Draft Environmental Assessment for the Sierra Space Dream Chaser Vehicle Operator License at the Shuttle Landing Facility, Brevard County, Florida

2021

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AGENCIES: Federal Aviation Administration (FAA), lead Federal agency; National Aeronautics and Space Administration, United States Space Force, United States Fish and Wildlife Service, and the National Park Service, cooperating agencies.

The FAA is releasing this Environmental Assessment (EA) for public review pursuant to Section 102(2)(C) of the National Environmental Policy Act of 1969 (NEPA), as amended (42 United States Code 4321, et seq.), Council on Environmental Quality (CEQ) NEPA implementing regulations (40 Code of Federal Regulations Parts 1500 to 1508), and FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*.

DEPARTMENT OF TRANSPORTATION, FEDERAL AVIATION ADMINISTRATION: The FAA is evaluating Sierra Space Corporation's (herein referred to as Sierra Space) proposal to conduct Dream Chaser reentry operations at the Shuttle Landing Facility (SLF) at Cape Canaveral Spaceport in Florida. To conduct Dream Chaser reentry operations at the SLF, Sierra Space must obtain a Vehicle Operator License from the FAA. Issuing a reentry Vehicle Operator License is considered a major Federal action subject to environmental review under NEPA. Under the Proposed Action, the FAA would issue a reentry Vehicle Operator License to Sierra Space that would allow Sierra Space to conduct Dream Chaser reentry operations at the SLF. Sierra Space is proposing to conduct up to four reentry operations per year over the next five years (2022–2026). Under the Proposed Action, the FAA would also issue Letter(s) of Agreement to Sierra Space to outline notification procedures prior to, during, and after an operation and procedures for issuing a Notice to Air Mission. This EA tiers off the January 2021 Programmatic Environmental Assessment for the Shuttle Landing Facility Reentry Site Operator License.

PUBLIC REVIEW PROCESS: In accordance with the applicable requirements, the FAA is initiating a 35-day public review and comment period for the Draft EA. The public comment period begins with the publication of the Draft EA. Comments are due on January 24, 2022. The Notice of Availability published in the *Federal Register* provides information regarding public meetings and how to submit comments.

CONTACT INFORMATION: For questions, please contact: Ms. Chelsea Clarkson, Sierra Space at SLF, c/o ICF, 9300 Lee Highway, Fairfax, VA 22031; email SierraSpaceSLF@icf.com.

This Environmental Assessment becomes a Federal document when evaluated, signed, and dated by the responsible FAA Official.

Responsible FAA Official:

MICHELLE S MURRAY

Digitally signed by MICHELLE S MURRAY
Date: 2021.12.13 09:14:02 -05'00'

Date: _____

Michelle Murray

Acting Manager, Operations Support Branch

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Acronyms and Abbreviations

°	Degrees
CDNL	C-Weighted Day-Night Average Sound Level
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO_2	Carbon Dioxide
CRS2	Commercial Resupply Service 2
dB	Decibel
dBA	A-Weighted Decibel
DNL	Day-Night Average Sound Level
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Order
FAA	Federal Aviation Administration
FONSI	Finding of No Significant Impact
ft	Feet
H_2O_2	Hydrogen Peroxide
ISS	International Space Station
kg	Kilogram
Km	Kilometer
KSC	Kennedy Space Center
LEO	Low Earth Orbit
LOA	Letter of Agreement
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NGA	National Geospatial Intelligence Agency
nmi	Nautical Miles
NOTAM	Notice to Air Missions
NOTMAR	Notice to Mariners
PEA	Programmatic Environmental Assessment
psf	Pounds per Square Foot
RCS	Reaction Control System
RP-1	Kerosene
RSOL	Reentry Site Operator License
SHA	Ship Hazard Area
SLF	Shuttle Landing Facility
SNC	Sierra Nevada Corporation
SUA	Special Use Airspace
U.S.	United States
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
USSF	United States Space Force

Chapter 1
Introduction

Sierra Space is applying for a Vehicle Operator License to conduct Dream Chaser reentry operations at the Shuttle Landing Facility (SLF), which is managed by Space Florida and located at the Cape Canaveral Spaceport (see **Figure 1-1**).[1] Under the Proposed Action addressed in this Environmental Assessment (EA), the Federal Aviation Administration (FAA) would issue a Vehicle Operator License to Sierra Space for up to four annual reentry operations over five years (2022-2026) at the SLF. The FAA would also develop Letter(s) of Agreement (LOAs) with Sierra Space to outline notification procedures prior to, during, and after an operation as well as procedures for issuing a Notice to Air Missions (NOTAM).

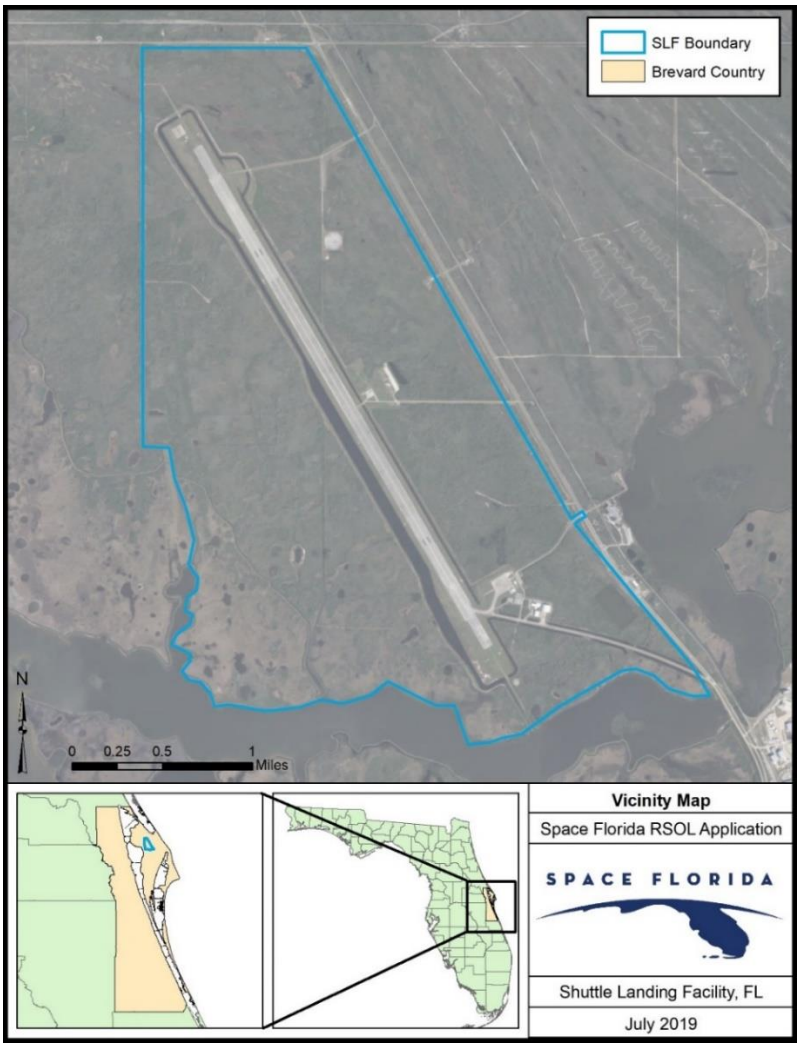

Figure 1-1. Vicinity Map

[1] Cape Canaveral Spaceport includes both NASA's Kennedy Space Center, where the SLF is located, and the Cape Canaveral Space Force Station. Florida Statute 331.304, states that CCAFS and John F. Kennedy Space Center may be referred to as the Cape Canaveral Spaceport.

This EA analyzes the impacts of the activities associated with Sierra Space's reentry operations. This EA tiers from the January 2021 Final Programmatic Environmental Assessment (PEA) for the Shuttle Landing Facility Reentry Site Operator License (2021 PEA). The 2021 PEA analyzed the potential environmental impacts of Space Florida operating the SLF as a commercial space reentry site. The representative reentry vehicle operations described in the 2021 PEA were based on Sierra Space's[2] Dream Chaser Vehicle and proposed operations at the SLF, which are consistent with the proposed vehicle and operations described in this EA. This tiered EA focuses on the vehicle specific operations and associated impacts, and it evaluates changes to the human environment from the Proposed Action or alternatives that are reasonably foreseeable and have a reasonably close causal relationship to the Proposed Action or alternatives. The successful completion of the environmental review process does not guarantee that the FAA would issue a Vehicle Operator License to Sierra Space. The Proposed Action must also meet FAA safety, risk, and financial responsibility requirements established in 14 Code of Federal Regulations (CFR) Part 400.

The Dream Chaser would be launched to orbit as a payload atop the United Launch Alliance's vertically launched Vulcan rocket or equivalent from Cape Canaveral Space Force Station. Upon receiving the application, the FAA has 180 days to make a license determination. The potential environmental impacts of Vulcan or equivalent launches from Cape Canaveral Space Launch Complex 41 were analyzed in the June 2019 Environmental Assessment for Vulcan Centaur Program operations and launch on Cape Canaveral Air Force Station (June 2019 EA). The FAA was a cooperating agency and adopted the June 2019 EA and issued a Finding of No Significant Impact (FONSI) to support the potential issuance of a launch license for Vulcan operations from Cape Canaveral Space Force Station on February 27, 2020. Processing of payloads similar to the Dream Chaser vehicle is assessed in the NASA 2011 Environmental Assessment for Launch of NASA Routine Payloads (2011 EA).[3]

1.1 Background

The FAA previously analyzed the potential environmental impacts of issuing a launch site operator license (LSOL) to Space Florida for the operation of a commercial space launch site at the SLF in the 2018 *Final Environmental Assessment for the Shuttle Landing Facility Launch Site Operator License* (2018 EA). The 2018 EA assessed the potential environmental impacts of construction and operation of a commercial horizontal launch site at the SLF for Concept Y and Concept Z vehicles with annual launches ranging from 14 launches in 2018 to 74 launches by 2022. The FAA determined that issuing a LSOL would not significantly affect the quality of the human environment pursuant to Section 102(2)(c) of NEPA and issued a Final EA and Finding of No Significant Impact (FONSI) in November 2018.[4] The FAA issued a LSOL to Space Florida on November 8, 2018.

[2] The space systems group within Sierra Nevada Corporation (SNC) formed a subsidiary called Sierra Space Corporation on June 1, 2021. This document references Sierra Space when discussing the January 2021 PEA.

[3] The 2011 EA can be accessed online at: www.nasa.gov/pdf/603832main_FINAL%20NASA%20Routine%20Payload%20EA%20Resized.pdf

[4] The 2018 EA can be downloaded from the FAA website at: https://www.faa.gov/about/office_org/headquarters_offices/ast/environmental/nepa_docs/review/documents_progress/space_florida/media/SLF_FONSI_ROD_and_Final_EA_with_Appendices_508_Compliant.pdf.

The FAA also previously analyzed the potential environmental impacts of issuing a reentry site operator license (RSOL) to Space Florida for the operation of a commercial space reentry site at the SLF in the 2021 PEA. The 2021 PEA evaluated the potential environmental impacts of operation of a commercial space reentry site at the SLF. The FAA determined that issuing a RSOL would not significantly affect the quality of the human environment pursuant to Section 102(2)(c) of NEPA and issued a Finding of No Significant Impact (FONSI) in January 2021.[5] The FAA issued a Reentry Site Operator License and a renewed LSOL on January 15, 2021 (LRSO 18-018).[6] For the purposes of the RSOL application, the Dream Chaser was used as a representative reentry vehicle for noise and sonic boom analysis.

The 2021 PEA assessed up to six annual reentry operations from 2021 to 2025.[7] Sierra Space is applying for a Vehicle Operator License for the time period of 2022 – 2026. No reentry operations were conducted at the SLF in 2021 and therefore no impact occurred in 2021 as analyzed under the 2021 PEA. As described in Chapter 3, environmental conditions from 2022 to 2026 are not expected to be significantly different than those previously analyzed in the 2021 PEA. Therefore, the description of existing conditions from the 2021 PEA is incorporated by reference in this EA.

Sierra Space's Vehicle Operator License was not analyzed in the 2021 PEA. To focus this tiered EA on impacts specific to FAA's Proposed Action, valid and current information and analysis from the 2021 PEA is summarized and incorporated by reference for relevant portions of the affected environment section (see Chapter 3 for more information). This EA expands on the analysis provided in the 2021 PEA to include an analysis of the potential environmental impacts of the operational activities associated with licensing the Dream Chaser for reentry operations.

1.2 Federal Agency Roles

1.2.1 FAA Office of Commercial Space Transportation

As the lead Federal agency, the FAA is responsible for analyzing the potential environmental impacts of the Proposed Action. The Commercial Space Launch Act of 1984, as amended and codified at 51 United States Code 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 FAA is also responsible for creating airspace closure areas in accordance with FAA Order 7400.2M, *Procedures for Handling Airspace Matters*, to ensure public safety.

[5] The 2021 PEA can be downloaded from the FAA website at: https://www.faa.gov/space/environmental/nepa_docs/slf_ea/media/SLF_Final_PEA_and_FONSI_508.pdf.

[6] https://www.faa.gov/about/office_org/headquarters_offices/ast/licenses_permits/media/Final%20SF%20SLF%20LRSO%2018-018%20License%202021.01.15.pdf

[7] Space Florida's RSOL expires in 2025. Space Florida can apply to renew the license at that time.

1.2.2 Cooperating Agencies

A cooperating agency is an agency, other than the lead agency, that has jurisdiction by law or special expertise regarding any environmental impact resulting from a Proposed Action or reasonable alternative. The National Aeronautics and Space Administration (NASA), U.S. Space Force (USSF), U.S. Fish and Wildlife Service (USFWS), the National Park Service, and U.S. Coast Guard (USCG) are cooperating agencies for this EA due to their special expertise and jurisdictions (40 CFR §§ 1508.15 and 1508.26). The cooperating agencies and the roles of these agencies have not changed from the 2021 PEA.

1.3 Purpose and Need

The purpose of Sierra Space's proposal is to conduct Dream Chaser reentry missions at the SLF. Sierra Space has chosen to conduct reentry operations at the SLF due to its existing infrastructure and proximity to Cape Canaveral Space Force Station, Kennedy Space Center (KSC), and other commercial space operations. Sierra Space's proposal is needed to support its civil and commercial customers, which includes a NASA contract for resupply of the International Space Station (ISS). Specific to Sierra Space's ISS Commercial Resupply Services 2 (CRS2) contract with NASA, NASA desires the reentry to occur at the SLF due to the proximity of lab facilities for post mission processing of payloads and other cargo being returned from the ISS.

1.4 Agency Involvement

The FAA is coordinating with Federal and State agencies and tribal governments including, but not limited to, the USFWS, National Park Service, NASA, USCG, Florida State Division of Historic Resources (the State Historic Preservation Office), Catawba Indian Nation, Chitimacha Tribe of Louisiana, Coushatta Tribe of Louisiana, Eastern Band of Cherokee Indians, Jena Band of Choctaw Indians, Miccosukee Tribe of Indians of Florida, Muscogee (Creek) Nation, Poarch Band of Creek Indians, and Seminole Tribe of Florida.

Consultation letters for this EA are included in Appendix A. The FAA sent the following consultation letters on October 21, 2021:

- An Endangered Species Act Section 7 consultation initiation letter to USFWS;
- A National Historic Preservation Act Section 106 consultation initiation letter to the Florida State Division of Historic Resources; and
- National Historic Preservation Act Section 106 and Government-to-Government consultation initiation letters to Catawba Indian Nation, Chitimacha Tribe of Louisiana, Coushatta Tribe of Louisiana, Eastern Band of Cherokee Indians, Jena Band of Choctaw Indians, Miccosukee Tribe of Indians of Florida, Muscogee (Creek) Nation, Poarch Band of Creek Indians, and Seminole Tribe of Florida.

1.5 Public Involvement

The FAA is using the FAA's Office of Commercial Space Transportation stakeholder engagement website for outreach and communication on Sierra Space's proposed operations (https://www.faa.gov/space/stakeholder_engagement/shuttle_landing_facility/). The FAA has released this Draft EA for a 35-day public review period. The FAA provided public notice of the availability of the Draft EA for public review and comment through the *Federal Register*, the FAA's Office of Commercial Space Transportation website (https://www.faa.gov/space/stakeholder_engagement/shuttle_landing_facility/), and local newspaper advertisements.

Questions and comments on the preparation of the Draft EA may be addressed to Ms. Chelsea Clarkson, Environmental Protection Specialist, Sierra Space at SLF EA, c/o ICF, 9300 Lee Hwy, Fairfax, VA 22031 or submitted by email to SierraSpaceSLF@icf.com. Before including your address, phone number, e-mail address, or other personal identifying information in your comment, be advised that your entire comment—including your personal identifying information—may be made publicly available at any time. While you can ask us in your comment to withhold from public review your personal identifying information, we cannot guarantee that we will be able to do so.

The FAA invites interested government agencies, organizations, Native American tribes, and members of the public to submit comments on any aspect of this Draft EA. Following the close of the public comment period, the FAA will revise the EA, as appropriate, in response to comments received on the draft document, and a Final EA will be prepared. The Final EA will reflect the FAA's consideration of comments and will provide responses to substantive comments. Following review of the Final EA, the FAA will either issue a Finding of No Significant Impact (FONSI) or issue a Notice of Intent to prepare an Environmental Impact Statement (EIS).

Chapter 2
Proposed Action and Alternatives

This chapter describes the Proposed Action considered in this Draft EA. This chapter also describes the No Action Alternative. FAA Order 1050.1F, Paragraph 6-2.1 states, "An EA may limit the range of alternatives to the Proposed Action and No Action Alternative when there are no unresolved conflicts concerning alternative uses of available resources." In the absence of unresolved conflicts, the consideration of other alternatives to avoid or minimize potential effects is not warranted. Therefore, the Proposed Action and No Action Alternative considered in this EA represent the range of reasonable alternatives commensurate with the nature of the project.

2.1 Proposed Action

This EA expands on the anlaysis provided in the 2021 PEA to include analysis of potential enviromental impacts of the FAA issuing Sierra Space a Vehicle Operator License to conduct reentry operations at the SLF.

2.1.1 Dream Chaser

Sierra Space's Dream Chaser is a multi-mission space utility vehicle designed to transport cargo to low Earth orbit (LEO) destinations such as the ISS. Dream Chaser missions are, in part, to support a NASA/Sierra Space contract to resupply the ISS. NASA purchases these missions to provide a commercial resupply service, thus allowing the vehicle to be used to support additional missions for other government and non-government customers.

The Dream Chaser is a lifting-body spacecraft with small wings that provide directional stability in flight (see **Figure 2-1**). The lift is created by the body of the vehicle (the underside) which is wide and flat. The lifting-body design gives Dream Chaser a higher lift-to-drag ratio and allows for greater cross-range landing capability. The minimum runway length desired for landing is 10,000 feet.

Dream Chaser measures approximately 30 feet in length, has a wingspan of 27 feet, and weighs approximately 24,600 pounds. Dream Chaser propellants, Hydrogen Peroxide (H_2O_2) and Kerosene (RP-1), are used by a reaction control system (RCS) for orbital maneuvers, deorbit burn, and high-altitude attitude control during reentry. The propulsion system is not used near or on the ground. Near Mach 4, Dream Chaser transitions from RCS attitude control to flight control surfaces. The vehicle lands with residual propellant and any margin not used during reentry. Maximum expected quantities of residual propellant and oxidizer were used as inputs for the explosive siting conducted in the 2021 PEA. The pressurized/unpressurized cargo capacity is 5,500 kilograms or 30 cubic feet. The return payload capacity is 1,850 kilograms.

Typical cargo includes scientific experiments, items no longer needed on the ISS packaged in cargo transfer bags, and trash for disposal in the cargo module. Overall, for CRS2 missions, NASA provides Sierra Space and thus the FAA an integrated bag level hazard analysis (IBLHA). The integrated bag level hazard analysis

assesses any hazards present in the proposed cargo manifest. Sierra Space does not expect any hazardous material as defined by the FAA to be manifested on a reentry.

Figure 2-1. Dream Chaser Reentry Vehicle

Figure 2-2 shows a notional mission profile for the Dream Chaser vehicle. The Dream Chaser would be launched to orbit atop a vertical launch vehicle. Accordingly, launch activities for Dream Chaser would occur at a FAA-licensed launch site or other government facility under a separate license or approval.

Figure 2-2. Dream Chaser Mission Profile

2.1.2 Pre-Reentry Activities

As discussed in the 2021 PEA, Sierra Space would notify Space Florida, FAA Office of Commercial Space Transportation, FAA Air Traffic Organization, Space Launch Delta 45, and KSC before a planned reentry of

the Dream Chaser at the SLF. Sierra Space would be made aware of other activities at or near the SLF and work with the stated stakeholders to resolve potential conflicts for use. Flight and ground crews would be trained for nominal and non-nominal operations before each reentry, and training would be repeated with various failure scenarios and irregular performance to ensure crew readiness per FAA regulations.

While on orbit, Dream Chaser would be prepared for entry, descent, and landing by conducting vehicle checkouts and maneuvering to mission specific deorbit burn targets. As discussed previously, Dream Chaser is a lifting body vehicle and thus has a large cross-range capability.

For a visualization of cross-range capability, please refer to **Figure 2-3.** For example, a zero cross-range trajectory would be when the ground track of the orbiting vehicle naturally crosses directly over the SLF. Because of the rotation of the Earth, ground tracks of orbiting objects have precession relative to objects on Earth; as a result, each time the vehicle orbits around the Earth, the ground track changes relative to a landing site. Dream Chaser has a cross-range capability of ±700 nautical miles (nmi), meaning the ground track of the current vehicle orbit can be up to 700 nmi away when perpendicular to the landing site for Dream Chaser to have enough energy to successfully land. This ability provides added operational capability to lifting body reentry vehicles by not having to wait for an orbital ground track to align perfectly with the intended landing site. As explained the 2021 PEA, only ascending[8] trajectories would be considered.

The specific trajectory Dream Chaser would fly is a function of where the orbital ground track is relative to the landing site at the time of departure from orbit. This can be calculated in advance of a reentry as it is based on the orbital mechanics (physics) of the orbit relative to the Earth.

[8] The ascending phase of an orbital spacecraft is the portion of the orbital path that travels in a northerly direction relative to the latitudes of earth. In this context, ascending should not be confused with the “ascent” or launch phase of a mission which places the spacecraft into orbit around the Earth.

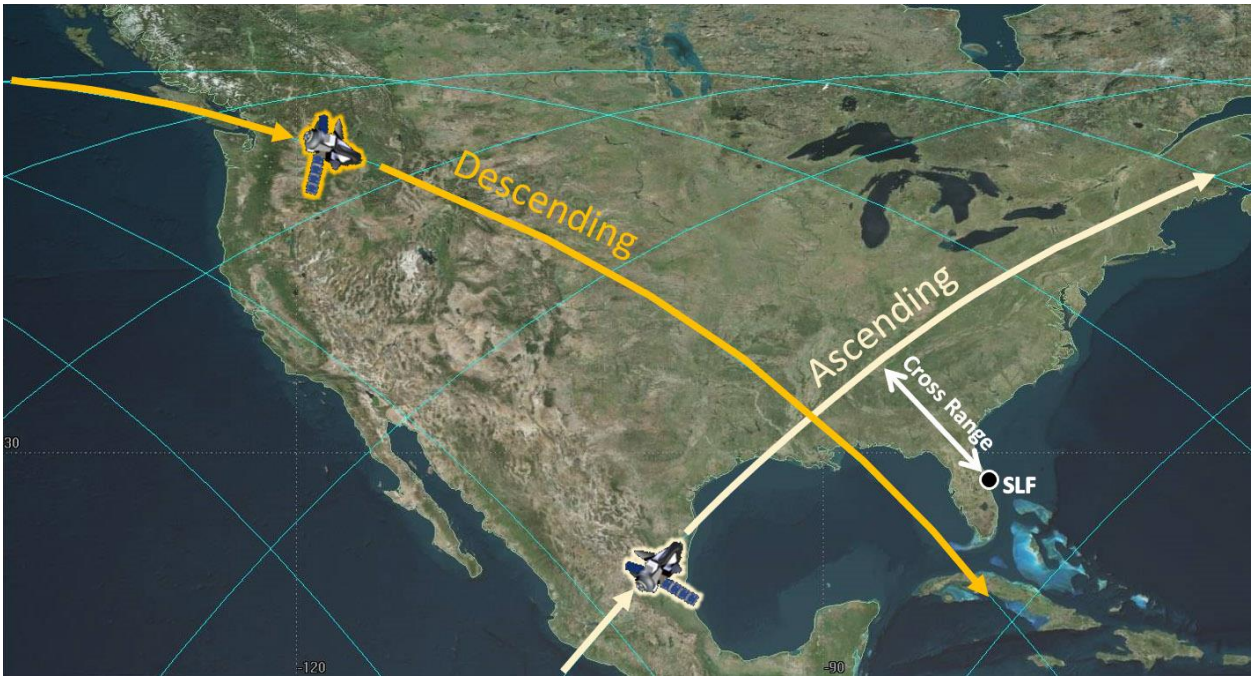

Figure 2-3. Dream Chaser Reentry Vehicle

2.1.3 Proposed Reentry Operations

Dream Chaser would reenter from west/southwest on an ascending reentry trajectory before landing at the SLF. Ascending reentry trajectories would include high atmospheric overflight of Central American countries as well as overflight of the southern half of Florida, south of 29° North latitude. Dream Chaser's trajectories over Florida for landings on Runway 15 and Runway 33 are shown in **Figure 2-4**, which is identical to the figure shown in the 2021 PEA.

The reentry vehicle would descend below 60,000 feet altitude above mean sea level approximately 30-40 miles from the SLF prior to landing and would be operating below 60,000 mean sea level for less than 30 seconds before entering Cape Canaveral Restricted Airspace. The reentry vehicle would remain in the Cape Canaveral Restricted Airspace for the remainder of its reentry and landing at the SLF (for approximately 2.5 – 3 minutes). The vertical profile of the Dream Chaser reentry operation is shown in **Figure 2-5**.

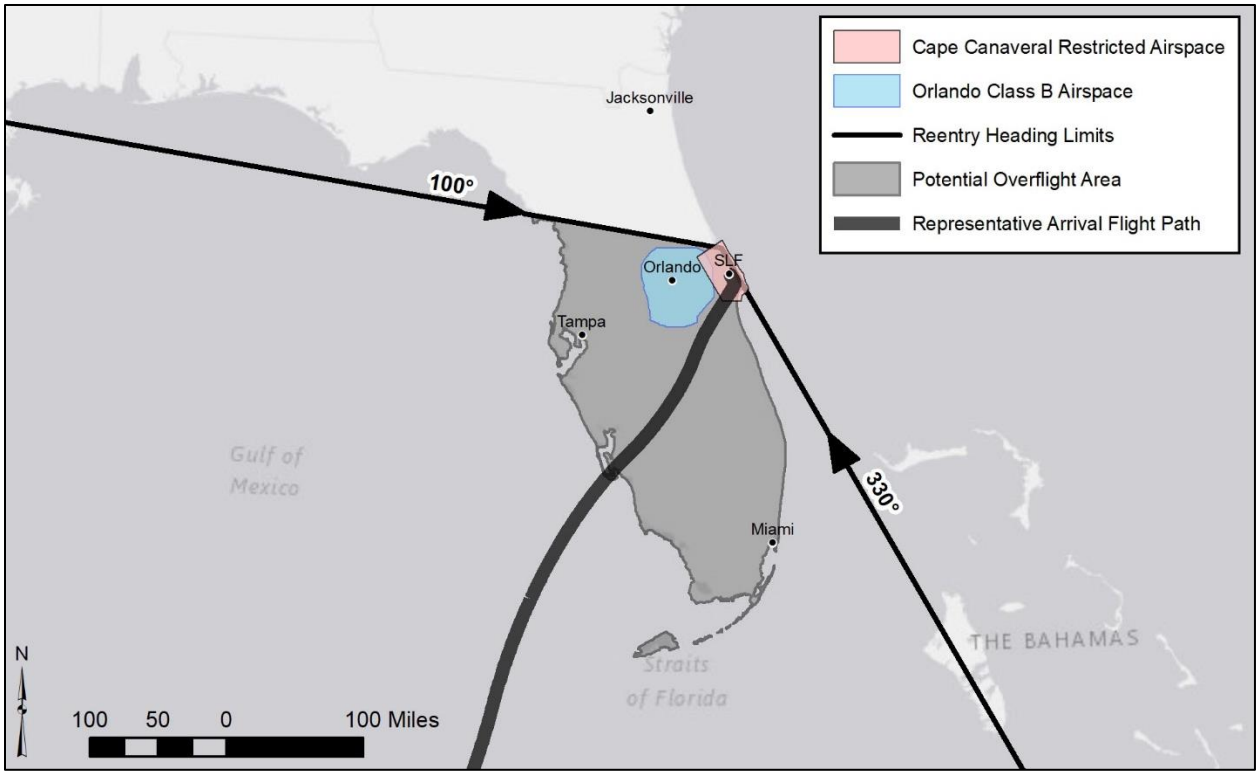

Figure 2-4. Dream Chaser Trajectories for SLF Landing (2021 PEA)

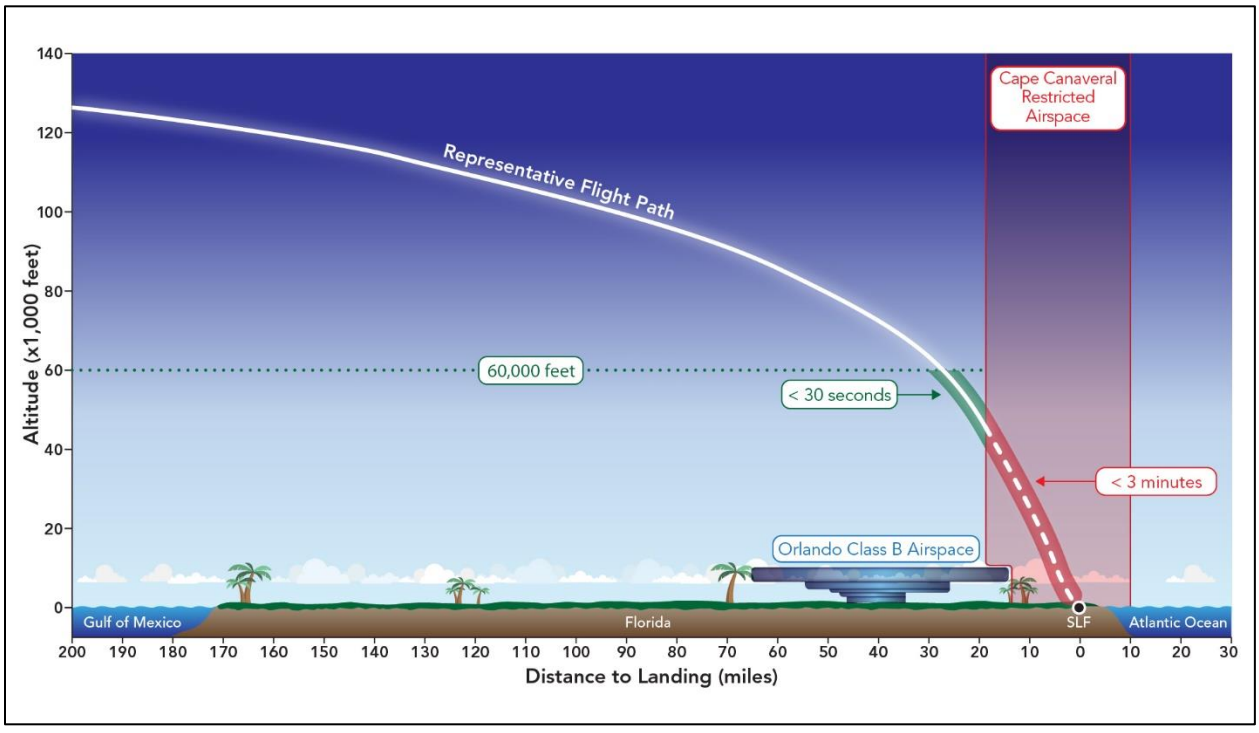

Figure 2-5. Dream Chaser Vertical Flight Profile for SLF Landing

Sierra Space anticipates up to four reentries per year (each reentry could occur during daytime or nighttime, depending on the mission) with reentries beginning below that threshold in 2022 and steadily increasing through 2026 (see Table 2-1). Dream Chaser's cargo module would be disposed of during reentry and any surviving debris would be intentionally placed in a remote part of the Pacific Ocean (see Section 2.1.5, *Cargo Module*). Based on flight safety analysis conducted as a part of the license application, Sierra Space anticipates that there are no areas within the State of Florida that will exceed individual or cumulative risk criteria limits.[9] Therefore, Sierra Space does not expect Dream Chaser reentry operations would require any closures of non-involved KSC property or public use areas (e.g., Merritt Island National Wildlife Refuge, Canaveral National Seashore), including coastal waters.

Table 2-1. Anticipated Annual Dream Chaser Reentries at the SLF

	2022	2023	2024	2025	2026
Dream Chaser Reentry Operations	1	2	3	4	4

2.1.4 Airspace Considerations

Airspace management considers how airspace is designated, used, and administered to best accommodate the individual and common needs of military, commercial, and general aviation. The FAA considers multiple and sometimes competing demands for airspace in relation to airport operations, Federal airways, jet routes, military flight training activities, commercial space operations, and other special needs to determine how the National Airspace System (NAS) can be best structured to address all user requirements.

The FAA designs and manages the NAS based on 14 CFR Part 71. The FAA has designated four types of airspace above the United States: controlled airspace, Special Use Airspace (SUA), other airspace, and uncontrolled airspace.

The FAA conducts an analysis of the effects on airspace efficiency and capacity for each licensed operation to determine whether the proposed launch or reentry would result in an unacceptable limitation on air traffic. If that were the case, the FAA would work with the operator to identify appropriate mitigation strategies, such as shortening the requested launch/reentry window or shifting the launch/reentry time, if possible. The FAA currently shares data with launch/reentry operators to avoid operations during days with high aviation traffic volume. These analyses have concluded that most commercial space launch/reentry operations result in minor or minimal impacts on commercial and private users of airspace. This is largely due to the FAA's ability to manage the airspace for all users.

As commercial space operations increase and new vehicles are developed, the FAA continues to explore ways to better manage airspace to increase the efficiency and capacity of the NAS for all users. For example, the FAA's Air Traffic Organization is currently examining dynamic launch and reentry windows and time-based launch procedures to enable air traffic to move dynamically through airspace even when it is closed via a NOTAM. These procedures involve Air Traffic Control being in constant contact with the launch/reentry operator and knowing the status of a launch or reentry so the airspace can be used by

[9] Risk criteria is defined in 14 CFR § 450.101

aircraft as long as possible prior to the moment a rocket takes off or a reentry vehicle reenters Earth's atmosphere.

The Proposed Action does not include altering the dimensions (shape and altitude) of the airspace. However, temporary closures of existing airspace through issuance of a NOTAM and/or activation of SUA would be necessary to maintain public safety during reentry operations per FAA requirements. A NOTAM provides notice of unanticipated or temporary changes to components of, or hazards in, the National Airspace System (FAA Order 7930.2, *Notices to Airmen*). The FAA issues a NOTAM 24 to 72 hours prior to a launch or reentry activity in the airspace to notify pilots and other interested parties of temporary conditions. SUA consists of airspace wherein activities must be confined because of their nature, or wherein limitations are imposed upon aircraft operations that are not part of those activities, or both. To comply with the FAA's licensing requirements, Sierra Space will enter into a LOA with relevant Air Traffic Control facilities to accommodate Dream Chaser reentry operations. The LOA defines responsibilities and procedures applicable to operations, including the technical procedures to follow when issuing a NOTAM defining the affected airspace, or activating SUA, prior to reentry operations.

The reentry trajectories would be west/southwest over the state of Florida, as shown in **Figure 2-4**. The study area's airspace is controlled primarily by the Miami Air Route Traffic Control Center. Specific latitude and longitude coordinates for reentry operations are not known to Sierra Space or the FAA at this time; each specific reentry trajectory and associated aircraft hazard area[10] would be provided to the FAA in advance of the reentry activity. The size, location, and extent of these areas varies mission-to-mission, based on mission-specific parameters. However, for the purposes of this EA, the general dimensions of an aircraft hazard area, as well as the geographic range that has the potential to be affected by an aircraft hazard area (and therefore subject to NOTAMs), have been identified. **Figure 2-6** shows a representative aircraft hazard area generated for a single deorbit opportunity. Since Dream Chaser has a cross-range capability of ±700 nmi, the location of the aircraft hazard area could vary based on the specific deorbit opportunity being executed for a particular mission. **Figure 2-7** shows the geographic range that has the potential to be affected by an aircraft hazard area for a given deorbit opportunity based on the ±700 nmi cross-range capability. Both the representative aircraft hazard area and geographic range were generated using conservative assumptions that account for variables such as seasonal winds, time of mission, and operational changes. The vertical profile of the Dream Chaser reentry operation with the representative aircraft hazard area is shown in **Figure 2-8**.

[10] Under 14 CFR § 450.101(b)(3), an aircraft hazard area is defined by the 10^{-6} risk contour that is generated by the risk analysis performed as part of licensing. The aircraft hazard areas for Dream Chaser were developed using a series of cross-range cases. Hazard areas were produced assuming a 747-400 aircraft cruising between 11 and 12 km in altitude.

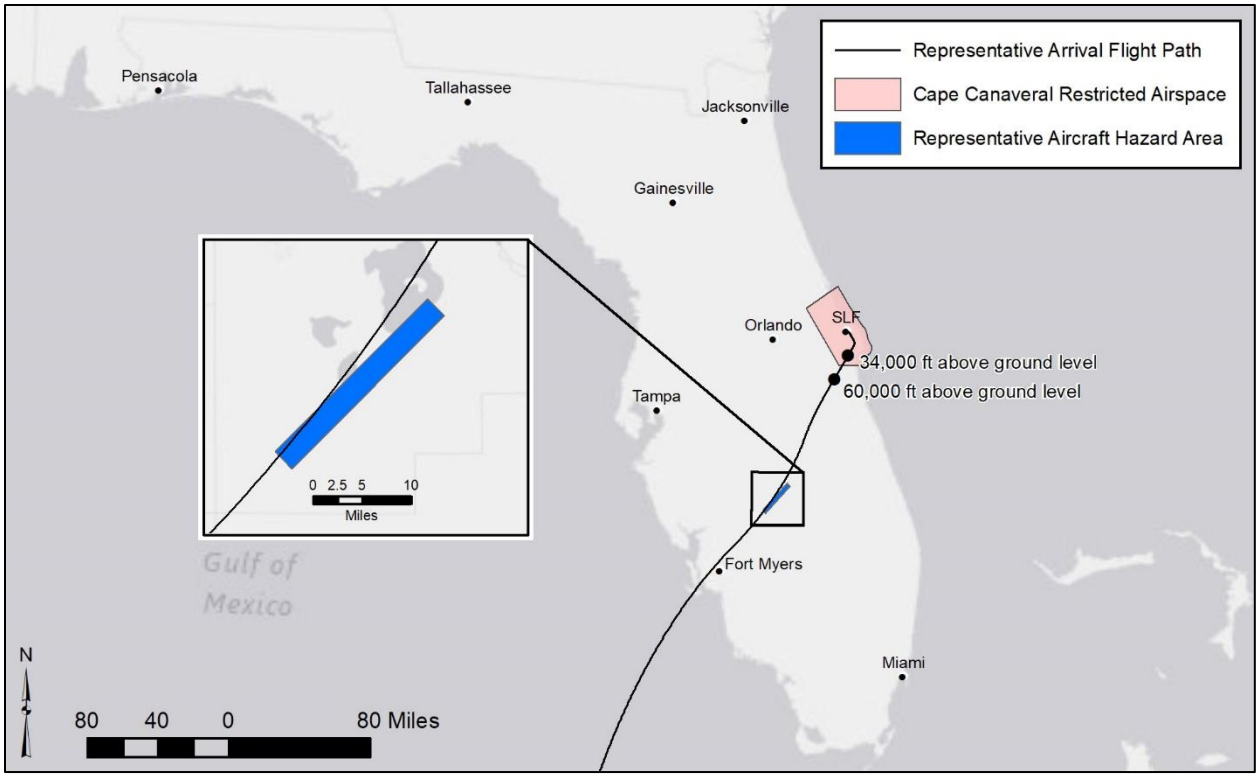

Figure 2-6. Representative Aircraft Hazard Area

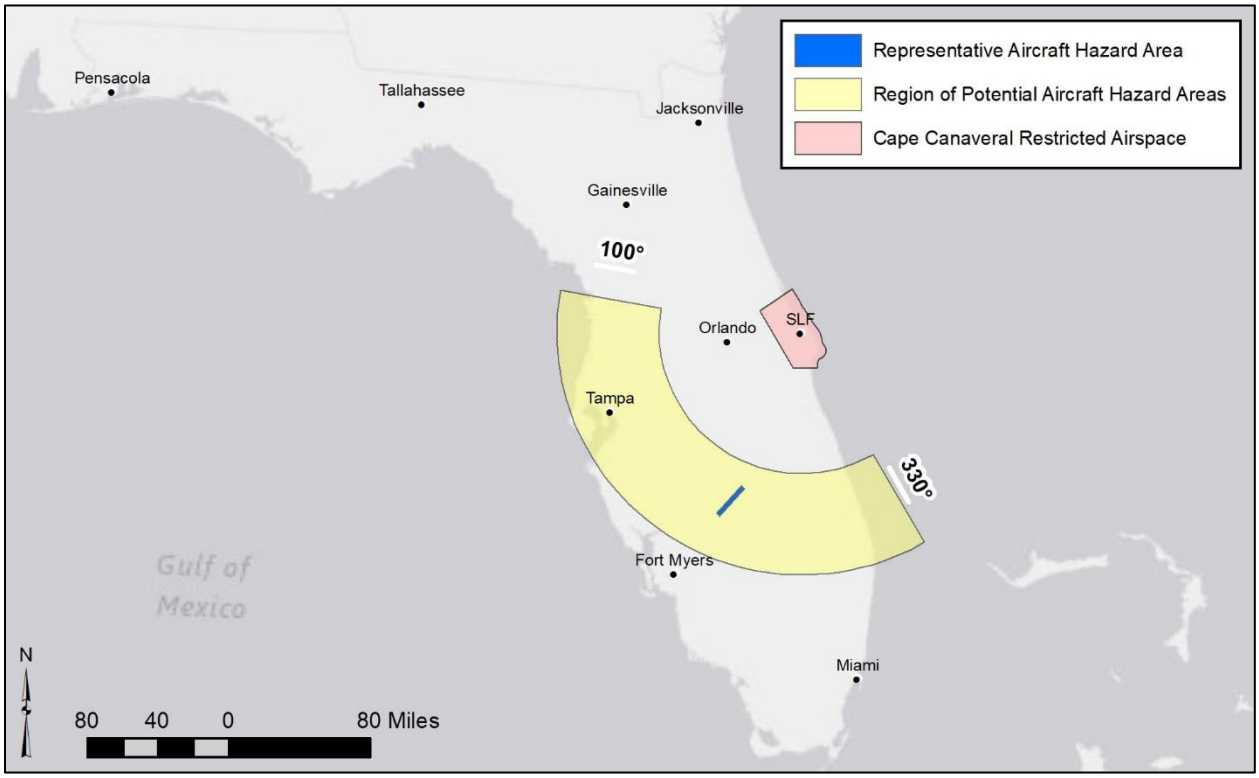

Figure 2-7. Geographic Range for Potential Aircraft Hazard Areas

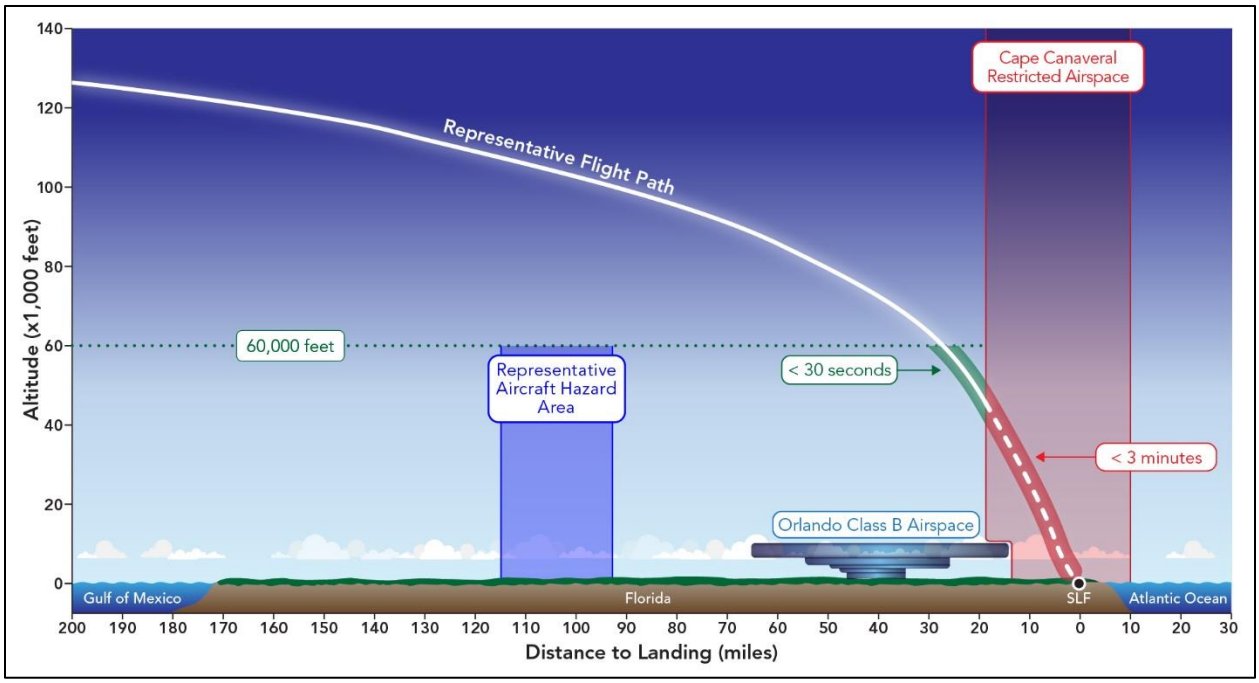

Figure 2-8. Dream Chaser Vertical Flight Profile with Aircraft Hazard Area for SLF Landing

Reentries would be of short duration and scheduled in advance to minimize interruption to airspace. Dream Chaser operations would require closing airspace for a period of time before a scheduled reentry. Prior to reentry, the specific temporarily closed airspace would be defined and published through a NOTAM. The NOTAM would establish a closure window that is intended to warn aircraft to keep out of a specific region throughout the time that a hazard may exist. The length of the window is primarily intended to account for the time needed for the operator to meet its mission objectives. The location and size of the closure area is defined to protect the public. For a launch or reentry, typically the keep-out must begin at the time of launch or reentry operation and ends when the mission has been completed, terminated, or cancelled. SUA, temporary flight restrictions, and altitude reservations are immediately released once the mission has successfully cleared the area and all planned jettisoned items no longer impose a risk to the public. Under the Proposed Action, it is anticipated that a NOTAM for each deorbit opportunity[11] would be in place for approximately one hour. Due to the cross-range capability of Dream Chaser discussed in previous sections, in many cases the vehicle will have what is referred to as back-to-back deorbit opportunities. Similar to Space Shuttle reentry, back-to-back deorbit opportunities to the SLF could exist separated by approximately ninety minutes, the period of one orbit around Earth. This would require that two hazard areas be published to prepare for the scenario where the Dream Chaser does not deorbit during the first opportunity.

[11] Two deorbit or back-to-back deorbit opportunities could exist to the landing site separated by ~90 minutes (one orbit around Earth). In this case, two hazard areas would have to be published to prepare for the scenario Dream Chaser does not deorbit on the first viable opportunity to the landing site.

The duration of the cargo module's descent into remote areas of the Pacific Ocean would be brief. Because the airspace above these areas are not heavily used by commercial aircraft and would be removed from the en-route airways and jet routes crossing the Pacific Ocean, impacts to airspace over these areas would be minimal. Sierra Space is entering into LOAs with foreign air navigation service providers and would coordinate potential impacts to international airspace prior to reentry operations. Sierra Space is also entering into LOAs with foreign air navigation service providers to coordinate any potential impacts to international airspace over the Pacific Ocean due to the cargo module disposal.

Airspace closures due to commercial space operations can result in delayed aircraft departures and arrivals, aircraft being re-routed along established alternative routes in the airspace, and aircraft flying more miles due to the re-routing. Aircraft departures could be delayed if airspace was closed over or around the airport. Ground delays are also used under some circumstances to avoid airborne reroutes. After departure, the aircraft is re-routed as needed along established alternative routes to avoid the closed airspace. Based on the FAA's previous experience with commercial space operations at KSC, most of the NAS-related impact is aircraft being re-routed in the airspace and thus aircraft flying more miles. Rarely, if ever, does the FAA receive notification that a space operation-related airspace closure resulted in aircraft departures or arrivals being delayed at least 15 minutes (referred to as a "reportable" delay). Re-routing associated with reentry-related closures represents a small fraction of the total amount of re-routing that occurs from all other reasons in a given year. For example, weather results in the greatest amount of re-routing for any single year.

All aircraft re-routing in response to commercial space operations would occur along established alternative routes according to existing flight procedures that have already undergone environmental review. The alternative flight paths would be the same flight paths that are used for other re-route reasons, such as weather issues, runway closures, wildfires, military exercises, and presidential flights. The magnitude of aircraft re-routing depends on several conditions, including the time of day, the day of the week, and the month of the year, since air traffic volume fluctuates over time. For example, a Dream Chaser reentry operation occurring during the day would have more airspace-related impacts than a nighttime operation when there are fewer or no aircraft that could enter the affected airspace. The duration of the closure also affects the number of necessary re-routes to ensure safety in the affected airspace.

2.1.5 Cargo Module

As described in Section 2.1.4, the cargo module is designed to demise during reentry. If portions of the cargo module survive reentry, any remaining debris would be intentionally placed in the broad open ocean of the Pacific and would be expected to sink. Contents within the cargo module are dependent on the mission manifest. However, hazardous materials are not intended to be transported within the cargo module.

Sierra Space is entering into a Letter of Intent with the USCG, which will describe the required responsibilities and procedures for both Sierra Space and USCG during cargo module reentry and demise/disposal operations, resulting in the issuance of a Notice to Mariners (NOTMAR). The NOTMAR does not alter or close shipping lines; rather, the NOTMAR provides a notification regarding a temporary hazard within a defined Ship Hazard Area (SHA) to ensure public safety during the proposed operations.

Sierra Space would use its internal SHA analysis to help USCG define NOTMARs. Sierra Space would provide coordinates to USCG, where it would be published in the Local Notice to Mariners. For international areas, the coordinates are transmitted to the USCG and the National Geospatial Intelligence Agency (NGA). NGA publishes the international notice through the Maritime Safety Office (https://www.nga.mil/). The length of the NOTMAR window is primarily intended to account for the time needed for the operator to meet its mission objectives. For cargo module reentry, the NOTMAR and associated SHA restriction would begin just after the deorbit burn prior to the separation of the Cargo Module from the Dream Chaser and end when the cargo module and any potential debris have reached the ocean surface. USCG manages the duration, location, and size of its SHA in a way that is similar to how the FAA manages its reserved airspace. For example, The USCG and the operators take steps to reduce the duration of the SHA as a mission unfolds. The location of the NOTMAR is heavily dependent on mission specific items such as the particular cross range the deorbit is occurring on and the final manifest of cargo being disposed of in the Cargo Module. Given rules/regulations[12] around orbital debris mitigation, a specific disposal trajectory for the cargo module will be selected that places any surviving debris in the broad open ocean of the Pacific Ocean and well away from any inhabited coastlines or landmass. The coordinates of the resulting NOTMAR(s) will be calculated as part of Sierra Space's process leading up to reentry and coordinated with the USCG per the Letter of Intent agreed upon by both Sierra Space and USCG.

2.1.6 Landing

The Dream Chaser would land on Runway 15/33 in an unpowered landing. Upon touch down, the vehicle would brake and come to a complete stop along the runway. Due to the potential for residual propellants on vehicle, a safety area would be established around the vehicle within the SLF property boundary.

2.1.7 Post-Flight Handling

Propellant handling operations, following landing and wheel-stop, and unloading of cargo would follow procedures that are dependent on the cargo manifest needs.

To process the Dream Chaser post-flight, Sierra Space would begin safing the vehicle on the runway. This would include activities such as disengaging and locking out the propulsion system, aerodynamic system, pressurized system, and other safety checks. If present, time-critical cargo would be unloaded, and Dream Chaser would be towed to a designated location, as defined in the explosive site plan. Residual propellants would then be removed or diluted, offloaded into approved storage containers, and transported and disposed of in accordance with all applicable local, state, and federal regulations.

Consistent with the 2021 PEA, Runway 15/33 would be unavailable to other operations or activities while Dream Chaser is stopped on the runway. Space Florida would perform a runway inspection prior to reopening the runway for other aircraft/spacecraft. Dream Chaser would be prepped for transportation from SLF and moved to Sierra Space facilities.

[12] Sierra Space complies with orbital debris mitigation by complying with applicable elements of NASA Standard 8719.14 - Process for Limiting Orbital Debris as well as the applicable portions of FAA Part 450 regarding disposal in broad open ocean areas.

2.2 No Action Alternative

NEPA requires agencies to consider a "no action" alternative in their NEPA analyses and to compare the effects of not taking action with the effects of the action alternative(s). Thus, the No Action Alternative serves as a baseline to assess the comparative impacts of the action alternative(s), including the Proposed Action. Under the No Action Alternative, the FAA would not issue a Vehicle Operator License to Sierra Space to conduct reentry operations at the SLF. If Sierra Space does not obtain a Vehicle Operator License for reentry operations at the SLF, Sierra Space would be unable to meet their NASA/Sierra Space contract obligations to resupply the ISS. The No Action Alternative would not satisfy the FAA's need to fulfill its responsibilities under EO 12465 and Chapter 509 of Title 51 of the U.S. Code for oversight of commercial space launch activities.

Chapter 3
Affected Environment and Environmental Consequences

3.1 Introduction

This chapter provides a description of the geographic area and environmental resources therein that the Proposed Action may affect as required by FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*.

The study area for this EA is the geographic area that could be directly or indirectly affected by the Proposed Action. This includes the Cape Canaveral Restricted Airspace, the airspace surrounding the reentry trajectory, and the airspace associated with any hazard area that must be protected to ensure public safety (see Section 2.1.4 for a depiction of the range of potential aircraft hazard areas). Additionally, the study area includes remote areas of the Pacific Ocean where the cargo module may be disposed; the discrete location of the cargo module disposal would be calculated by Sierra Space in advance of a specific reentry operation. These areas are mission dependent and would be determined prior to a scheduled reentry. The Proposed Action would not result in ground disturbing activities.

The Dream Chaser was the representative vehicle evaluated in the 2021 PEA and the total number of reentry operations would not exceed those analyzed in the 2021 PEA. The 2021 PEA evaluated proposed reentry operations for the years 2021 – 2025. This EA also incorporates by reference the cumulative effects contained in the 2021 PEA. This tiered EA assesses proposed reentry operations for the years 2022 – 2026. No reentry operations were conducted at the SLF in 2021 and therefore no impact occurred in 2021 as analyzed under the 2021 PEA. Therefore, as discussed in Section 1.1, environmental conditions from 2022 to 2026 are not expected to be significantly different than those previously analyzed in the 2021 PEA (2021 to 2025). Because of this, per Section 1501.11 of CEQ Regulations, this EA incorporates by reference, and does not modify, the affected environment and environmental consequences contained in the 2021 PEA related to the below impact categories.

- **Coastal Resources:** The Proposed Action would be consistent to the maximum extent practicable with the enforceable policies of the Florida Coastal Management Program and would not adversely affect coastal resources, create plans to direct future agency actions, propose rulemaking that alters uses do the coastal zone that are inconsistent with the Program, or involve Outer Continental Shelf Leases.
- **Department of Transportation Act, Section 4(f):** Using the SLF as a landing facility for the Dream Chaser would not require the physical or constructive use of or have direct impact on any Section 4(f) properties.
- **Farmland:** The operation of the Dream Chaser at the SLF would not disturb surrounding soils or affect the air quality, water quality, or noise levels in a way that would affect near-by farmlands.
- **Historical, Architectural, Archaeological, and Cultural Resources:** The Dream Chaser using the SLF as a landing facility would have no adverse effect to historic properties, as determined by the FAA and concurred with by the Florida State Historic Preservation Office on August 3, 2020.

- **Land Use:** The Dream Chaser using the SLF as a reentry facility is compatible with the existing operations that occur at the SLF and would not significantly impact the land use.
- **Natural Resources and Energy Supply:** Local supplies of natural resources, fuel, or energy will not be required to land the Dream Chaser at the SLF. Therefore, the Proposed Action would not significantly impact Natural Resources and Energy Supply.
- **Visual Effects (including Light Emissions):** Operating the Dream Chaser at the SLF would have a similar visual effect as the current aircraft operations at the SLF. The Proposed Action would comply with the KSC Exterior Lighting Guidelines, the Lighting Management Plan, and requirements of the USFWS Biological Opinion for KSC impacts to threatened and endangered species.

Potential environmental impacts that are specific to this Proposed Action and were therefore not fully analyzed in the 2021 PEA are described below. Specifically, potential environmental impacts from noise and noise-compatible land use are analyzed in detail. Potential environmental impacts for the following impact categories are not analyzed in detail for the reasons stated below:

- **Air Quality:** There would be no combustion from reentry vehicles once the deorbit burn completes. Airspace closures associated with commercial space operations would result in additional aircraft emissions mainly from aircraft being re-routed and expending more fuel. Minimal, if any, additional emissions would be generated from aircraft departure delays because the FAA has rarely, if ever, received reportable departure delays associated with commercial space operations around Cape Canaveral. Based on Sierra Space's proposal, airspace-related impacts could occur up to a maximum of four times per year due to the Proposed Action. Any delays in aircraft departures from affected airports would be short term, as the NOTAM has a duration of one-hour or less. Thus, any increases in air emissions from grounded aircraft are expected to be minimal and would occur in attainment areas. Therefore, these emissions increases are not expected to result in an exceedance of a National Ambient Air Quality Standard for any criteria pollutant. Emissions from aircraft being re-routed would occur above 3,000 feet (the mixing layer) and thus would not affect ambient air quality.
- **Climate:** There would be no combustion from reentry vehicles once the vehicle enters the atmosphere, so the Proposed Action would not significantly affect climate. Airspace closures associated with commercial space operations would result in additional aircraft emissions mainly from aircraft being re-routed and expending more fuel. These emissions include carbon dioxide (CO_2), which is a greenhouse gas. Based on Sierra Space's proposal, these temporary increases in aircraft emissions could increase up to a maximum of four times per year. The amount of time that affected aircraft would spend being re-routed would be short. In addition, the number of aircraft that would be impacted per reentry would not be expected to produce additional emissions that would have a notable impact on climate. Therefore, the increases in greenhouse gases caused by short-term airspace closures during the Dream Chaser's reentry at the SLF is not expected to result in significant climate-related impacts.
- **Biological Resources:** Using the SLF as a reentry facility for the Dream Chaser "may affect, but would not adversely affect" Endangered Species Act-listed wildlife species, as determined by the FAA and concurred with by USFWS on May 8, 2020. Due to the low probability of potential bird strikes, the introduction of additional reentries would not significantly increase the chance of a bird strike during landing activities. In addition to this, the SLF has a Wildlife Hazard Management Plan in place to reduce the risk of impacts to birds and wildlife, in addition to improving the safety of reentry vehicle landing at the SLF. Potential splashdown of the cargo module, if it is not

completely demised during reentry, would occur in the remote Pacific Ocean and would not result in significant impacts on federally protected species or habitat due to lower species densities than compared to nearshore.

- **Hazardous Materials, Pollution Prevention, and Solid Waste:** The Proposed Action would not significantly alter the use and storage of hazardous materials onsite as there are similar operations currently handled at the SLF. Any additional hazardous materials needed would not be permanently stored onsite. When operating the Dream Chaser from the SLF, hazardous material use, storage, and disposal would comply with applicable regulations and therefore minimizing the potential effects from those materials. No hazardous materials would be disposed of in the cargo module.
- **Socioeconomics, Environmental Justice and Children's Environmental Health:** The Proposed Action is not expected to affect Brevard or Volusia Counties' population, labor force, and travel patterns. In addition, it would not have a disproportionately high or adverse human health or environmental impact on minority or low-income populations. Using the SLF as a reentry facility for the Dream Chaser would not significantly affect children's environmental health or safety. Socioeconomic impacts from re-routing aircraft due to landing of the Dream Chaser at the SLF would be similar to re-rerouting aircraft for other reasons (e.g., weather issues, runway closures, wildfires, military exercises, and presidential flights). Potential socioeconomic impacts would include additional airline operating costs for increased flight distances and times resulting from re-routing aircraft and increased passenger costs as a result of impacted passenger travel, including time lost from delayed flights, flight cancellations, and missed connections. Alternatively, restricting or preventing a reentry event would have socioeconomic impacts on Sierra Space, commercial payload providers, and consumers of payload services. Operations would not result in the closure of any public airport during the operation nor so severely restrict the use of the surrounding airspace as to prevent access to an airport for an extended period of time. Given existing airspace closures for commercial space operations are temporary as discussed above and the FAA's previous analyses related to the NAS have concluded minor or minimal impacts on the NAS from commercial space operations, the FAA does not expect airspace closures from Sierra Space's proposal would result in significant socioeconomic impacts. Furthermore, local air traffic controls would coordinate with airports and aircraft operators to minimize the effect of the reentry operations on airport traffic flows as well as traffic flows in en-route airspace.

  Water Resources: The Proposed Action would not affect wetlands. The measures required by Space Florida's National Pollution Discharge Elimination System and Environmental Resource permits and the Spill Prevention Control and Countermeasures and SLF emergency spill plan ensure that Dream Chaser operations at the SLF would not have impacts to the surface water. Development nor construction activities are not needed at the SLF for the Proposed Action and therefore no significant impact to water resources should occur. Potential splashdown of the cargo module, if it is not completely reduced during reentry, would occur in the remote Pacific Ocean and would not significantly impact water resources. The cargo module would not carry hazardous materials, has no propulsion tanks, and all hazards would be understood prior to reentry.

A detailed analysis of potential noise and noise-compatible land uses is included below in Section 3.3.

3.2 No Action Alternative

Under the No Action Alternative, the FAA would not issue a Vehicle Operator License to Sierra Space to conduct reentry operations at the SLF. Spaceport-related operations could continue under the terms of Space Florida's Launch Site Operator License and Reentry Site Operator License. However, all prospective launch or reentry vehicle operators would need to apply to the FAA for a Vehicle Operator License; their proposed operations would be subject to NEPA review. Under the No Action Alternative, there would be no change in environmental trends or conditions or new anticipated impacts to the environmental impact categories analyzed in this EA.

3.3 Noise and Noise-Compatible Land Use

3.3.1 Definition of Resource and Regulatory Setting

Sound is a physical phenomenon consisting of pressure fluctuations that travel through a medium, such as air, and are sensed by the human ear. Noise is considered any unwanted sound that interferes with normal activities (e.g., sleep, conversation, student learning) and can cause annoyance. Noise sources can be constant or of short duration and contain a wide range of frequency (pitch) content. Determining the character and level of sound aids in predicting the way it is perceived. Both launch noise and sonic booms are classified as short-duration events.

The compatibility of existing and planned land uses with proposed FAA actions is usually determined in relation to the level of aircraft (or launch vehicle) noise. Federal compatible land use guidelines for a variety of land uses are provided in Table 1 in Appendix A of 14 CFR part 150, *Land Use Compatibility with Yearly Day-Night Average Sound Levels*. Compatible land use analysis considers the effects of noise on special management areas, such as national parks, national wildlife refuges, and other sensitive noise receptors. The concept of land use compatibility corresponds to the objective of achieving a balance between the Proposed Action and the surrounding environment.

The FAA has determined that the cumulative noise energy exposure of individuals to noise resulting from FAA actions must be established in terms of yearly Day-Night Average Sound Level (DNL), the FAA's primary noise metric. DNL accounts for the noise levels of all individual aircraft/launch vehicle events, the number of times those events occur, and the period of day/night in which they occur. The DNL metric logarithmically averages sound levels at a location over a complete 24-hour period, with a 10-decibel (dBA) adjustment added to those noise events occurring from 10:00 p.m. to 7:00 a.m. The 10-dB adjustment is added because of the increased sensitivity to noise during normal nighttime hours and because ambient (without aircraft/launch vehicles) sound levels during nighttime are typically about 10-dB lower than during daytime hours. More information about noise and noise-compatible land use can be found in Chapter 11 of the FAA 1050.1F Desk Reference (FAA 2020).

3.3.2 Study Area

The study area for noise is consistent with the study area from the 2021 PEA, which was based on the composite of landings of Runway 15 and Runway 33 and the resulting combined footprint of the Dream

Chaser's 1.0 pounds per square foot (psf) sonic boom noise contour as it descends to land at the SLF (see Appendix B of the 2021 PEA for further description about how the sonic boom was calculated). The study area encompasses about 280 square miles including portions of Brevard and Volusia counties and extends over a portion of the Atlantic Ocean (see Figure 3-1 of the 2021 PEA).

3.3.3 Existing Conditions

Existing conditions are generally consistent with those that were analyzed in Section 3.4 of the 2021 PEA.

3.3.4 Environmental Consequences

The Proposed Action includes up to four annual nighttime reentries at the SLF, while the 2021 PEA analyzed up to two nighttime reentries. The increase in nighttime reentries would increase the C-weighted DNL (CDNL) from 41 C-weighted decibels to 43 C-weighted decibels, well below the significance threshold of C-weighted CDNL 60 C-weighted decibels (equivalent to a DNL of 65 dbA). Therefore, the noise and sonic boom analysis conducted in the 2021 PEA remains substantially valid and there would be no significant impact.

Airspace closures associated with commercial space operations could result in temporarily grounded aircraft at affected airports and re-routing of en-route flights on established alternate flight paths. As noted above, the FAA has rarely, if ever, received reportable departure delays associated with commercial space operations at KSC and the surrounding facilities. 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 as the planes sit idle. Also, depending on the altitude at which aircraft approach an airport, there could be temporary increases in noise levels in communities around the airports. However, aircraft would travel on existing en-routes and flight paths that are used on a daily basis to account for weather and other temporary restrictions. In addition, not all reentry missions would affect the same aircraft routes or the same airports, and re-routing associated with reentry-related closures would represent a small fraction of the total amount of re-routing that occurs from all other reasons in any given year. Any incremental increases in noise levels at individual airports would only last the duration of the airspace closure on a periodic basis and are not expected to meaningfully change existing day-night average sound levels at the affected airports and surrounding areas. Therefore, airspace closures due to reentry operations of the Dream Chaser at the SLF are not expected to result in significant noise impacts. Advancements in airspace management as mentioned above are expected to further reduce the number of aircraft that would contribute to noise at the affected airports and surrounding areas.

Chapter 4
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Chapter 5
List of Agencies and Persons Consulted

Federal Agencies

Federal Aviation Administration Air Traffic Organization

National Aeronautics and Space Administration

National Park Service

United States Coast Guard

United States Fish and Wildlife Service

United States Space Force

State Agencies

Florida State Division of Historic Resources

Tribes

Catawba Indian Nation

Chitimacha Tribe of Louisiana

Coushatta Tribe of Louisiana

Eastern Band of Cherokee Indians

Jena Band of Choctaw Indians

Miccosukee Tribe of Indians of Florida

Muscogee (Creek) Nation

Poarch Band of Creek Indians

Seminole Tribe of Florida

Chapter 6
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