any anomalies occurred during the operation, SpaceX would respond to all accidental releases of polluting substances quickly and implement appropriate cleanup measures in accordance with applicable laws to minimize impacts to the environment.

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

Starship-Super Heavy is constructed primarily of stainless steel, which is non-toxic and inert. Other debris includes thermal heat tiles composed of silica, which has similar properties to glass and is highly resistant to degradation. The heat tiles are considered inert. Impacts on air quality or water chemistry are not expected. Glass is known to shatter or break apart into smaller pieces, with the sharp edges becoming rounded and smooth over time. It is likely that the heat tiles would similarly change if the same environmental conditions were present. Starship-Super Heavy's propellants are liquid oxygen and

[5] An anomaly is defined as “any condition during licensed or permitted activity that deviates from what is standard, normal, or expected, during the verification or operation of a system, subsystem, process, facility, or support equipment.” 14 CFR § 401.7.

liquid methane which are non-hazardous rather than highly toxic hypergolic fuels. Residual propellant is anticipated to evaporate or be diluted quickly due to surface currents and ocean mixing.

Starship would have approximately 34 gallons of hydraulic fluid. In the event of an anomaly, hydraulic fluid may remain contained in the vehicle, ignite, or be released. Remaining hazardous materials such as ordnance, or chemicals would be transported back to SpaceX in accordance with regulations for transport of hazardous substances.

The are no changes from the Proposed Action that would affect solid waste or pollution prevention. Based on the above findings, the data and analyses are consistent with those discussed in the 2022 PEA and April 2025 Tiered EA, and the Proposed Action would not result in significant impacts to hazardous materials, solid waste and pollution prevention.

3.4 Socioeconomics

Airspace impacts and ground stops delays cost airlines and passengers every year. Typical delay causes are weather, equipment issues, staffing, etc. No data is available yet for 2024, but in 2023 the average cost of aircraft block (taxi plus airborne) time for U.S. passenger airlines was $100.80 per minute.[6]

Assuming that costs have not decreased from 2023 to 2025, with a potential for a minimum of 175 flights to be impacted by delays from Starship-Super Heavy Flight 9, the cost of aircraft block time for the affected commercial flights, in total, would be at least $17,640 per minute (175 flights multiplied by $100.80 per minute). With the expected approximate 40 minute delay, the cost could be at least $705,000 for 40 minutes, and up to approximately $2,100,000 for two hours, in total, to the affected commercial airlines. Any costs to the general aviation community would be beyond these airline costs.

In addition to airline costs, there would be costs to passengers per hour ($49.93 in 2025 USD)[7]. Also, due to the location of the airspace closures (the Bahamas and Turks & Caicos), and the prevalence of tourism travel to those locations, passengers on the delayed airlines would likely also be experiencing lost time for vacations. Using a median rate for an all-inclusive resort in these countries of $400 per day[8], this would equate to $16.67 per hour of lost value for passengers who are delayed as a result of the airspace closure.

The Proposed Action would restrict the use of portions of airspace and initiate ground stops at multiple airports for approximately 40 minutes, subject to the timing of the launch occurring at the beginning of the two hour launch window.[9] Though the Proposed Action would include these restrictions, there would be no change in the number of operational personnel or taxes. There would be changes in expenditures due to the delays and associated airline income, but there would be no change expected to economic activity, personal income, employment, population, sustenance, public services, and/or social conditions.

[6] U.S. Passenger Carrier Delay Costs | Airlines For America. Accessed May 2025.
[7] https://www.faa.gov/sites/faa.gov/files/regulations_policies/policy_guidance/benefit_cost/econ-value-section-1-tx-time.pdf
[8] https://www.travelocity.com/
[9] The delay could be incrementally greater based on the delay of the start of the launch within the two-hour launch window.

Accordingly, consistent with the data and analyses contained in the 2022 PEA and the April 2025 Tiered EA, the Proposed Action would not result in significant socioeconomic impacts.

4. Conclusion

The 2022 PEA and April 2025 Tiered EA examined the potential for significant environmental impacts from Starship-Super Heavy launch operations at the Boca Chica Launch Site and defined the regulatory setting for impacts associated with Starship-Super Heavy. The areas evaluated for environmental impacts in this Tiered EA include air quality; climate; noise and noise-compatible land use; hazardous materials; and socioeconomics. In each of these areas, FAA has concluded that no significant impacts would occur as a result of the Proposed Action.

5. List of Preparers

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