Federal Aviation Administration

Final Environmental Assessment for Boom Technology XB-1 Supersonic Test Flights

Responsible FAA Official

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Purpose and Need

1.1 Introduction and Background

Boom Technology is a Colorado-based company developing a supersonic demonstrator aircraft, called XB-1, in a risk reduction effort for the future development of a supersonic airliner, Overture. The XB-1 demonstrator aircraft will test design features and operations, develop technologies, and validate tools (e.g., design codes and methodologies) that aid in reducing later risks associated with the ultimate/final aircraft design. This would enable the development of a robust, safe design for the company's supersonic airliner aircraft, Overture. The focus of testing XB-1 is to inform and ensure safety on the design of a new aircraft. As an experimental flight demonstrator, XB-1 is designed for a limited, specific flight test campaign. As a company, Boom Technology is committed to industry-leading standards of speed, safety, and sustainability, and strives to apply these principles to all of its activities, including the XB-1 program.

As a company advancing a civil supersonic aircraft, Boom requires a waiver under 14 CFR 91.817-818 ("Special flight authorization to exceed Mach 1") that restricts civilian supersonic operations over land in the U.S. Boom plans to operate XB-1 from Mojave Air and Space Port (MHV) subsonically, and only fly supersonically within pre-existing supersonic corridors; thus, Boom is requesting this waiver for limited supersonic flight operations within the confines of the pre-existing supersonic corridors within the R-2508 Airspace Complex that are used for daily military aircraft supersonic testing.

This Environmental Assessment (EA) has been prepared to satisfy the requirements of the National Environmental Policy Act (NEPA) as amended (42 U.S.C. 4321-4347), the regulations of the Council on Environmental Quality (40 CFR parts 1500-1508), U.S. Department of Transportation Order 5610.1C, *Procedures for Considering Environmental Impacts,* Federal Aviation Administration (FAA) Order 1050.1F, *Environmental Impacts: Policies and Procedures*, and its accompanying Desk Reference. This EA addresses the environmental impacts of proposed supersonic operations within the pre-existing supersonic corridors, as well as the effects of the associated landing and takeoff (LTO) operations at Mojave Air and Space Port. The proposed supersonic flight operations evaluated in this EA would consist of a limited number of test flights (10-20 supersonic tests of the XB-1 and its chase aircraft) occurring within a one-year duration. The Proposed Action would not cause a permanent change in the number of supersonic flight operations that already occur in the area.

1.2 Proposed Action

As an experimental aircraft, XB-1 would be completing its entire test program operating to and from Mojave Air and Space Port, in Mojave CA. The XB-1 is a three-engine (GE J85 -15) aircraft. The XB-1 flight test program would consist of subsonic and supersonic flights of the experimental aircraft. A chase aircraft would accompany the XB-1 during all flight test operations, including flying supersonically. The proposed supersonic operations are anticipated to be conducted within the Black Mountain Supersonic Corridor and portions of the High-Altitude Supersonic Corridor. Boom plans to operate all aircraft supersonically only above 30,000 ft Mean Sea Level (MSL) for these flight tests. Depending on the flight

test airspeed increments dictated by flight test data from lower speeds, the supersonic portion of the test program is expected to include approximately 10 - 20 supersonic tests, with each supersonic test including up to 2 aircraft (XB-1 and chase, or two chase aircraft) flying supersonically. The safety-critical chase aircraft may also conduct supersonic flight tests in advance of XB-1 flights to ensure safe overall flight operations.

The chase aircraft would be either a Northrop T-38 Talon (NH-T38) or a Northrop F-5 (NH-F5) aircraft. This EA evaluates the environmental consequences of both the supersonic flight regimes of XB-1 and/or accompanying chase planes in the existing supersonic corridors, as well as the landing and takeoff portion of these flights at the Mojave Air and Space Port. For purposes of this evaluation, the Northrop F-5E/F Tiger II aircraft was used to evaluate air quality and climate for both XB-1 and chase aircraft. The F-5E/F Tiger II is a 2-engine aircraft that operates the J85-GE-21 engines. The results for the F-5 aircraft were scaled up by 3/2 since the XB-1 will operate with 3 engines. This approach would produce a conservative estimate of environmental effects because: (1) both the T-38 and F-5 engines are lighter and have less thrust than the F-5E/F Tiger II assumed in this EA, and (2) despite having one more engine, XB-1 is lighter than the F-5 E/F Tiger II, requiring less thrust for takeoff and climb.

Boom is requesting approval to fly supersonically overland in the existing R-2508 Complex. The R-2508 Complex includes all of the airspace associated with land presently used and managed by military activities. Within the R-2508 Complex are areas designated for bombing ranges, supersonic corridors, and low altitude high speed maneuvers among others. Boom is proposing to fly supersonic in the Black Mountain Supersonic Corridor and in a portion of the High-Altitude Supersonic Corridor within the R-2515 airspace, as shown in **Figure 1**[1] (approximately between longitudes W118 20 and W 116 30) at or above 30,000 ft MSL for these supersonic tests. An important distinction of the Proposed Action, relative to the current tests that are carried out by the military within the R-2508 Complex, is that the Proposed Action would not involve supersonic testing below 30,000 ft MSL whereas tests conducted by the military (unrelated to the Proposed Action) routinely involve supersonic flights at lower altitudes, which would result in lower sonic boom overpressure impacts from the Proposed Action relative to some existing military operations. **Figure 2** shows a closer view of the Proposed Action area.

The timeframe associated with the Proposed Action would be for 1 calendar year from the date of authorization approval of the SFA.

The Proposed Action would occur within the existing large airspace complex referred to as the R-2508 Complex. **Figure 3** provides a description of the R-2508 airspace. This airspace complex is jointly managed and used by the Air Force Flight Test Center (AFFTC), Naval Air Warfare Center Weapons Division at Naval Air Weapons Station China Lake, and Fort Irwin National Training Center (U.S. Army), and is currently used by the military for various test, evaluation, and training purposes. The R-2508 Complex is comprised principally of two types of special use airspace: restricted area and military operations area (MOA), and air traffic control assigned airspace (ATCAA).

Special use airspace is designated by the FAA, overlies a specifically defined area of the surface of the Earth, is depicted prominently on charts used by both civil and military aircrews for aeronautical

[1] High Altitude Supersonic Corridor in the R-2508 Airspace is 240 nautical miles long and Black Mountain Supersonic Corridor 8 nm wide. Per the highlighted proposed airspace, affected area is estimated at about 2,720 nautical square miles (~16 nm X ~240 nm X .5 for HASSC and portion of BMSSC ~8 nm X ~100 nm X .5).

navigation, and has specified lower and upper altitude limits (also referenced respectively as an altitude floor and ceiling). The lateral boundaries of ATCAAs are not shown on aeronautical charts but usually correspond to or are in close association with those of MOAs or restricted areas. ATCAAs also have defined altitude floors and ceilings. The ceiling of an MOA may extend up to, but cannot include, 18,000 feet MSL, whereas an ATCAA has a floor at or above 18,000 feet MSL and a ceiling at some higher altitude. The basic purpose of restricted areas, MOAs, and ATCAAs is to provide airspace in which hazardous flight activities such as aerial missile launches, gunnery or bombing, flight test maneuvers, or air combat maneuvering can be performed without presenting an unacceptable level of risk to aircraft that are not participating in the activity.

The High-Altitude Supersonic Corridor and the Black Mountain Supersonic Corridor are contained within the existing R-2515 restricted area except for the westernmost segment of the Black Mountain Supersonic Corridor (which extends into the Isabella ATCAAIR-2508 airspace and is used for supersonic flight only above 30,000 ft MSL) and the eastern most segment of the High-Altitude Supersonic Corridor (which extends to the Colorado River south of Las Vegas). The Proposed Action area includes the entirety of the Black Mountain Supersonic Corridor and the portion of the High-Altitude Supersonic Corridor that lies within the R-2515 restricted area (see Figure 1, Figure 2, and Figure 3). The corridors are designated work areas within R-2515 and are not separately depicted on standard aeronautical charts. Neither corridor may be activated or used for supersonic flight unless R-2515 is also active. Non-participating aircraft are restricted from entering R-2515 when this airspace is active.

Supersonic flights in the Black Mountain corridor range from 345 to 414 tests per year; a peak year of test flights occurred in 2022 at 414 tests.[2] Fluctuations in the number of supersonic flights reflect the variations of operational intensity of various military test and training programs such as the F-35, F-22, F-16, T-38, and the F-18 aircraft (USAF, 2010). Of these, approximately 20-25% of supersonic flight tests occurred below 30,000 ft in altitude.

[2] The most recent data on supersonic sorties in the Black Mountain Supersonic Corridor and the Alpha Corridor/PIRA is for 2022, per the 412th Operations Support Squadron.

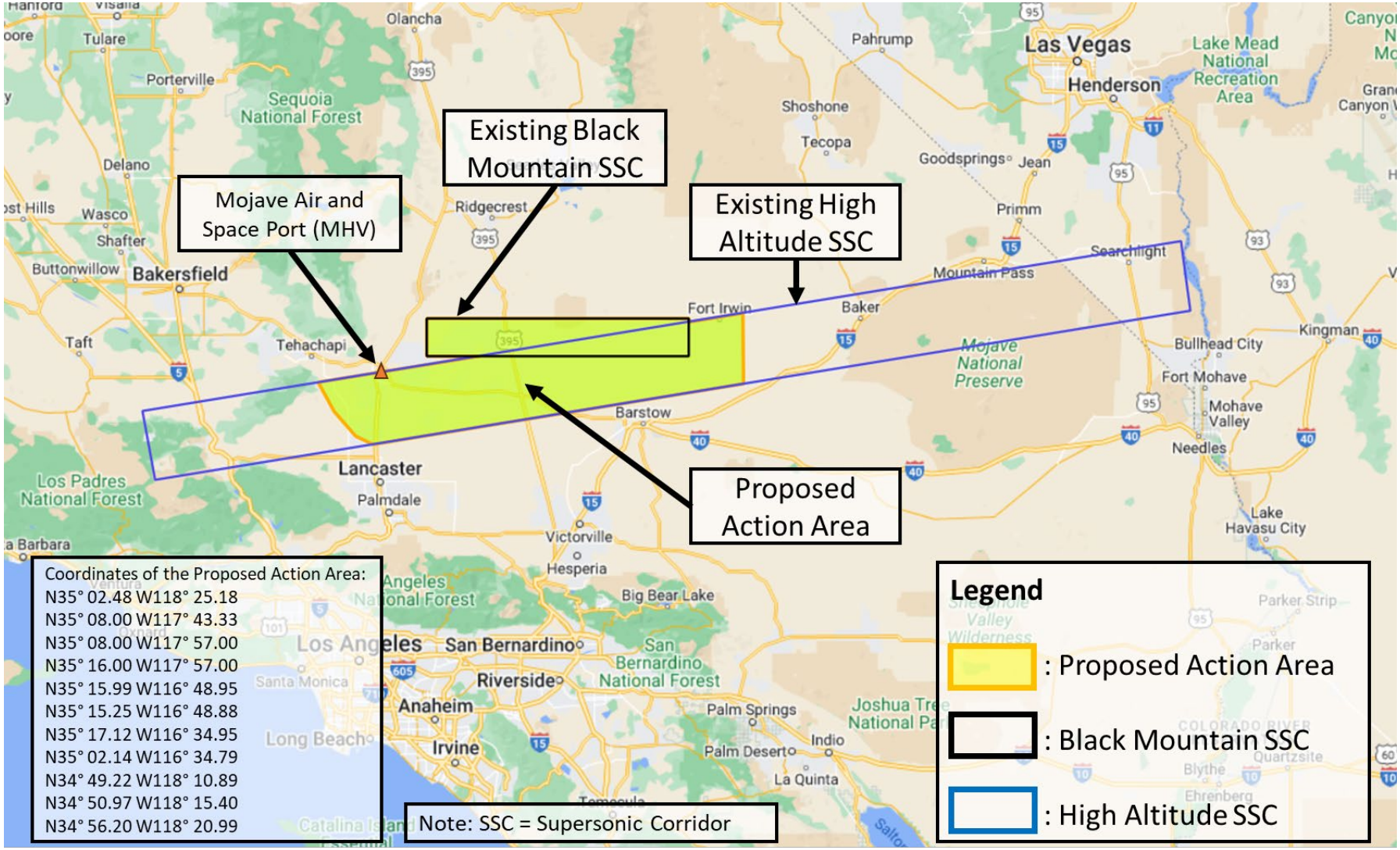

***Figure 1**: Proposed Action Area*

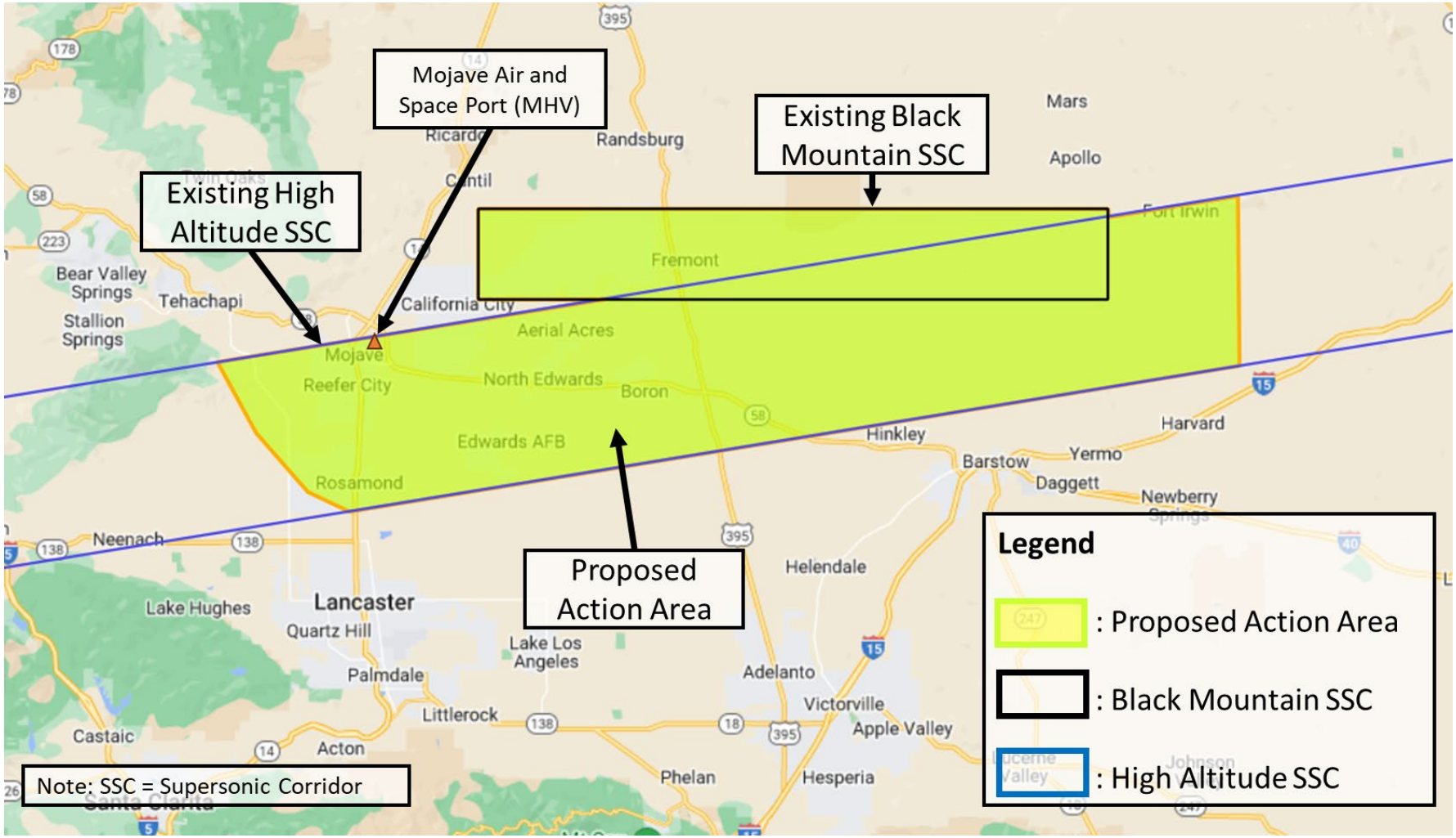

Figure 2: *Proposed Action Area (closer-in)*

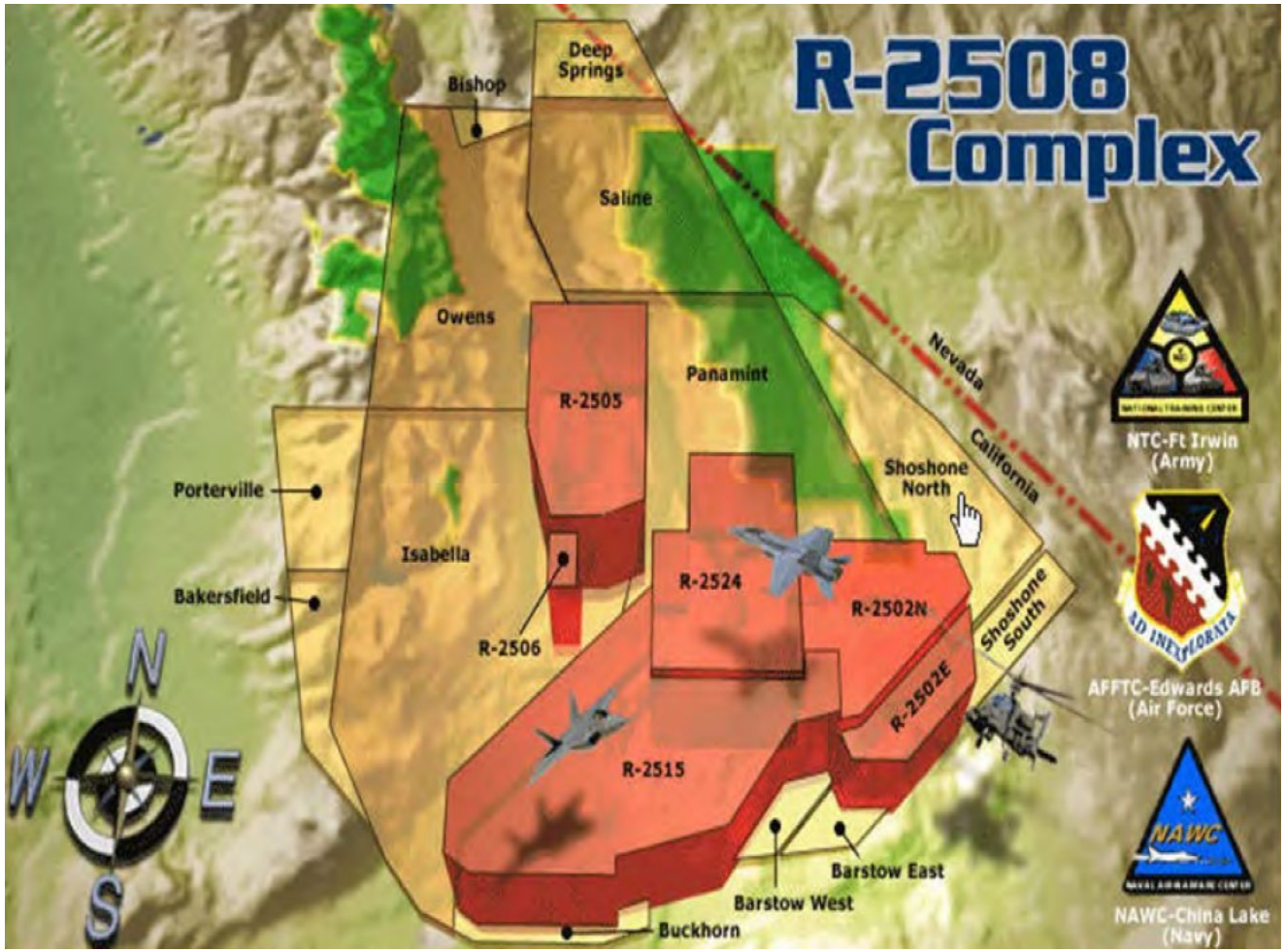

Figure 3: *R-2508 Airspace Description Surrounding the Proposed Action Area (https://www.edwards.af.mil/About/R-2508/)*

1.3 Purpose and Need

The purpose of the project is to conduct over-land supersonic flight testing of the XB-1 experimental aircraft in a risk reduction effort for the future development of a supersonic airliner, Overture.

The need for the testing is to ensure the safe development of a new technology aircraft. The XB-1 demonstrator aircraft will test design features and operations, develop technologies, and validate tools that aid in reducing later risks associated with the ultimate/final aircraft design. This would enable the development of a safe, airworthy design for the company's full-size supersonic airliner aircraft, Overture. The focus of testing XB-1 supersonically is to inform and ensure safety. XB-1 would serve as a flying data collector; a massive data acquisition system is integrated into the airplane. All of the data would be reviewed by flight test engineers and serve to refine and validate engineering calculations and program processes. For example, flying XB-1 supersonically allows the company to refine and validate its analytical methods including computational fluid dynamics, external loads development, system simulation modeling, and mass property management. It would also allow the company to refine and validate its operational processes including supply chain management, quality control, manufacturing procedures, and safety management. There is no alternative to refining and validating the above-mentioned parameters without conducting supersonic flight testing of XB-1. The XB-1 aircraft must operate over land to avoid and/or minimize the safety risk to the XB-1 aircraft and crew. The aircraft does not have sufficient range to operate over water. The XB-1 aircraft is designed for short sprints of supersonic flight for aircraft testing and thus holds insufficient fuel for long-distance operations. It also has very high takeoff and landing speeds requiring long runways to maintain sufficient margin for possible aborted takeoffs or heavy-weight landings. Furthermore, XB-1 will require monitoring of critical safety of flight parameters by the mission control room. This limits the range at which the aircraft could operate away from the antenna and not lose the critical monitoring which ensures the safety of the operations. To this end, the proposed corridor for operations would provide the highest and only acceptable level of safety for XB-1 operations.

As referenced above, Boom estimates that 10 to 20 supersonic tests would fulfill the flight test needs. The timeframe associated with the Proposed Action would be for 1 year following the FAA issuance of the XB-1 experimental airworthiness approval.

As outlined in the Project Description, the XB-1 flight test program would involve the use of a chase aircraft that accompanies the XB-1. Chase flights are an essential safety component of the flight test program as they are used to calibrate systems onboard the experimental XB-1, perform visual safety checks of XB-1 during different phases of flight, and assist in troubleshooting issues as they arise. Ahead of the XB-1 flights, it is expected that a certain number of supersonic flight tests will be flown by a single chase plane, as well as "profile development" flights involving the primary chase aircraft and a second chase aircraft acting as a surrogate for XB-1. Note that each XB-1 supersonic test would include up to 2 aircraft flying supersonically. The purpose of these chase-only flight tests is for the XB-1 flight test team and controlling agencies to exercise the operational procedures, protocols, and constraints for supersonic flight within the Proposed Action area as outlined in Figure 1. This would ensure that the supersonic flight tests with XB-1 are conducted safely and efficiently. The chase-only supersonic flights are included within the estimated total number of supersonic tests provided above (i.e., the total number of supersonic test flights would still be 10-20).

1.4 Public Involvement

The FAA created a Notice of Availability (NOA) with information about the Draft EA and provided it to local, state, and federal officials, interest groups, and federally recognized tribes. The NOA provided information about the proposed action and requested public review and comments on the draft EA, which was published on the FAA's website https://www.faa.gov/about/office_org/headquarters_offices/apl/aee/env_policy/sfa_supersonic. The public comment period was January 12 to February 2, 2024. Interested parties were invited to submit comments on any environmental concerns related to the proposed action. No comments were received. The Final EA can also be found at the website above.

Chapter 2
Proposed Action and Alternatives

2.1 Proposed Action

The Proposed Action would be to conduct 10-20 supersonic flight tests of Boom's XB-1 demonstrator aircraft and associated chase aircraft within pre-existing supersonic corridors over the Mojave Desert, namely within the Black Mountain Supersonic Corridor and portions of the High-Altitude Supersonic Corridor. Boom would operate all aircraft subsonically from Mojave Air and Space Port and supersonic only above 30,000 ft Mean Sea Level (MSL) in the existing supersonic corridors for these flight tests. The Proposed Action areas are outlined in Chapter 1.

The Proposed Action satisfies all the evaluation criteria identified above. The Proposed Action would occur in a location that would minimize proximity to population centers in order to avoid safety risks to the surrounding areas, it occurs in a location that would minimize safety risks to the flight test crew, ensure aircraft safety and recoverability, and maintain safety-critical communications with the ground crew, and allows all necessary data to be collected and protected adequately given that XB-1 features several export-controlled technologies and Controlled Unclassified Information to support a U.S. government contract. Most importantly from an environmental perspective, the Boom tests would occur in an area already designated and experiencing supersonic flight operations.

Federal guidelines concerning this environmental review process require that all reasonable alternatives that might address the "purpose and need" be considered. The examination of alternatives is of critical importance to the environmental review process and serves to ensure that an alternative that might enhance or have a less detrimental effect on environmental quality has not been prematurely dismissed from consideration.

As stated in Chapter 1, Purpose and Need, the purpose of the Proposed Action is to conduct supersonic flight testing of the XB-1 experimental aircraft in a risk reduction effort for the future development of a supersonic airliner, Overture. This chapter identifies and evaluates reasonable alternatives that could meet the purpose and need for the Proposed Action.

2.2 Alternatives

Reasonable alternatives to the Proposed Projects, including the No-Action Alternative, were identified, and evaluated in this EA in accordance with NEPA, Council on Environmental Quality (CEQ) guidance, and FAA guidance and policies, including FAA Order 1050.1F. FAA Order 1050.1F (para 6-2.1d) specifically states:

"The alternatives discussed in an EA must include those that the approving official will consider. There is no requirement for a specific number of alternatives or a specific range of alternatives to be included in an EA. An EA may limit the range of alternatives to the proposed action and no action when there are no unresolved conflicts concerning alternative uses of available resources. Alternatives are to be considered to the degree commensurate with the nature of the proposed action and agency experience with the environmental issues involved."

The following criteria were established to evaluate alternatives to the Proposed Action that meet the stated Purpose and Need:

- Population Safety: The Proposed Action must occur in a location that would minimize proximity to population centers in order to avoid safety risk to the surrounding areas.
- Flight Safety: The Proposed Action must occur in a location that would minimize safety risks to the flight test crew, ensure aircraft safety and recoverability if an immediate return to base or bailout is necessary, and maintain safety-critical communications with the ground crew at all times.
- Ability to collect flight test data: The Proposed Action must enable the collection of all necessary data to refine and validate engineering calculations and design/development processes described in Chapter 1 – Purpose and Need.

2.2.1 Alternative 1: Supersonic Flight Testing Over Water

One alternative that was considered was conducting supersonic test flights over the ocean. This would not require any federal action as the supersonic flight tests would be conducted at such a distance away from coastlines that there would be no sonic boom impacts reaching land.

The available civilian coastal runways from which to launch the XB-1 aircraft are all located in very densely populated areas within congested Class B airspace (which is the area used to control the traffic around major commercial service airports). The XB-1 aircraft is restricted by its FAA-assigned operating limitations to avoid flight over densely populated areas or within congested airways; therefore, the FAA would not allow the XB-1 aircraft to operate from these civilian coastal airports. In addition, the XB-1, as a test aircraft, does not have the fuel capacity to fly from long inland runways (e.g., Mojave) to 30 miles out over the ocean for its supersonic testing and return to base with required fuel reserves. Further, conducting supersonic tests over the sea would provide no alternative airports in which XB-1 can land if needed, significantly increasing risk to the crew and aircraft.

Thus, to ensure safety relative to large populations on the ground and the safety of the air crew, this alternative was deemed to be infeasible per the selection criteria established herein, and therefore not carried forward in the analysis.

2.2.2 Alternative 2: Supersonic Flight Testing Outside the U.S.

Boom Technology could look to test their aircraft outside of the United States. This option was considered but is not a prudent alternative since Boom Technology is a U.S. company and testing elsewhere is not feasible as (1) XB-1 contains export-controlled technologies (which requires an export license and potential restrictions for testing abroad) and (2) some of the test data would be considered Controlled Unclassified Information in support of a U.S. Government contract which cannot be adequately protected if collected overseas. Further, Boom will ultimately seek certification from U.S. regulators for its supersonic airliner.

Because this alternative does not satisfy all criteria required to accomplish the stated Purpose and Need, this alternative is not feasible and therefore not carried forward in the analysis.

2.2.3 No Action Alternative

The Council of Environmental Quality (CEQ) regulations include specific directions in the consideration of alternatives. Section 1502.14(d) of said regulation states: “Agencies shall include the alternative of no action in any environmental analysis.” The No Action Alternative (also referred to as No Action) for this study assumes that Boom does nothing and does not test supersonically overland.

This would negate the entire purpose of the XB-1 demonstrator program, which is to provide data on the flight performance capabilities of several novel technologies that have not been previously flight tested or certified and demonstrate that these technologies would not adversely impact flight safety. If Boom does not conduct supersonic testing of XB-1, it could introduce increased safety risks into the design and development of the supersonic airliner program, Overture.

The No Action Alternative does not meet the criteria established to serve the “purpose and need” identified in Chapter 1. However, Council on Environmental Quality (CEQ) Regulations and the Federal Aviation Administration’s (FAA) Order 1050.1F, prescribe the need to analyze and compare the No Action Alternative to the Proposed Action. Therefore, this No Action Alternative is carried forward in the analyses.

Chapter 3
Affected Environment and Environmental Consequences

Pursuant to the FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*, the potential impacts of the projects associated with the No Action Alternative and Proposed Action Alternatives are described in this chapter. This combined Affected Environment and Environmental Consequences Chapter includes a description of the existing conditions and potential impacts for the following environmental resource categories:

- Air Quality
- Biological Resources
- Climate
- Department of Transportation Section 4(f) Lands
- Hazardous Materials, Solid Waste, and Pollution Prevention
- Historical, Architectural, Archaeological, and Cultural Resources
- Natural Resources and Energy Supply
- Noise and Noise Compatible Land Use
- Socioeconomic, Environmental Justice, and Children's Environmental Health and Safety Risks
- Cumulative Impacts

3.1 No Action Alternative

The No Action Alternative assumes that Boom does nothing and does not test supersonically overland. Therefore, the environmental impacts associated with the No Action Alternative would be expected to be identical to existing conditions described in the Affected Environment section of each resource area, since the actions being considered in the EA occur in the current timeframe and not in a future year. Therefore, this alternative is not explicitly discussed further.

3.2 Resources Identified as Not Applicable

The following resource areas have been identified as not affected by the Proposed Action. Therefore, they are not considered further in this analysis:

- Coastal Resources: The Black Mountain and High-Altitude Supersonic Corridors (where the Proposed Action would occur), or the Mojave Air and Space Port where associated LTO operations would occur, do not overlay any coastal resources.
- Farmlands: Farmland exists in the area. However, since no construction would occur with the Proposed Action, the Proposed Action would not convert any farmland into other land uses.
- Land Use: No construction would occur with the Proposed Action; therefore, no land use changes would be expected (such as disruption of communities, relocation of residences or businesses, or impact natural resource areas, apart from noise and noise compatible land use impacts that are discussed in this chapter), nor would a wildlife hazard be created.
- Visual Effects: The Proposed Action would not result in construction/new facilities. Therefore, the Proposed Action would not block or obstruct views of visual resources beyond existing conditions. Boom does not propose to conduct flight testing at night, and therefore the Proposed Action would

not create light emissions that would cause annoyance or interfere with normal activities of nearby residents.

- Water Resources: The Proposed Action is not located over any USEPA-designated Sole Source Aquifers (USEPA, 2023a) or near any wild and scenic rivers (USFWS, 2023). The only surface water occurs on a small portion of Harper Dry Lake just outside the southeast border of the Black Mountain Supersonic Corridor semi-circular maneuver area, but within the High-Altitude Supersonic Corridor and the Proposed Action area. According to U.S. Air Force evaluations conducted for the existing supersonic corridors, this area is being maintained as a wetland using well water pumping by the BLM to reestablish habitat that has disappeared since the 1900s. The Proposed Action would not result in construction/new facilities that would disturb or add to pollution of wetlands, floodplains, groundwater, surface waters or wild and scenic rivers. The Proposed Action would not affect BLM activities to reestablish habitat.

3.3 Air Quality

An air quality assessment requires consideration under both the Clean Air Act of 1970, as amended (CAA), and the National Environmental Policy Act of 1969, as amended (NEPA). These two federal laws require distinct analyses and may be separately applicable to any project.

The CAA establishes standards and programs to evaluate, achieve, and maintain acceptable air quality in the United States. In accordance with CAA requirements, the United States Environmental Protection Agency (USEPA) established the National Ambient Air Quality Standards (NAAQS), for six common air pollutants (known as "criteria air pollutants") that are potentially harmful to human health and welfare.[3]

The USEPA considers the presence of the following six criteria pollutants to be indicators of air quality:

- Carbon monoxide (CO);
- Nitrogen dioxide (NO2);
- Ground-level Ozone (O3);
- Sulfur dioxide (SO2);
- Particulate matter (PM10 and PM2.5);[4] and,
- Lead (Pb).[5]

Since 1975, lead emissions have been in decline due in part to the introduction of catalyst-equipped vehicles and the decline in production of leaded automobile gasoline. Lead continues to be used in 100LL aviation fuel for general aviation aircraft. The Proposed Action would not include the use of 100LL fuels and thus, no Proposed Action-related lead emissions are expected. Therefore, lead is not discussed further.

The NAAQS are summarized in **Table 1**. For each of the criteria pollutants, the USEPA established primary standards intended to protect public health, and secondary standards for the protection of other aspects of public welfare, such as preventing materials damage, preventing crop and vegetation damage, and assuring

[3] EPA, 40 C.F.R. § 50, National Primary and Secondary Ambient Air Quality Standards (NAAQS).

[4] PM10 and PM2.5 are airborne inhalable particles that are less than ten micrometers (coarse particles) and less than 2.5 micrometers (fine particles) in diameter, respectively.

[5] Airborne lead in urban areas is primarily emitted by vehicles using leaded fuels.

good visibility. Areas of the country where air pollution levels consistently exceed these standards may be designated nonattainment by the USEPA.

Table 1: *National Ambient Air Quality Standards*

Pollutant		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide		Primary	8-hour	9 ppm	Not to be exceeded more than once per year
			1-hour	35 ppm	
Lead		Primary and Secondary	Rolling 3-month average	0.15 µg/m3 (1)	Not to be exceeded
Nitrogen Dioxide		Primary	1-hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		Primary and Secondary	1 year	53 ppb (2)	Annual Mean
Ozone		Primary and Secondary	8-hour	0.070 ppm (3)	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particulate Matter	PM2.5	Primary	1 year	12.0 µg/m^3	Annual mean, averaged over 3 years
		Secondary	1 year	15.0 µg/m^3	Annual mean, averaged over 3 years
		Primary and Secondary	24-hour	35 µg/m^3	98th percentile, averaged over 3 years
	PM_{10}	Primary and Secondary	24-hour	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide		Primary	1-hour	75 ppb (4)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		Secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

(1) In areas designated nonattainment for the Pb standards prior to the promulgation of the current

(2008) standards, and for which implementation plans to attain or maintain the current (2008) standards have not been submitted and approved, the previous standards (1.5 µg/m3 as a calendar quarter average) also remain in effect.
(2) The level of the annual NO_2 standard is 0.053 ppm. It is shown here in terms of ppb for the purposes of clearer comparison to the 1-hour standard level.
(3) Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) O_3 standards additionally remain in effect in some areas. Revocation of the previous (2008) O_3 standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards.
(4) The previous SO_2 standards (0.14 ppm 24-hour and 0.03 ppm annual) will additionally remain in effect in certain areas: (1) any area for which it is not yet 1 year since the effective date of designation under the current (2010) standards, and (2)any area for which an implementation plan providing for attainment of the current (2010) standard has not been submitted and approved and which is designated nonattainment under the previous SO2 standards or is not meeting the requirements of a SIP call under the previous SO2 standards (40 CFR 50.4(3)).
(5) Notes: ppm is parts per million; ppb is parts per billion, and µg/m3 is micrograms per cubic meter.
Source: EPA, https://www.epa.gov/criteria-air-pollutants/naaqs-table Accessed July 2019

3.3.1 Regulatory Review

Based upon actual measurements, the USEPA designates areas as attainment, nonattainment, maintenance, or unclassified. A designation of attainment/maintenance means that the pollutant is currently or in the recent past is in attainment/meets the NAAQS. Areas that are nonattainment or maintenance are subject to a State Implementation Plan (SIP) to ensure that the NAAQS for that pollutant are not exceeded (i.e., are maintained). The federal CAA requires that states develop SIPs stating how they will attain or maintain NAAQS; SIPs are a compilation of new and previously approved plans, programs, district rules, state regulations and federal controls. States and local air quality management agencies prepare SIPs for USEPA approval.

General Conformity (40 CFR 93.150-160) is a key component of the CAA strategy intended to ensure federal actions do not jeopardize a state's ability to reach attainment, as federal projects are required to show that they conform with the current approved SIP(s). Federal agencies are required to evaluate their proposed actions to ensure that they (1) do not cause or contribute to new violations of any federal ambient air quality standards, (2) do not increase the frequency or severity of any existing violations of federal ambient air quality standards, and (3) do not delay the timely attainment of federal ambient air quality standards. To this end, the USEPA General Conformity rule requires a formal conformity determination for federally sponsored or funded actions in nonattainment or maintenance areas when the net increase in direct and indirect project-related emissions of nonattainment or maintenance pollutants exceed the specified de minimis threshold applicable to the pollutant and non-attainment/maintenance designation.

A federal action is exempt from General Conformity requirements if the total emissions resulting from the action are equal to or less than the de minimis thresholds. Thus, the action's calculated emissions are compared against established de minimis emission levels based on the nonattainment status for each applicable criteria pollutant in the area of concern to determine the relevant compliance requirements.

Table 2 defines the de minimis thresholds for nonattainment areas.

Table 2: *De Minimis Thresholds in Nonattainment Areas*

Pollutant	Degree of Non-attainment	de minimis Level (tpy)
Ozone (using NOx and VOC as proxies)	Serious	50
	Severe	25
	Extreme	10
	Marginal and Moderate (outside an ozone transport region)	100
	Marginal and Moderate (inside an ozone transport region)	50 (VOC)
		100 (NOx)
Carbon monoxide	All	100
Particulate matter	Moderate	100
	Serious	70
SO2 or NO2	All	100

Notes: NO = nitrogen monoxide, NO2 = nitrogen dioxide, NOx = nitrogen oxides (NO and NO2), SO2 = sulfur dioxide, tpy = tons per year, VOC = volatile organic compound.

3.3.2 Affected Environment

The Proposed Action would occur in the northwest portion of the Southeast Desert Air Basin (SEDAB). The SEDAB consists of the eastern part of Kern and Los Angeles counties, the desert portions of San Bernardino and Riverside counties, and all of Imperial County. The project area overlays Los Angeles County, Kern County, and San Bernardino County. The non-attainment or maintenance designations, relative to the NAAQS are noted in **Table 3** below.

Table 3 identifies the air quality status of the three areas of the Proposed Action. Current supersonic testing by the US. military and their representatives occur in parts of the region that are designated as maintenance or non-attainment for carbon monoxide (CO), ozone (O3), and particulate matter of 10 microns or smaller (PM10).

Table 3: *Air Quality Status of the Three Areas of the Proposed Action*

	Attainment/Non-Attainment/Maintenance Designation and Applicable De Minimis Threshold		
	Kern Co	San Bernardino Co	Los Angeles Co
Carbon monoxide	Bakersfield Maintenance 100 tpy de minimis	Maintenance 100 tpy de minimis	Attainment
Ozone	2015 Serious nonattainment 2008 Severe non-attainment	2015 Severe nonattainment 2008 Severe nonattainment	2015 Severe nonattainment 2008 Severe nonattainment

	Attainment/Non-Attainment/Maintenance Designation and Applicable De Minimis Threshold		
	Kern Co	San Bernardino Co	Los Angeles Co
	25 tpy Severe/50 tpy Serious	25 tpy Severe/50 tpy Serious	25 tpy Severe/50 tpy Serious
Nitrogen dioxide	Attainment	Attainment	Attainment
Sulfur dioxide	Attainment	Attainment	Attainment
Particulate matter (PM_{10})	Eastern Kern County-serious nonattainment 70 tpy de minimis	San Bernardino Co Moderate nonattainment 100 tpy de minimis	Attainment
Particulate matter (PM2.5)	Attainment	Attainment	Attainment
Lead	Attainment	Attainment	Attainment

Note: tpy=tons per year Note that General Conformity does not apply to attainment areas, and thus have no de minimis threshold
Source: USEPA Greenbook at https://www.epa.gov/green-book

3.3.3 Methodology

In evaluating aircraft emissions, the FAA requires the use of the Aviation Environmental Design Tool (AEDT). AEDT-3e was used in this evaluation as it is the current FAA state-of-the-art tool for evaluating aircraft emissions. Due to the experimental nature of the XB-1, it does not match any other aircraft in the AEDT database. XB-1 will use three J85-CAN-15 jet engines for propulsion. Therefore, to conduct this evaluation, AEDT-3e was used to prepare an emissions inventory using the F-5E/F Tiger II which uses a slightly larger engine from the J85 engine family (J85-GE-21). The 21-engine variant has a higher fuel consumption (thus higher emissions) than the CAN-15 and is considered a conservatively high surrogate for the analysis of emissions. The emissions were then scaled to 3 engines for the XB-1 aircraft, from the 2 engines that are present on the F-5. The chase aircraft engines (either the T-38 or F-5) have slightly less thrust than the Northrop F-5E/F Tiger II assumed in this EA; the F-5E/F Tiger II emissions calculated by AEDT therefore represent a conservatively high estimate of air emissions from the chase aircraft.

As the Proposed Action would involve a maximum of 20 supersonic test events that would occur above 30,000 ft, it is important to note that the supersonic-related emissions would not affect local air quality, due to the mixing height being at approximately 3,000 feet above ground; in general, criteria pollutant emissions occurring above the mixing height do not affect local air quality (Wayson & Fleming, 2000). Even though emissions above the mixing height do not affect local air quality, the emissions occurring in the Supersonic mode were estimated for disclosure purposes. Supersonic mode emissions were estimated in proportion to the Boom Technology simulator fuel results for XB-1, the estimated fuel consumption of the chase aircraft, the annual number of test flights, and the AEDT emissions during the takeoff ground roll phase of the F-5E/F Tiger II aircraft. During supersonic test flights, the fuel burned during the supersonic sprints of the XB-1 would be 2,800 – 3,300 lbs. of fuel per event for a total of between 28,000 and 66,000

lb. of Jet A fuel, depending on the specific airspeed build-up tests that must be done to safely expand the supersonic envelope.[6] The chase aircraft would add 2,500 lbs. of fuel per supersonic test.

3.3.4 Environmental Consequences

Landing and Takeoff Impacts at Mojave Air and Space Port

AEDT was run to estimate emissions from one Landing and Takeoff Cycle (LTO)[7] as reflected in **Table 4**, with the LTO occurring at Mojave Air and Space Port and capturing the approach and departure of the aircraft below 3,000 feet. Results in **Table 4** represent emissions from both XB-1 and the chase aircraft operating during each LTO over the one-year test period. This represents a conservative estimate of emissions, since a certain number of supersonic test flights are expected to occur with one or two chase aircraft ahead of XB-1 flight testing.

Table 4: *Emissions from Landing and Takeoff Cycle (LTO) Operations Associated with the Proposed Action*

	Carbon Monoxide (CO)	**Nitrous Oxides (NOx)**	**Volatile Organic Compounds (VOC)**	**Sulfur Oxides (SOx)**	**Coarse Particles (PM10)**	**Fine Particles (PM2.5)**
Per LTO (lb.), assuming one flight each of XB-1 and the chase aircraft	137.2	4.0	18.8	1.6	0.2	0.2
Annual (lb. assuming 20 flight test events occur in 1 year)	2,743.2	80.2	376.0	32.1	4.0	4.0

Note: emissions are rounded to the nearest tenth of a pound.

Source: AEDT-3e emissions in the LTO as reported in pounds for the F-5E Tiger operating the J85-GE-21 engine as a surrogate for the XB-1 aircraft. To estimate the XB-1, the F-5 emissions were increased by 50% reflecting that the XB-1 has 3 engines, and the F-5 has 2 engines. The chase aircraft was included reflecting an F-5.

The Clean Air Act General Conformity regulation uses tons per year, so the annual pounds are translated to tons in **Table 5** below (assuming all flight test events occur in the same year representing a high-end estimate). As **Table 5** focuses on the LTO at Mojave Air and Space Port, located in Kern County, the de minimis thresholds for Kern County were used. As is noted, less than 1 ton of most criteria pollutant

[6] Results of the XB-1 Simulator were used to estimate fuel burn.

[7] The LTO includes the approach from 3,000 above ground to touchdown, taxi in, taxi out, engine start, takeoff, and climbout to 3,000 feet.

emissions would occur in the LTO cycle (the only exception being CO which would be 1.4 tons). The emissions from the Proposed Action would be less than the de minimis threshold for each of the attainment/non-attainment-maintenance area designations.[8] These results represent a conservative estimate of emissions since a certain number of the supersonic test flights are expected to occur with one or two chase aircraft ahead of XB-1 flight test events.

Table 5: *Proposed Action LTO Emissions at Mojave Air & Space Port Comparison to Kern County General Conformity Thresholds*

	CO	**NOx**	**VOC**	**SOx**	**PM10**	**PM2.5**
Annual LTO (lbs.)	2,743.2	80.2	376.0	32.1	4.0	4.0
Annual (tons)	1.4	<0.1	0.2	<0.1	<0.1	<0.1
Kern County De Minimis threshold (tons per year)	100 Maintenance	25 Severe	25 Severe	100 (when considering PM2.5)	70 Serious	100
Are emissions below de minimis?	Yes	Yes	Yes	Yes	Yes	Yes

2000 lbs. = 1 ton Note that the emissions above include the chase aircraft. For the attainment area, the de minimis threshold for a maintenance area was used for illustration purposes.

Source: Boom Supersonic, based upon AEDT-3e results for the F-5E/F Tiger II operating the J85-GE-21 engine. Results of the F-5 were increased by 50% to reflect that the XB-1 has 3 engines, and the F-5 has 2 engines, and results also include emissions from the chase aircraft.

Supersonic Operations

The Proposed Action would also involve operations in the supersonic mode, which is at 30,000 ft, well above the 3,000 feet mixing height. Even though they do not affect local air quality, the emissions occurring in the Supersonic mode were estimated for disclosure purposes. Emissions from the supersonic mode were calculated by taking the AEDT-3e results for the takeoff ground roll of the F-5 and increasing the criteria pollutants in proportion to the simulator fuel burn (for XB-1) and the estimated fuel burn for the T-38 chase aircraft. Doing so indicates that the emissions in the supersonic mode, all of which would occur above 30,000 ft, would be less than 0.1 ton per LTO for any pollutant except CO emissions (< 2 tons for 20 supersonic tests) and NO_X (~ 0.3 tons for 20 supersonic tests). These results represent a conservatively high estimate of emissions, since a certain number of supersonic test flights are expected to occur with one or two chase aircraft ahead of XB-1 flight test events. Because those emissions are above the mixing height, there is no de minimis threshold. However, for comparison purposes, the emissions above the mixing height would also be de minimis.

[8] For attainment areas, the de minimis threshold for a maintenance area was used for illustration purposes.

As shown in **Table 5**, emissions from the Proposed Action in the LTO mode are all below the General Conformity de minimis threshold.

As noted earlier, emissions above the mixing height do not affect the ability of states and regions to meet their Clean Air Act requirements. However, if the emissions of the Proposed Action (operation of the XB-1 aircraft in the supersonic mode and its chase aircraft) were added to that of the LTO noted above, the emissions would remain well below de minimis and not be significant.

Given that the potential emissions of criteria air pollutants from the Proposed Action (the supersonic portion of flight) as well as due to LTO activity are de minimis, a General Conformity Determination is not required and the resultant emissions from the Proposed Action would not be significant.

3.4 Biological Resources

For purposes of this EA, the term "biological resources" refers to various types of flora and fauna, as well as habitat types that would support these species. This section also addresses federally listed and state-listed threatened or endangered species and their habitats.

The term "endangered species" means any member of the animal kingdom (mammal, fish, or bird) or plant kingdom (seeds, roots, etc.) that is in danger of extinction throughout all or a significant portion of its range. "Threatened species" refers to those members of the animal kingdom or plant kingdom, which are likely to become endangered within the foreseeable future. Section 7 of the Endangered Species Act of 1973 requires each federal agency that carries out, permits, licenses, funds, or otherwise authorizes activities that may affect a listed species must consult with the Fish and Wildlife Service to ensure that its actions are not likely to jeopardize the continued existence of any listed species.[9]

The following are considered special-status biological resources:

- Plant and wildlife species that are federally listed, proposed for listing, or candidates for listing.
- Plant and wildlife species that have been delisted.
- Plant and wildlife species that are state listed or candidates for listing.
- California Fully Protected Species.
- Wildlife species considered California Species of Special Concern by the California Department of Fish and Wildlife (CDFW).
- Plant species listed as sensitive by the California Native Plant Society (CNPS).
- Golden and bald eagles protected under the Bald and Golden Eagle Protection Act.
- Federal Birds of Conservation Concern.

3.4.1 Affected Environment

The High-Altitude Supersonic Corridor and Black Mountain Supersonic Corridor, where the Proposed Action would occur are situated over the western portion of the Mojave Desert. According to the Air Force's 2010 environmental review (which is the most recent evaluation available), both corridors are entirely within the Mojave Desert scrub biotic community (USAF, 2010). This area contains little topographic variation and

[9] Section 7(a)(2) of the Endangered Species Act of 1973

consists mainly of arid plains with intermittent low mountain ranges. The corridors overlay peaks or upland areas that rise above the surrounding relatively level terrain.

Desert scrub communities underlying the corridors provide a relatively simple wildlife habitat. A large variety of invertebrate species are found in the desert scrub including insects; fairy, tadpole, and clam shrimp which are found within areas of permanent playas and clay pans. Amphibians are relatively scarce because of the absence of permanent water. Reptiles are relatively common in desert scrub communities, particularly lizards. Common lizard species include the western whiptail *(Cnemidophorus tigris),* side-blotched lizard, *(Uta stansburiana),* desert iguana *(Dipsosaurus dorsalis),* and desert homed lizard *(Phrynosoma platyrhinos).* Lizards in rocky areas include the chuckwalla *(Sauromalus obesus),* collared lizard *(Crotaphytus collaris),* and banded gecko *(Coleonyx variegatus).* Common snakes include the glossy snake *(Arizona elegans),* gopher snake *(Pituophis melanoleucus),* and coachwhip *(Masticophisflagellum).*

In general, the abundance and diversity of bird species in Mojave Desert scrub communities is low. Birds are more common where there is dense vegetation, such as some large washes. Ravens *(Corvus corax)* are common and widespread resident birds. Common resident songbirds include the homed lark *(Eremophila alpestris),* black-throated sparrow *(Amphispiza bilineata)* and cactus wren *(Campylorhynchus brunneicapillus).* Common birds of prey include the red-tailed hawk *(Buteo jamaicensis),* golden eagle *(Aquila chrysaetos),* and American kestrel *(Falco sparverius).* Most mammals in desert scrub communities are nocturnal as a means of conserving water. Typical nocturnal mammals include the Merriam's kangaroo rat *(Dipodomys merriami),* little pocket mouse *(Perognathus longimembris),* desert woodrat *(Neotoma lepida),* and southern grasshopper mouse *(Onychomys torridus).* Mammalian predators include kit foxes *(Vulpes macrotis)* and coyotes *(Canis latrans).* Two notable exceptions are the whitetail antelope squirrel *(Ammospermophilus leucurus)* and black-tailed jackrabbit *(Lepus cali/omicus).*

Two designated BLM Wilderness Areas are in the Proposed Action area: Black Mountain, and Grass Valley. Each of these wilderness areas are home to various raptors, Mohave ground squirrels, desert tortoise, and Joshua tree. BLM notes that in Grass Valley Wilderness (which is in the Proposed Action area), “the vegetation is dominated by a creosote bush scrub community. Raptors forage here, and desert tortoises and Mojave ground squirrels find suitable habitat in this barren area” along with “a few Joshua trees” (USBLM, 2023b). At Black Mountain Wilderness Area, BLM notes “Golden eagles and prairie falcons have been seen foraging in this area, which is also known for its occasional display of spring flowers” (USBLM, 2023a).

The US Fish & Wildlife Services IPaC (Information for Planning and Consultation) (USFWC, 2023) was consulted relative to known threatened and endangered species that occur in the Proposed Action area. That review indicates 6 endangered or threatened species, 2 critical habitats, and numerous migratory bird species. Specifically noted were the endangered California Condor (*Gymnogyps californianus*), the threatened Western Snowy Plover (*Charadrius nivosus nivosus*); reptiles threatened Desert Tortoise (*Gopherus agassizii)*; candidate insect species Monarch Butterfly *(Danaus plexippus);* endangered mammal Fisher (*Pekania pennanti);* flowering plant endangered Lane Mountain Milk-vetch (*Astragalus jaegerianus*). The critical habitats in the project area were noted for the Desert Tortoise and Lane Mountain Milk-vetch. Migratory birds noted were the Bald Eagle (*Haliaeetus leucocephalus*), Black-chinned Sparrow *(Spizella atrogularis*), California Thrasher (*Toxostoma redivivum*), Clark’s Grebe (*Aechmophorous clarkia*), Costa’s Hummingbird (*Calypte costae*), Golden Eagle (*Aquila chrysaetos*), Lawrence’s Goldfinch (*Carduelis lawrenci*), Le Conte’s Thrasher (*toxostoma lecontei*), Long-eared Owl (*asio otus*), Marbled Godwit (*Limosa fedoa*), Pinyon Jay (*Gymnorhinus cyanocephalus*), Rufous-winged Sparrow (*Aimophila carpalis*), Short-billed

Dowitcher (*Limnodromus griseus*), Tricolored Blackbird (*Agelaius tricolor*), Western Grebe (*aechmophorus occidentalis*), and Willet (*Tringa semipalmata*).

In addition to USFWS species, the State of California has listed protected species[10] that might be in the action area include the blunt nosed leopard lizard (G*ambelia sila*), San Francisco garter snake (*Thamnophis sirtalis tetrataenia*), American peregrine falcon (F*alcon peregrinus),* brown pelican *(Pelecanus occidentalis californicus),* California black rail (*Laterallus jamaicensis coturniculus*), California clapper rail (*Rallus longirostris obsoletus*), California condor (*Gymnogyps califonianus*), California least tern (*Sterna albifrons browni*), golden eagle (*Aquila chrysaetos*), greater sandhill crane (G*rus canadensis tabida*), kight-footed clapper rail (*Rallus longirostris levipes*), southern bald eagle (*Haliaeetus leucocephalus leucocepohalus*), trumpeter swan (*Cygnus buccinator*), white-tailed kite (*Elanus leucurus*), Yuma clapper rail (*Rallus longirostris yumanensis*), Morro Bay kangaroo rat (*Diopodomys heermanni morroensis*), bighorn sheep (*Ovis canadensis*), ring-tailed cat (*Genus Bassariscus*), salt-marsh harvest mouse (*reithrodontomys raviventris*), wolverine (*Gulo luscus*), Santa Cruz long-toed salamander (*Ambystoma macrodactylum*), limestone salamander (*Hydromantes brunus*), and black toad (*Bufo boreas exsul*).

No known state-listed endangered plant species reside within the area of either supersonic corridor.

3.4.2 Environmental Consequences

Per FAA Order 1050.1F, a significant impact on biological resources would occur if the USFWS or the NMFS determines that the action would be likely to jeopardize the continued existence of a federally listed threatened or endangered species or would result in the destruction or adverse modification of federally designated critical habitat. The FAA has not established a significance threshold for unlisted species. However, FAA Order 1050.1F includes "factors to consider" when evaluating the context and intensity of potential environmental impacts to unlisted species, including the following:

- A long-term or permanent loss of unlisted plant or wildlife species, i.e., extirpation of the species from a large project area (e.g., a new commercial service airport);
- Adverse impacts to special status species (e.g., state species of concern, species proposed for listing, migratory birds, bald and golden eagles) or their habitats;
- Substantial loss, reduction, degradation, disturbance, or fragmentation of native species' habitats or their populations; and
- Adverse impacts on a species' reproductive success rates, natural mortality rates, non-natural mortality (e.g., road kills and hunting), or ability to sustain the minimum population levels required for population maintenance.

No long-term, permanent loss of plants or wildlife is expected to result from the Proposed Action. The Proposed Action would not result in construction and thus, no construction-related impacts related to earthmoving or land use change would exist. Direct taking of species or their habitat is not expected from implementation of the Proposed Action, and no substantial loss, reduction, degradation, disturbance, or fragmentation of native species habitats or populations would be expected to occur.

The Proposed Action would not affect species protected under the Migratory Bird Act. The Proposed Action would not result in construction and thus, no direct impacts to Migratory Birds would be expected.

[10] The classification Fully Protected is a designation used by the state to provide added protection for animals that were rare or faced possible extinction. https://wildlife.ca.gov/Conservation/Fully-Protected

Indirect effects could include impacts to migratory birds as a result of operations from the Proposed Action, as is the case with current activity in the corridors. The Proposed Action would entail aircraft operating at supersonic speeds at altitudes above 30,000 ft. According to the FAA's Aeronautical Information Manual Section 7-5-1 "The altitudes of migrating birds vary with winds aloft, weather fronts, terrain elevations, cloud conditions, and other environmental variables. While over 90 percent of the reported bird strikes occur at or below 3,000 feet AGL, strikes at higher altitudes are common during migration. Ducks and geese are frequently observed up to 7,000 feet AGL and pilots are cautioned to minimize en route flying at lower altitudes during migration"(FAA, 2023c). Thus, the Proposed Action would occur above 30,000 ft above ground where few migratory birds fly. However, there is the possibility of bird strikes at this altitude as occurs with today's supersonic activity in the corridors. Any strikes would be reported in accordance with standard aviation practices. In addition to the above indirect effects, the Proposed Action would not result in construction and thus, no impacts to Migratory Birds would be expected.

The Proposed Action is not expected to have an adverse impact on species' reproduction rates, mortality rates, or ability to sustain population levels. With respect to operational impacts, previous evaluations of biological species in the vicinity of Edwards AFB and the R-2508 complex have concluded that "although range flight activities may have the potential to impact wildlife, many species have shown an ability to acclimate to high noise levels, including sonic booms", and specifically that "desert tortoise do acclimate to aircraft-related noise exposure and do not exhibit significant adverse effects related to their hearing, behavior, or heart rate" as well as "other species, including falcons, bighorn sheep, and wild horses, are known to successfully and consistently reproduce throughout ranges where aircraft operations occur" (USAF, 2009). Therefore, no impacts to reproduction rates or mortality rate or ability to sustain population levels would be expected from operations in the limited number of additional flights from the Proposed Action.

Consideration was given to the potential effects of aircraft noise and the sonic boom impact on biological species. As there would be no physical alteration to the ground with the Proposed Action, the assessment focused on indirect effects due to noise.

According to the FAA's 1985 *Aviation Noise Effects* document (FAA, 1985), while some bird species react to aviation noise, the report concluded that "While instances may arise in which aviation noise does create a concern for those protecting wildlife or involved in animal husbandry, in general, aviation noise has a minimal impact on animals."

The US Air Force's 1988 *Report Effects of Aircraft Noise and Sonic Booms on Domestic Animals and Wildlife* identifies research effects of sonic booms on various species and identifies possible negative effects on birds, amphibians, reptiles, and invertebrates. The document notes "A number of animal studies during the 1960s and early 1970s involved exposure to sonic booms; however, the majority of these studies were behavioral studies using domestic animals. Only a few involved observations of wildlife. In almost all these behavioral studies, domestic animals and wildlife exhibited a startle response. This behavioral response of wildlife has been fully described, but the accompanying physiological response to aircraft noise has not been well studied, due primarily to the difficulty of assessing these effects in the field (USAF, 1988).

Previous evaluations of biological species specifically in the vicinity of Edwards AFB have concluded that "wildlife in the vicinity of the Edwards AFB airfield is expected to be acclimated to routine flightline activities and noise levels", and additionally that "many species have shown an ability to acclimate to high noise levels, including sonic booms" when referring to military overflight operations (USAF, 2009).

Of the candidate, threatened, and endangered species, habitats for the desert tortoise and the Lane Mountain milk-vetch were noted by US Fish & Wildlife in the Proposed Action area. The Lane Mountain milk-vetch (*Astralagus jaegerianus*) is an herbaceous perennial species whose habitat occurs in the eastern sector of the supersonic corridor. The US Fish and Wildlife Service has designated the area as a restricted area specifically for the maintenance of the desert tortoise population. The U.S Fish and Wildlife Service's 2014 Biological Opinion for noise impacts from Edwards Air Force Base operations on the desert tortoise (8-8-14-F-14) cites research from Bowles et al. (Bowles et al., 1999), who found that subsonic and supersonic aircraft noise did not elicit substantial responses from desert tortoises. This represents the most recent assessment of aircraft noise impacts on desert tortoises that was identified in preparing this EA.

The Proposed Action would add no more than 20 supersonic tests in the action where already 345-414 supersonic tests occur each year. Given that any species in the area would have already adapted to the existing environmental conditions, the additional 10-20 tests would not be expected to result in a significant adverse effect.

No significant impacts to biological resources are expected. Boom proposes to implement the following best practices to minimize any potential effects to biological resources:

- Boom will comply with AFI 91-202, The U.S. Air Force Mishap Prevention Program;
- Boom will follow The U.S. Air Force Base Bird/Wildlife Aircraft Strike Hazard (BASH) plan, which outline actions designed to reduce BASH through bird avoidance and control to allow for safe operational flight missions; and,
- Boom will comply with The Desert Tortoise Handout (DT Handout 412 TWPA Release #18150 20180316) distributed by Edwards Air Force Base.

In summary, the Proposed Action would not cause long-term, permanent loss of plants or wildlife; would not have impacts to direct taking of species or their habitat; would not result in substantial loss, reduction, degradation, disturbance, or fragmentation of native species habitats or populations; would not have an adverse impact on species' reproduction rates, mortality rates, or ability to sustain population levels, and would not affect species protected under the Migratory Bird Act. Therefore, the Proposed Action would not have significant impacts to biological resources in the project area.

3.5 Climate

Research has shown that an increase in greenhouse gas (GHG) emissions is significantly affecting the Earth's climate. These conclusions are based on scientific record that includes substantial contributions from the United States Global Change Research Program (USGCRP), mandated by Congress in the Global Change Research Act to "assist the Nation and the world to understand, assess, predict, and respond to human-induced and natural processes of global change" (USG, 1990).

In 2009, based primarily on scientific assessments of the USGCRP, the National Research Council, and the Intergovernmental Panel on Climate Change (IPCC), the United States Environmental Protection Agency (USEPA) issued a finding deeming it reasonable to assume that changes in climate caused by elevated concentrations of GHG in the atmosphere endanger the health and welfare of current and future generations. By summer 2016, the USEPA acknowledged that scientific assessments by that time "highlight the urgency of addressing the rising concentration of carbon dioxide (CO2) in the atmosphere" and formally announced that GHG emissions from certain classes of aircraft engines contribute to climate change.

The most prevalent GHG from aviation are CO2, and very small amounts of methane (CH4), and nitrous oxide (N2O). GHG emissions are typically reported in units of metric tons (MT) of carbon dioxide equivalents (CO2e).

Although there are no federal standards for aviation related GHG emissions, it is well established that GHG emissions affect climate (FAA, 2007). Following procedures detailed in FAA's 1050.1F Desk Reference, FAA's policy is that GHG emissions should be quantified in a NEPA document when there is reason to quantify emissions for air quality purposes or when changes in the amount of aircraft fuel used are computed/reported.

3.5.1 Affected Environment

Worldwide emissions of GHG in 2021 were 54.6 billion metric tons of CO2e per year (Ritchie et al., 2023). In 2016, the United States emitted about 6,340 million metric tons of CO2e. Total U.S. emissions have decreased by 2.3 percent from 1990 to 2021, and emissions increased from 2020 to 2021 by 5.2 percent (314.3 million metric tons of CO2e). Between 2020 and 2021, the increase in total greenhouse gas emissions was driven largely by an increase in CO2 emissions from fossil fuel combustion due to economic activity rebounding after the height of the COVID-19 pandemic (US EPA, 2023).

Of the five major sectors nationwide - residential and commercial, industrial, agriculture, transportation, and electricity – transportation accounts for the highest fraction of GHG emissions (approximately 29 percent), closely followed by electricity (approximately 25 percent) and by industry (approximately 24 percent). The most recent USEPA data indicate that in 2021, aircraft accounted for 8.6 percent of U.S. transportation GHG emissions (US EPA, 2023).

3.5.2 Environmental Consequences

The Council on Environmental Quality (CEQ) has issued interim guidance directing agencies to quantify, disclose, and contextualize climate impacts, as well as address the potential climate change effects of the Proposed Action (CEQ, 2023). The FAA has not established a significance threshold for Climate impacts. As such, this section quantifies and discloses the potential greenhouse gas (GHG) emissions from the Proposed Action, provides context by monetizing the results using social cost of carbon estimates and discusses mitigation measures taken to address the effects of GHG emissions.

The Proposed Action would result in an increase of emissions of Greenhouse gases (GHG). The Proposed Action would require the consumption of jet fuel which would thus result in the generation of greenhouse gas emissions, namely carbon dioxide (CO_2). The XB-1 aircraft contains a maximum of 6,000 lbs. of fuel in its tanks, and the T-38 chase aircraft contains a maximum of 3,900 lbs. of fuel. Therefore, each test flight event would potentially consume up to 9,900 lbs. of jet fuel, for a total fuel consumption of 198,100 lbs. assuming 20 test flights.

Assuming all the 20 test flights operate using fossil Jet A fuel, the Proposed Action would result in up to 284 metric tons of CO_2.[11] These results represent a conservative estimate of emissions, since a certain number of the supersonic test flights are expected to occur with one or two chase aircraft ahead of XB-1 flight testing. In 2021, the USEPA estimates that all sources in the U.S. emitted 6,347.7 million metric tons of

[11] Calculated assuming a CO2 emission index of 3.16 kg CO2/kg fuel. Source: U.S. EPA, Airplane Greenhouse Gas Standards Technical Support Document (TSD) (US EPA, 2020).

CO_2e (US EPA, 2023). In the context of global and U.S. Greenhouse Gas emissions, the Proposed Action emissions would not be significant.

In order to provide disclosure and context for the climate effects of the Proposed Action, the Interagency Working Group on Social Cost of Greenhouse Gases social cost of CO_2 for emissions in 2025 was applied to the GHG emissions estimated above (IAWG, 2021). The monetization of the Proposed Action's GHG emissions results in $16,000 of societal costs assuming a discount rate of 3%. Sensitivity around discount rate assumptions results in costs between $4,800 - $24,000 for a 2% - 5% discount rate range, with a 95th percentile cost at the 3% discount rate of $48,000.

Boom will evaluate the usage of sustainable aviation fuel (SAF) for a portion of the flight testing where feasible, subject to program safety considerations and SAF availability. Boom will purchase carbon removal or high-quality nature-based offsets to cover residual greenhouse gas emissions that are not otherwise reduced as part of their broader commitment to carbon neutrality.[12]

In considering the impact of climate change on the Proposed Action, the foreseeable state of the environment is not expected to change significantly over the limited duration of the Proposed Action, which spans one year, since effects are typically felt on decadal time scales. For example, the ACRP guidance on *Climate Change Adaptation Planning: Risk Assessment for Airports* (ACRP Report 147, 2015) provides short-term and long-term forecasts for the years 2030 and 2060 and recommends a re-evaluation of climate change risks to airports every 3-5 years. Therefore, no significant impacts to the Proposed Action, nor its environmental impacts assessed in this document, are anticipated as a result of climate change effects occurring during the span of the Proposed Action.

3.6 Section 4(f)

Section 4(f) of the Department of Transportation Act of 1966 (DOT Act) currently codified as 49 USC Section 303I, [hereinafter referred to as Section 4(f)], provides for the protection of certain publicly owned lands. These lands include public parks, recreation areas, or wildlife and waterfowl refuges of national, state, or local significance. In addition, Section 4(f) applies to all historic sites of national state, or local significance, regardless of whether these sites are publicly owned or open to the public. Typically, Section 4(f) protects only historic or archeological properties that are on, or eligible for inclusion on, the National Register of Historic Places (NRHP).

Programs or projects that are developed with federal funding or require a federal action, which adversely affect or use Section 4(f) lands, will not be approved unless there are no prudent and feasible alternatives to their use, and such programs include all planning to minimize harm. If it is determined that an action would involve a Section 4(f) resource, then the lead federal agency, in this case the FAA, is required to prepare a Section 4(f) Evaluation.

In addition to lands identified under Section 4(f) of the DOT Act, other lands funded by the Land and Water Conservation Fund Act of 1966 (LAWCON) must be considered. When proposed improvements affect lands purchased or developed using LAWCON funds, as administered by the U.S. Department of the Interior (USDOI), changes in use to other than public outdoor recreation at assisted sites may only be made with the prior approval of the Secretary of the Interior. Also, converted properties must be replaced by substitute

[12] Boom first achieved carbon neutrality across all three GHG Protocol scopes in 2021.

properties of at least equal fair market value and of reasonably equivalent location and usefulness. As the Proposed Action would not acquire or displace property, no further review was required for Section 6(f) and the evaluation of 4(f) effects was focused on determining if the Proposed Action would create a constructive use effect.[13]

3.6.1 Affected Environment

DOT 4(f) lands include public parks, recreational areas, or wildlife or waterfowl refuges as well as historic sites of national, state, or local significance. A search of the National Park Service's online National Register of Historic Places (NRHP) noted the presence of four sites within the Proposed Action area. A review of BLM data also indicates the presence of the National Scenic and Historic Trails/Old Spanish Trail and the Mojave trails.

***Table 6**: Historical Sites in the Vicinity of the Proposed Action*

Ref#	Property Name	Restricted Address	City
85002816	Rogers Dry Lake/Muroc Dry Lake		Mojave Desert
02000980	Fossil Canyon Petroglyph Site	Yes	Barstow
85002813	Pioneer Goldstone Deep Space Station Communication Complex		Fort Irwin
00001046	Black Can–n--Inscription Can–n--Black Mountain Rock Art District	Yes	Hinkley
	National Scenic and Historic Trails/Old Spanish Trail		Multiple jurisd.
	Mojave Trails		Multiple jurisd.

Source: https://www.nps.gov/subjects/nationalregister/database-research.htm

In addition to the sites noted in the NRHP, an internet search noted the presence of the Husky Monument (a site dedicated to past motor cross track users) in the area of the Black Mountain Supersonic Corridor portion of the Proposed Action area.

In addition to historic sites noted above, a search was conducted to identify parks, recreational areas, and wildlife/waterfowl refuges in the project area. The table below lists the resources identified.

[13] Constructive use involves an indirect impact to the Section 4(f) property of such magnitude as to effectively act as a permanent incorporation. Rather a constructive use would severely impact important features, activities or attributes associated with it, and to substantially impair its use.

Table 7: *DOT Section 4(f) Parks/Recreation and Wildlife Areas*

Park/Recreation Area Name	Ownership/Recreational Resources
Afton Canyon Campground	BLM – Each campsite is equipped with a shade structure, parking area, table, fire pit, and grill. Vault toilets are centrally located.
Arnold Park and BMX Track	Edwards AFB features playground equipment, covered picnic areas, a stage, restrooms, and a BMX track.
Black Mountain Wilderness Area	BLM – 21,000-acre wilderness area. Note that some of the area in this wilderness is privately owned.
Boron Park	Kern County - 10-acre community park with active recreation facilities (i.e., 2 ballfields with dugouts, and bleachers, concession stand, announcing stand, concrete multipurpose pad, 13 horseshoe pits with bleachers, basketball court, 2 shade shelters, picnic tables and BBQ, 2-5 tot lot, 5-12 play equipment (swings), restroom building, golf driving range, tennis backboard with lights, recreation building.).
Carl Park	Edwards AFB – neighborhood park with playground
Edwards AFB Fitness Center/Rosburg Fitness Center	Edwards AFB – Fitness center
Edwards Bark Park	Edwards AFB – Dog park
Edwards Community Park	Edwards AFB – Base park that provides active recreation
El Tortuga Viejo Establo	This is a nonprofit refuge certified by the National Wildlife Federation as an Advanced Wildlife Habitat.
Grass Valley Wilderness Area	BLM – This area consists of about 30,000 acres in a series of scattered hills, gently rising to elevations from 200 to 600 feet above the desert valley floor. This wilderness is bisected by a vehicle corridor running north-south, and visitors must remain on this route if traveling in any sort of vehicle. The boundaries are the Cuddeback Bombing Range on the west and the China Lake Naval Weapons Center to the east.
Harper Dry Lake	BLM – Open space.
Hummel Hall Senior Center	Kern County - Community Center with 2 meeting rooms with capacity for 101 people.
Mojave Trails	BLM - The Mojave Trails National Monument spans 1.6 million acres of federal lands, including more than 350,000 acres of already Congressionally designated wilderness, managed by the Bureau of Land Management between Barstow and Needles, California

Park/Recreation Area Name	Ownership/Recreational Resources
Mojave East Park	Kern County - Mojave 8-acre active recreation neighborhood park - Little League baseball diamond with lights and bleachers, concession stand, tennis backboard with lights, horseshoe pit, shuffleboard court, group picnic shelter, picnic tables on concrete slabs, restroom bldg., play areas, lighted basketball courts.
Mojave Veterans Memorial Building/Senior Center	Kern County - Mojave – 3 meeting rooms seat 300 or more.
Mojave West Park	Kern County- 10-acre active recreation park with open space (1 baseball field with bleachers, parking, open space.)
Muroc Lake Golf Course	Edwards AFB – a championship 185-acre 17-hole golf course.
North Edwards Park	Kern County - Edwards – 5-acre active recreation park - Softball field with players' benches/bleachers, picnic tables/BBQ, restroom building, tot lot and swings, sand area.
Old Spanish National Historic Trail	BLM/National Park Service. This trail links Santa Fe and Los Angeles across six states and covers 2,700 miles. The trail takes its name from the Spanish colonies in northern New Mexico and southern California that were linked by this rugged route.
Onizuka Park/Roberts Field/Arnold Park/Fam Camp	Edwards AFB – active recreation park with 5 ball fields, a soccer field, and other recreational facilities.
Pioneer Park	Kern County – tot lot.
Rainbow Basin Natural Area/Owl Canyon Campground	BLM - An Area of Critical Environmental Concern with outstanding views and geological and paleontological features. Owl Canyon Campground has 22 campsites (no hookups).
Rosamond Park	Kern County - Rosamond – 10-acre active recreation community park and Building. Recreation Center, tot lot and play area, 2 lighted full basketball courts, 2 baseball fields (1 lighted, with bleachers/dugouts and scoreboard), 2 restroom buildings, meeting room building.
Fremont Valley Ecological Reserve	State of California - Approximately 4,100 acres in 10 parcels in Kern County consisting of typical northwest Mojave Desert terrain. The natural vegetation community is primarily a creosote bush scrub community. Vertebrates include a number of mammals, reptiles, and birds.
Western Mojave Desert Ecological Reserve	State of California - Approximately 18,000 acres in over 40 parcels. The dominant vegetation is burro-weed, with creosote bush also abundant though not as evenly distributed. Wildlife observed on or known to inhabit the property includes rabbits, coyotes, mice, larks, ravens, doves, and lizards

Source: Kern County Parks Recreation Master Plan; https://mybaseguide.com/installation/edwards-afb/community/parks-recreation/, BLM Wilderness Connect, https://wildlife.ca.gov/Conservation/Fully-Protected and aerial photo inspection.

3.6.2 Environmental Consequences

The Proposed Action would not involve the acquisition or displacement of any lands, including lands considered DOT 4(f). Thus, the evaluation focused on the indirect effects of noise and emissions on potential DOT 4(f) lands.

Numerous designated BLM Wilderness Areas are in the vicinity of the Proposed Action area: two in the action area (Black Mountain, Grass Valley), and eight outside of the Proposed Action area (Avawatz Mountains Wilderness, Golden Valley, Hollow Hills, Mojave National Preserve, Rodman Mountains Wilderness Area, Newberry Mountains Wilderness Area, Bright Star Wilderness and Kiavah Wilderness) (USBLM, 2023c). Black Mountain Wilderness is a plateau of exposed basalt rising as high as 1,900 feet above the area (USBLM, 2023a). Grass Valley Wilderness is a flat area with scattered hills (USBLM, 2023b). Each of these wilderness areas are the home to various raptors, Mohave ground squirrels, desert tortoise, and Joshua tree. A review of BLM web sites did not indicate that these wilderness areas are designated for natural quiet as would be expected in light of the current level of aircraft overflight and sonic booms.

With regards to operational impacts, the Proposed Action would not result in a significant change in aircraft noise or emissions. As is disclosed in the Noise and Noise Compatible Land Use section below, the Proposed Action is expected to result in additional sonic booms in the area. As shown in the Noise and Noise Compatible Land Use section below, the individual events associated with the Proposed Action are expected to result in significantly lower noise levels than existing supersonic operations in the corridors. The Proposed Action would add less than 5 percent more operations (between 10-20 supersonic tests) to an area already receiving 345-414 annual supersonic tests, and existing operations involve larger aircraft flying supersonically at lower altitudes which would produce a stronger sonic boom overpressure than the XB-1 or the chase aircraft. Similar to the supersonic tests that occur today, the sonic boom carpet could exceed the boundaries of the Proposed Action area, depending on where in the corridor the aircraft flies. However, the magnitude of sonic boom overpressures decreases with distance away from the centerline of the flight path (Kane & Palmer, 1978), and therefore any sonic boom impacts that exceed the boundaries of the Proposed Action area would also be of a lower magnitude than existing operations that also occur within the Proposed Action area. The Proposed Action is not expected to result in noise that would impair the use of the parks, recreational uses, wilderness areas, or historic sites in the area. Therefore, no significant impacts to DOT 4(f) lands are expected and a DOT 4(f) statement is not warranted.

3.7 Hazardous Materials, Solid Waste, and Pollution Prevention

Hazardous materials and wastes are defined and identified by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (42 U.S.C. 9601–9675); the Toxic Substances Control Act (15 U.S.C. 2601-2671); the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act (RCRA; 42 U.S.C. 6901-6992); and the corresponding State of California laws and regulations. Both federal and state OSHA regulations govern the protection of personnel in the workplace. In general, these hazardous materials and wastes may

present substantial danger to public health and welfare, to workers, or to the environment due to their quantity, concentration, or physical, chemical, or infectious characteristics. Solid waste management includes the waste streams that would be generated by a project and evaluates how these wastes would impact environmental resources. Solid waste management also evaluates the impacts on waste handling and disposal facilities that would likely receive the waste.

Hazardous waste impacts are typically associated with the current or future use, transfer, or generation of hazardous material within the limits of the proposed improvements or the acquisition of properties that contain hazardous materials. Environmental concerns related to solid waste disposal range from adequate landfills for normal urban trash and garbage to the safe disposal of industrial waste.

3.7.1 Affected Environment

Numerous types of hazardous materials are currently used at Mojave Air and Space Port, which in turn generate hazardous wastes. The hazardous materials at Mojave Air and Space Port mostly consist of airplane fuels and rocket propellants (i.e., oxidizers and fuels). Other hazardous materials used, generated, and/or stored onsite include acetylene, paints, used motor and hydraulic oil, gear lubricant, and hydraulic fluid.

Management of hazardous waste would comply with the RCRA Subtitle C (40 CFR Part 240-299) and with California Hazardous Waste Control Laws as administered by the California EPA, Department of Toxic Substances Control (DTSC), under Title 22, Division 4.5 of the CCR. These regulations require that hazardous wastes be handled, stored, transported, disposed of, or recycled according to defined procedures. Boom would be required to follow all federal, state, and local laws and regulations, which regulate hazardous waste, including its generation, storage, transportation, and disposal.

3.7.2 Environmental Consequences

Small quantities of waste may be generated at Mojave Air and Space Port associated with the conduct of the supersonic flight tests in the Proposed Action. This could contain aircraft fluids, aircraft parts, and paper associated with documentation. However, all quantities can be handled through the existing disposal infrastructure and practices at Mojave Air & Space Port, in Kern County. Therefore, the operation of the Proposed Action would not generate significant amounts of solid waste. Furthermore, the Proposed Action would not involve construction (use of land), and therefore would not disturb any existing land containing hazardous material or cause further contamination of the land or generate hazardous material that would adversely affect human health. Therefore, no significant impacts to this resource category are expected from the Proposed Action.

3.8 Historical, Architectural, Archaeological, and Cultural Resources

In accordance with FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*, this EA includes an investigation of impacts due to federal undertakings upon areas of historic, architectural, archaeological, and cultural significance. The purpose of this section is to document compliance with the National Historic Preservation Act of 1966 as amended (NHPA) by identifying historic properties within the Area of Potential Effect (APE), including a description of the probable impact of the alternatives under consideration on these resources.

3.8.1 Affected Environment

The National Park Service's NRHP was consulted to identify historic, architectural, archaeological, and Cultural Resources that are in the area where the Proposed Action would occur. The sites identified are noted earlier in relation to DOT Section 4(f) Lands. As described in the DOT 4(f) Lands Section, six (6) historic/architectural/archaeological/cultural resources are in the Proposed Action area.

Additionally, five Native American tribes find their homes in or near the corridors: the Kawaiisu, the Chemehuevi, the Vayume, the Serrano, and the Mojave (Feller, n.d.). According to the Tribal Directory Assessment Tool (USHUD, 2023), the following tribes have interests in San Bernardino and Kern Counties: Chemehuevi, Colorado River Indian Tribes, Fort McDowell Yavapai Nation, Fort Mojave Tribe, Kaibab Band of Paiute Indians, Las Vegas Tribe of Paiute Indians, Los Coyotes Band of Cahuilla and Cupeno Indians, Moapa Band of Paiute Indians, Paiute Indian Tribe San Manuel Band of Mission Indians, Soboba Band of Luiseno Indians, Twenty-Nine Palms Band of Mission Indians, Fort Independence Indian Community of Paiute Indians, Te-Moak Tribe of Western Shoshone Indians of Nevada, Tejon Indian Tribe, and Tule River Indian Tribe.

3.8.2 Environmental Consequences

The Proposed Action would not require the acquisition of tribal lands nor a physical disturbance to them. As no construction would occur with the Proposed Action, no cultural or archaeological sites would be physically affected.

As noted in the section on Noise and Compatible Land Use, the Proposed Action would generate sonic booms of approximately 1 psf. However, the sonic booms are not expected to physically affect the sites nor alter their use. US Air Force data indicates that Early American Petroglyphs/caves might experience damage to sonic booms at 1 psf[14] – with a 0.18 percent probability. At 2 psf, the probability might increase to 1.1% probability. In contrast, masonry/stone structures with a roof would expect to have damage at 3.9% probability at 1 psf and 16% at 2 psf (Reinke et al., 2021). Since these sites have experienced sonic booms for over 3 decades from military aircraft with peak overpressures potentially greater than that of the Proposed Action, it is unlikely that the additional 10-20 supersonic tests in the Proposed Action would have an adverse effect on historic, architectural, or cultural resources.

Per a recent U.S Air Force Environmental Assessment at Edwards AFB (Reinke et al., 2021), "Potential impacts to cultural resources in the Edwards Restricted Airspace are not anticipated, except from … supersonic corridor operations that directly overfly cultural resources at or below 2,500 feet AGL", and while "noise due to overflight of a Native American site could disrupt a ceremony, no noise complaints of this type have been registered." Since the Proposed Action (including both XB-1 and associated chase aircraft) would involve supersonic flights well above 2,500 ft AGL, and they would operate within existing flight test areas, no significant impacts to cultural resources and tribal communities are anticipated as the Proposed Action is in keeping with the current operations where there have been no complaints.

A consultation letter was sent by email to Julianne Polanco, the State Historic Preservation Officer (SHPO), in Sacramento CA on October 27, 2020. The correspondence requested the SHPO review the proposed undertaking by the FAA involving authorization of Supersonic Test Flights in the High-Altitude Supersonic corridor associated with Edwards AFB in Kern, San Bernadino, and Los Angeles Counties. No response was

[14] Pounds per square foot.

received, and FAA sent a follow-up email on January 4, 2021, requesting a response by January 11, 2021. As such, the FAA is proceeding with a determination of no potential to affect historic properties.

Thus, no significant impacts to historic/architectural/archaeological/cultural resources would be expected as a result of the Proposed Action.

3.9 Natural Resources and Energy Supply

Sources of energy originate from fossil fuels (coal, oil, gas, etc.), nuclear power (uranium) and renewable elements (wood, sun, wind, water, etc.). Natural resources refer to the various forms of wealth supplied by nature including the sources of energy listed above.

Staff supporting the flight testing at Mojave Air and Space Port would likely consume energy, water, and other small quantities of natural resources. The additional consumption associated with the Proposed Action would not be expected to affect supply. The Proposed Action would not have any measurable impact on any natural resource and energy supply except for jet fuel.

3.9.1 Affected Environment

Mojave Air and Space Port consumes various types of natural resources ranging from oil, gasoline, Jet A fuel, wood, and water. Total annual jet fuel consumption at Mojave Air and Space Port is approximately 6.9 million lbs. in 2021-2022 (MHV, 2022), and it has not changed significantly across recent years. In addition, military operations in the supersonic corridors consume various levels of natural resources. While specific quantities of those natural resources are not publicly available, sufficient supply for those quantities appears available.

3.9.2 Environmental Consequences

The Proposed Action would not require any construction, and therefore no energy or natural resources would be consumed for construction activities. The Proposed Action would consume as much as 198,100 lbs. of Jet A fuel for the entirety of the supersonic flight testing (including the landing and takeoff operations from Mojave Air and Space Port, subsonic and supersonic flight activity). This is approximately 2.8% of the total annual jet fuel consumption at Mojave Air and Space Port. Since this is a relatively small fraction of total annual jet fuel usage, the Proposed Action is not expected to significantly affect the supply of jet fuel. It is expected that the Boom Technology flight testing will consume minor quantities of other resources, such as water and oil. However, these quantities are not expected to significantly affect the available supply.

3.10 Noise and Noise Compatible Land Use

Sound results from vibrations introduced into a medium such as air that stimulate the auditory nerves of a receptor to produce the sensation of hearing. Sound is undesirable if it interferes with communication, is intense enough to damage hearing, or diminishes the quality of the environment. Noise is defined as unwanted sound. Human responses to sound vary with the types and characteristics of the sound source, the distance between the source and receptor, receptor sensitivity, the background sound level, and other factors such as time of day. Sound may be intermittent or continuous, steady, or impulsive, and may be generated by stationary sources such as generators or mobile sources such as cars or aircraft.

Sound varies by both intensity and frequency. Sound pressure level, described in decibels (dB), is used to quantify sound intensity. The dB is a logarithmic unit that expresses the ratio of a sound pressure level to a standard reference level. Hertz (Hz) are used to quantify sound frequency. The human ear responds differently to different frequencies. "A-weighting" or measuring in A-weighted decibels (dBA), approximates a frequency response expressing the perception of sound by humans. **Table 8** provides sounds encountered in daily life and their sound levels.

Table 8: *Common Sounds and Their Levels*

Outdoor	Sound Level (dBA)	Indoor
Jet flyover at 1,000 ft (305 m)	100	Rock band
Gas lawnmower at 3 ft (0.9 m)	90	Food blender at 3 ft (0.9 m)
Downtown (large city)	80	Garbage disposal
Heavy traffic at 150 ft (48 m)	70	Vacuum cleaner at 10 ft (3 m)
Normal conversation	60	Normal speech at 3 ft (0.9 m)
Quiet urban daytime	50	Dishwasher in next room
Quiet urban nighttime	40	Theater, large conference room

Source: (Harris, 1991).

Note: dBA = A-weighted decibels, ft = feet, m = meter.

Sound pressure, as outlined above, describes steady noise levels, although very few noises are, in fact, constant. Therefore, additional noise metrics such as the following have been developed to describe noise:

- Maximum Sound Level (Lmax) – Lmax is the maximum sound level of an acoustic event in dB.
- Sound Exposure Level (SEL) – Sound Exposure Level (SEL), the most frequently used measure of noise exposure for an individual aircraft noise event, measures the total noise energy produced during an event, from the time when the A-weighted sound level first exceeds a threshold (normally just above the background or ambient noise) to the time that it again drops below the threshold. To allow comparison of noise events with very different durations, SEL "normalizes" the duration in every case to one second. SEL is expressed as the steady noise level with just a one-second duration, which includes the same amount of noise energy as the actual longer duration, time-varying noise.
- Equivalent Sound Level (Leq) – Leq is the average sound level in dB of a given event or period of time.
- Day-night Sound Level (DNL) – DNL is the average sound energy in a 24-hour period with a penalty added to the nighttime levels. Due to the potential to be particularly intrusive, noise events occurring between 10:00 p.m. and 7:00 a.m. are assessed a 10-dB penalty

when calculating DNL. DNL is a useful descriptor for aircraft and launch noise because it (1) averages ongoing yet intermittent noise, and (2) accounts for the total sound energy over a 24-hour period. DNL provides a measure of the overall acoustical environment, but it does not directly represent the sound level at any given time. For well-distributed sound, Leq is approximately 6.4 dBA lower than DNL.

- Community Noise Equivalent Level (CNEL) – CNEL is a variant of DNL used in the State of California, where in addition to the 10-dB penalty during the nighttime, the CNEL includes a 4.8 dB penalty for events during the evening (7:00 p.m. to 10:00 p.m.). As with DNL, CNEL does not directly represent the sound level at any given time. CNEL is always equal to or greater than DNL and may be used in lieu of DNL for FAA actions in California per FAA Order 1050.F Paragraph B-1 of Appendix B.
- Peak sound level (dBP) is the maximum instantaneous sound level for an individual acoustical event. For impulsive sounds, such as sonic booms, the true instantaneous peak sound pressure level, which lasts for only a fraction of a second, is important in determining impacts. The peak pressure of the shock wave, which is used to describe sonic booms, is usually presented in psf.

The intensity and width of a sonic boom path depends on the physical characteristics of the aircraft and how it is operated. In general, the greater an aircraft's altitude, the lower the overpressure on the ground. Larger and heavier aircraft also create higher sonic boom overpressures. Greater altitude also increases the boom's lateral spread, exposing a wider area to the boom. Overpressures in the sonic boom impact area, however, will not be uniform. Boom intensity is greatest directly under the flight path, progressively weakening with greater horizontal distance away from the aircraft flight track (USAF, 2023).

Ground width of the boom exposure area is approximately one mile for each 1,000 feet of altitude; that is, an aircraft flying supersonic at 30,000 ft will create a lateral boom spread of about 30 miles. For steady supersonic flight, the boom is described as a carpet boom since it moves with the aircraft as it maintains supersonic speed and altitude (USAF, 2023).

3.10.1 Affected Environment

The affected environment for noise is the areas on and immediately surrounding Mojave Air and Space Port (related to landing and takeoff noise impacts from the Proposed Action), as well as areas within the High Altitude and Black Mountain Supersonic Corridors identified as the Project Action areas (affected by supersonic overflights from the Proposed Action).

Most environments include near-constant, long-term sound sources that create a background sound level and intermittent, intrusive sources that create sound peaks that are noticeably higher than background levels. In remote areas far away from any human activities, the background sound level is determined by natural sources such as water (e.g., rain), and wind blowing through the vegetation. The extent to which an intrusive sound affects a given receptor in the environment depends upon the degree to which it exceeds the background sound level. Both background and intrusive sound may affect the quality of life in a given environment.

Landing and Takeoffs from Mojave Air and Space Port

The immediate area surrounding Mojave Air and Space Port is largely composed of undeveloped and rural land, with some unincorporated residential areas. Sound levels in nearby areas are typically low, but higher levels occur in industrial areas and along transportation corridors. The Cities of Mojave, California City, and

Rosamond are near Mojave Air and Space Port. The area to the north and east of the Mojave Air and Space Port is open and undeveloped land. Noise-sensitive areas, including commercial and residential development, are immediately west and south of Mojave Air and Space Port (Kern County, 2012). The two closest schools (Mojave Elementary School and Mojave Junior/Senior High School) are immediately west of Mojave Air and Space Port and approximately 1.25 miles (2.01 km) from the proposed pre-flight operations area. These noise-sensitive land uses are outside the 65 dB DNL noise contour prepared for year 2001 (Kern County, 2012).

Existing noise at Mojave Air and Space Port is primarily from aircraft activities, with a total of 21,302 annual aircraft operations in year 2022. **Table 9** provides the current aircraft fleet mix.

Table 9: *Mojave Air and Space Port Operations Fleet for 2022*

Type of Aircraft	Operations
Air Carrier	33
Air Taxi	6
General Aviation Local	8,426
General Aviation Itinerant	9,718
Military	3,119
Total	21,302

Source: (FAA, 2023b).

On-airport noise is generated by aircraft, automobiles, and trucks. Other less frequent but more intense sources of noise are from aerospace testing launches. The Kern County Airport Land Use Compatibility Plan illustrated noise contours above CNEL 65 dBA extending to the northwest and southeast past the boundaries of Mojave Air and Space Port (Kern County, 2012). The CNEL 65 dBA contour overlays land designated for commercial/industrial uses or open land. Although the noise contours are from 2001 (and published in 2012), newer noise contours were not available. The 2019 Written Reevaluation for the 2017 Environmental Assessment for Issuing a License to Virgin Orbit for LauncherOne Launches at the Mojave Air and Space Port states that the noise data and analyses conducted in the 2017 EA remain substantially valid (FAA, 2017). This 2017 EA used the same 2012 noise data from Kern County. The contours generally follow aircraft takeoff and landing routes and represent the overall sound level that a sensitive receptor currently encounters from aircraft activity with nighttime activities penalized 10-dBA (i.e., DNL) (Kern County, 2012).

High Altitude and Black Mountain Supersonic Corridors

Today, this area experiences supersonic military flights which generate a sonic boom. The DoD's supersonic flights occurring in the Black Mountain Supersonic Corridor and High-Altitude Supersonic Corridor are well-established and have occurred yearly since the 1960s. In recent years, the number of supersonic tests has ranged from 345 to 414 per year (with the peak occurring in 2022), although there were prior years when higher numbers of supersonic tests were conducted (USAF, 2010). Many of these tests are conducted with aircraft flying in formation, with a test aircraft and a chase aircraft. A portion of these current and past flight tests were conducted above 30,000 ft Mean Sea Level (MSL) with the remainder at lower altitudes.[15]

The 1998 EA for the R-2515 Corridor noted noise levels at various altitudes associated with individual military aircraft. The Single Event Sound Exposure Level of various aircraft at 100 ft. altitude above ground ranged from 100.5 dB for the C-17 to 125.8 dB for a B-1. The EA also identifies "Cumulative subsonic noise

15 Data provided by Edwards Air Force Base.

in the corridor ranging from a low of Lmax[16] 44.2 dB in the south-central Four Corners area to a high of 64.1 dB in the Alpha Corridor… The highest noise levels were found in the Alpha Corridor and Cuddeback/Three Sisters work areas. Noise levels in the Cuddeback/Three Sisters Work Areas range from Lmax 49 to 57 dB over most of the area…" (USAF, 1998)[17]. In addition, the following is noted "Aircraft traveling at, or above sonic velocity produce sonic booms with noise levels that are predominately less than Lcdn 55 dB within R-2515. The highest predicted sonic boom noise level is Lcdn 57.5 dB in an area over north-central R-2515, along the Black Mountain Supersonic Corridor, where the Black Mountain and High-Altitude Supersonic Corridors overlap. The area has been characterized as sparsely populated, having fewer than three people per square mile. This corridor overlies the Black Mountain Wilderness Area and Harper Dry Lake."

The 2021 USAF EA (Reinke et al., 2021) used the Community Noise Exposure Level (CNEL) metric to evaluate noise in the Edwards Restricted Airspace that includes R-2515. That document noted "The estimated CNEL from testing and training activities within the Edwards Restricted Airspace is 54.8 dBA in areas beneath the airspace. In areas outside the immediate vicinity of Edwards AFB and Edwards Air Force Auxiliary North Base Airfield, the overall average noise from aircraft operations from testing and training activities in the Edwards Restricted Airspace is substantially higher than background noise levels. In general, the aircraft operations are spread throughout the 1,812 square miles beneath Edwards Restricted Airspace. Outside of noise from runway operations at Edwards AFB and the Edwards Air Force Auxiliary North Base Airfield, noise from aircraft operations under Edwards Restricted Airspace does not exceed 65 dBA CNEL and would be compatible with all land uses (U.S. Air Force 2017a). This includes being compatible with all residential areas, churches, schools, and recreational areas underneath Edwards Restricted Airspace."

The 2021 EA further identifies estimated sound levels of individual overflights using Lmax, and sound exposure level (SEL) metrics. At an altitude of 20,000 feet above ground, the six aircraft identified were noted as producing a range of Lmax from 34 dBA to 78 dBA and an SEL ranging from 50 dBA to 78 dBA. The EA concluded that "Areas beneath Edwards Restricted Airspace would intermittently experience aircraft overflights that range from loud to very loud on the ground. Effects from these overflights are distributed throughout areas below and adjacent to Edwards Restricted Airspace. These overflights are brief, intermittent, distributed throughout the area, and are neither loud enough nor frequent enough to generate areas of incompatible land-use underneath the airspace. … There are approximately 13,000 individual aircraft operations per year conducting testing and training activities spread throughout Edwards Restricted Airspace. Individuals directly beneath, and adjacent to the flight paths of louder and lower-flying aircraft, pause there speech briefly, particularly when the aircraft is directly overhead … As aircraft overflights are intermittent and not continuous, no individuals are exposed to sound levels exceeding 80 dBA for 8 hours per day beneath Edwards Restricted Airspace. In addition, OSHA and the Air Force have adopted a threshold of 140 dB instantaneous noise level as a threshold for short-term exposure that may induce hearing loss. Some individual aircraft overflights within Edwards Restricted Airspace are supersonic, and generate sonic booms; however, there are no reported sound levels exceeding 140 dB from sonic booms under the supersonic corridors, and no noise-related hearing loss is expected … there is no potential to damage to structures."

Today, the boom carpet (the area experiencing a sonic boom) can fall outside of the supersonic corridors, depending on the altitude and ground track of the aircraft when operating supersonic as described earlier in this section. For example, the sonic boom from a supersonic aircraft at an altitude of 30,000 ft could be

16 Lmax refers to the "Single event maximum sound level (expressed in dBs)."

17 Page 56, Table 3-10. Note that the F-5 is note listed in these measurements and Section 3.2.4.10 beginning page 65.

heard within 15 nautical miles on either side of the ground track, but not likely beyond that distance. By comparison, the distance from the centerline of the Supersonic Corridor to California City is 10 nautical miles; to North Edwards and Boron is 12 nautical miles; and Hinkley and Barstow is greater than 15 nautical miles. In general, due to the undeveloped nature of the area, noise from manmade activities is quite low other than the currently approved testing of supersonic aircraft in this area or surface traffic on area roadways and trails. As noted above, this area regularly experiences sonic booms from test flights. In recent years, 345-414 supersonic tests were conducted in the area with a portion of these flight tests conducted at 30,000 ft or higher. Therefore, the sonic booms that are currently generated by existing supersonic flight testing in the area would also likely fall outside supersonic corridors.

Also as noted earlier, though, that the peak sonic boom overpressure occurs directly below the flight path (USAF, 2023), and that the magnitude of sonic boom overpressures decreases with distance away from the centerline of the flight path (Kane & Palmer, 1978). Therefore, analysis of sonic boom impacts based on the peak overpressures that fall within the proposed action area (i.e., the supersonic corridors) would be sufficient to capture potential effects of sonic boom impacts that may occur outside the corridors.

Noise impacts from the Proposed Action are evaluated in this EA for both the LTO cycle at Mojave Air and Space Port as well as sonic boom impacts from supersonic overflight operations within the supersonic corridors.

Landing and Takeoff Mojave Air and Space Port Noise Assessment

Landing and takeoff noise impacts from the Proposed Action at Mojave Air and Space Port were assessed using the FAA's Area Equivalent Method (AEM) model (FAA, 2023a). The AEM is a screening level process that estimates changes in the area of the existing DNL 65 dB contour. It is a screening tool used to determine if further analysis using the more detailed noise modeling (e.g., AEDT) is needed (FAA, 2020). As the Proposed Action would comply with existing flight and operating procedures in place at Mojave Air and Space Port, they would use existing air traffic flight tracks/profiles and therefore not affect the shape of the noise contours; therefore, use of AEM as a screening tool is determined to be valid for this EA.

The baseline fleet mix at Mojave Air and Space Port was determined based on the FAA's Terminal Area Forecast for civil and military aircraft operations at Mojave Air and Space Port in 2024. These activity counts were applied to fleet mix data developed for Mojave Air and Space Port's recent Runway 12-30 rehabilitation study. A 90%-10% split for daytime vs. night-time operations was assumed based on the Kern County Airport Land Use Compatibility Plan (Kern County, 2012). Details on the baseline aircraft inventory development are provided in Appendix A.

Activity from 20 chase aircraft LTO activities from the Proposed Action are modeled in AEM using the T-38 aircraft type. Activity from 20 LTO operations from the experimental XB-1 aircraft are modeled using the A-7E aircraft as a surrogate, based on guidance from the FAA AEE[18] on the basis of producing a conservative evaluation. All operations related to the Proposed Action would occur during the daytime hours.

Sonic Boom Assessment in the Existing Supersonic Corridors

Current modeling methods such as FAA's Aviation Environmental Design Tool (AEDT) and NASA's PCBOOM, are not practical or feasible options for XB-1 sonic boom analyses, given that the XB-1 is a one-of-a-kind experimental aircraft and therefore not included in any of those models. Surrogate aircraft were identified

[18] Via email correspondence with Sandy Liu, FAA Aviation Policy, Planning & Environment Engineer, Noise Division (AEE-100), on October 24, 2023

for XB-1 and the chase aircraft based on aircraft dimensions and other parameters that affect the strength of sonic booms, and the sonic boom impacts were assessed using the results of several NASA measurement studies, as shown in Figure 4 and Figure 5 below. The surrogate aircraft and proposed noise methodology are described in detail in Appendix B.

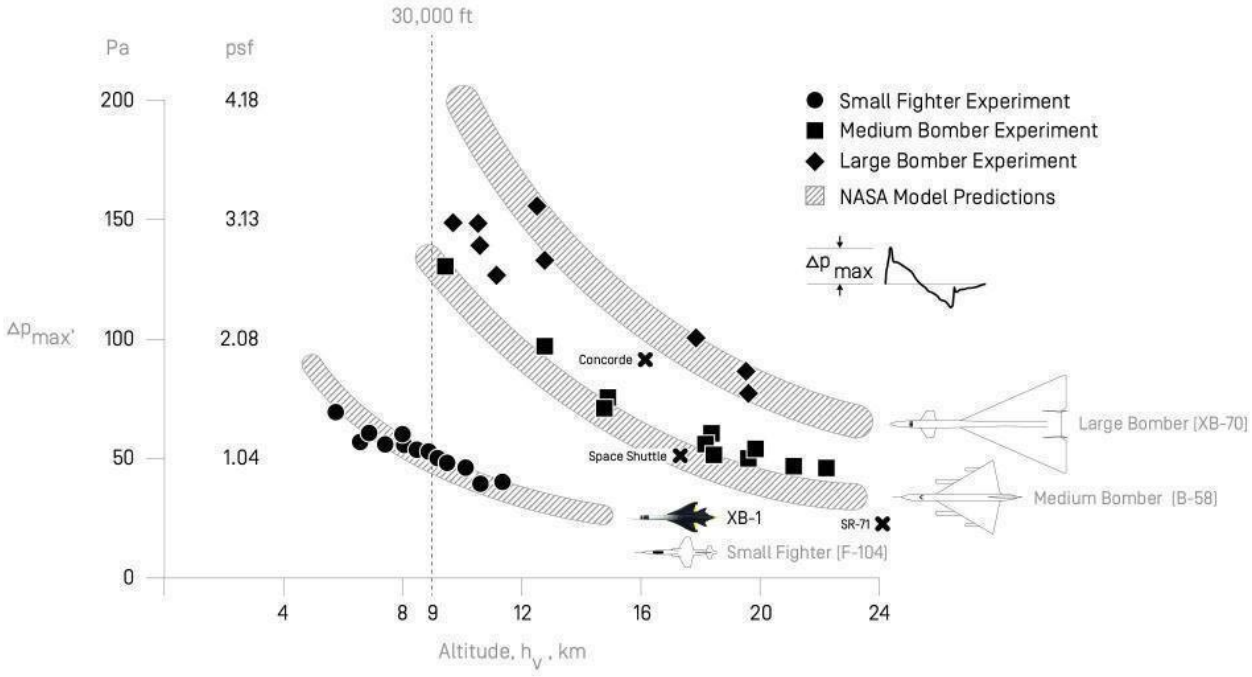

Figure 4: *Overpressure Relationship to Aircraft Altitude and Size*
Source: NASA, 1978 (Carlson, 1978) (reproduced from Figure 15 on pg. 47)

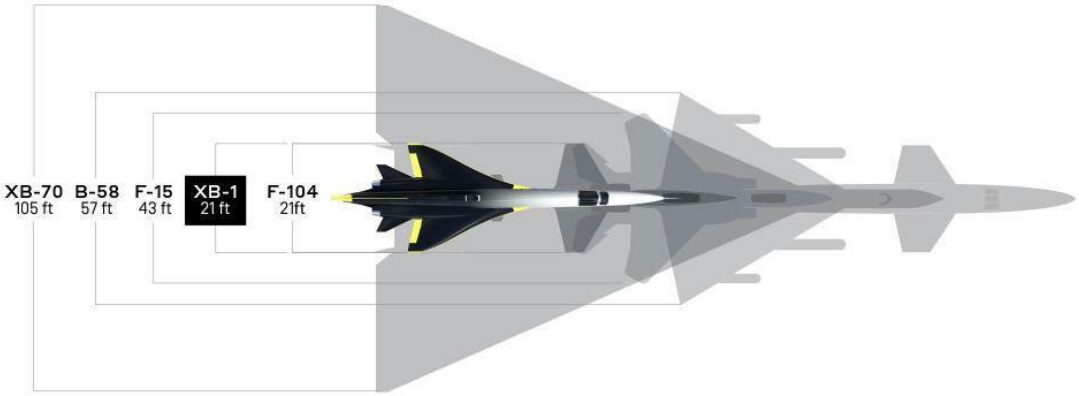

Figure 5: *Aircraft Size Comparison*

3.10.2 Environmental Consequences

LTO Impacts

Per FAA Order 1050.1F, Exhibit 4-1, significant noise impacts would occur if, "the action would increase noise by DNL 1.5 dB or more for a noise-sensitive area that is exposed to noise at or above the DNL 65 dB noise exposure level, or that will be exposed at or above the DNL 65 dB level due to a DNL 1.5 dB or greater increase, when compared to the no action alternative for the same timeframe." An area increases of less than 17% calculated by AEM would indicate that there are no significant impacts on a noise-sensitive area (FAA, 2018), while an increase in area of 17% or greater would indicate noise levels have the potential to increase by 1.5 dB or more, whereupon a more detailed noise model (e.g., AEDT) should be used (FAA, 2022).

Results from the AEM screening analysis are shown in **Table 10** below. It is seen that the Proposed Action would contribute to landing and takeoff noise to the Mojave Air and Space Port environs but increases in the noise contours are expected to be less than 1% for all noise contours, which is well below the FAA's AEM significance criteria of 17%. This indicates that the noise levels would increase by much less than 1.5 dB, and therefore the Proposed Action would not cause a significant impact with respect to Mojave Air and Space Port environs noise. The AEM model is submitted in Appendix C.

Table 10: *AEM Noise Screening Results*

DNL (dBA)	Baseline Area (Sq. Mi.)	Alternative Area (Sq. Mi.)	Percent Change in Area
65	2.2	2.2	0.6%
70	1.0	1.0	0.8%
75	0.4	0.4	1.1%
80	0.2	0.2	1.4%

Source: Boom using AEM (2023)

Sonic Boom Impacts in the Existing Supersonic Corridors

The environmental consequences associated with the supersonic portion of flights in the Proposed Action uses a noise methodology tailored to the XB-1 which was submitted to the FAA and approved on June 20, 2023 (see Appendix B). **Figure 4** shows the relationship between overpressure and flight altitude and aircraft size. The data provided in Figure 4 that the overpressure[19] from the sonic boom of XB-1 and the chase aircraft would be approximately one pound per square foot (psf) each, when flying supersonic at 30,000 ft (based upon the FA-104 "small fighter" aircraft). The figure shows that the XB-1 and chase aircraft would generate a smaller sonic boom footprint than other aircraft being tested in the High-Altitude Corridor.

Each supersonic event from the Proposed Action would consist of the operation (at or above 30,000 ft MSL) of either a single chase aircraft, two chase aircraft, or the XB-1 aircraft and a chase aircraft. While XB-1 and the chase aircraft (or both chase aircraft) would operate in close proximity to one another (approximately 1,000 ft apart), it is anticipated that an observer on the ground would likely experience two sonic booms in rapid succession. For example, ground level sonic boom signature measurement tests conducted for NASA's XB-70 aircraft utilized T-38, F-4, and B-58 supersonic chase aircraft which trailed the XB-70 by approximately 0.5 – 60 seconds, and distinct boom signature information was able to be measured separately for the XB-70 as well as the chase aircraft (Maglieri & Sothcott, 1992). The existing Department of Defense supersonic operations in the Project Area are operated in the same way (i.e., primary and chase aircraft flying supersonic while in close proximity) but occur at both the 30,000 ft MSL level as well as at lower levels, which Boom Technology does not propose to do. As noted in Figure 4, the sonic boom carpet from other larger aircraft operating in the corridor likely produces an overpressure equal to or greater than that which would occur even if the sonic booms from XB-1 and the chase aircraft overlap.

The XB-1 (and F-5 or T-38) aircraft is of the size of the "small fighter" noted in Figure 4 and Figure 5. At an altitude of 30,000 ft, XB-1 or the chase aircraft flying supersonically would generate an overpressure of 1 psf at ground level. At 1 psf overpressure, damage to nearby structures would be unlikely to occur. Overpressures of 1 to 2 psf may result in public reactions such as filing noise complaints. According to a

[19] Overpressure is the pressure caused by a sonic boom (or other shock wave) above the normal atmospheric pressure.

1971 USEPA report (*The Effects of Sonic Boom and Similar Impulsive Noise on Structures*), "[m]ost tests of the effects of sonic booms on structures have been made by the use of aircraft at level supersonic flight at high altitudes creating booms with over pressures of the order of 50 to 250 newtons/m^2 (1 to 5 psf). In that range of pressure there is little evidence of damage to modern residential buildings, except to plaster and window glass, and the probability that well-installed modern glass will fracture at such overpressure is very low indeed…".

To put this result into context, in recent years approximately 20-25% of supersonic operations in the Black Mountain Supersonic Corridor occurred below 30,000 ft in altitude, and the majority (>80%) of these operations were conducted by F-15, F-16, F-18, F-22 and F-35 aircraft which are all larger and significantly heavier than XB-1 and the T-38 or F-5 chase aircraft.[20] As seen from Figure 4, larger vehicles flying supersonically at lower altitudes would produce a stronger sonic boom overpressure. Additionally, previous modeling using the US Air Force's Boom10C model indicates that an F-18 flying at Mach 2 at an altitude of 20,000ft would produce a peak overpressure at the ground of 3.29 psf (USAF, 1998). Therefore, given that the number of supersonic flights in the Proposed Action (20 flight tests, with each test including up to 2 aircraft flying supersonically) is a fraction of existing supersonic activity levels (e.g., 414 in 2022), and that a portion of current supersonic tests occur below 30,000 ft, the supersonic flight operations from the Proposed Action would not increase noise-related impacts significantly over existing conditions.

Similar to the existing supersonic activity in the corridor, the proposed Boom test events may produce sonic boom carpets that fall outside of the physical boundaries of the corridor. As explained earlier, the magnitude of sonic boom overpressures decreases with distance away from the centerline of the flight path (Kane & Palmer, 1978), and therefore the impacts assessment performed above would be sufficient to capture potential effects of sonic boom impacts that may occur outside the corridors.

There would be up to 20 supersonic events with the Proposed Action. To estimate the change in noise exposure due to the proposed additional supersonic tests, at 2022 supersonic activity levels (414 supersonic tests), adding the 20 Boom Technology tests (with each test including up to 2 aircraft, a primary aircraft and chase aircraft) would result in a 0.5 dB increase in noise level[21] with all other factors being equal (e.g., altitude, speed, type of aircraft, time of day of operation, etc.) and assuming each of the present military supersonic tests in 2022 were performed using one aircraft. Of note, some of the Department of Defense supersonic flights in the Black Mountain Supersonic Corridor operate at lower altitudes than the Proposed Action (e.g., approximately 20-25% of flights between 2019-2022), such that the Proposed Action would produce much lower noise levels in comparison to the lower flying Department of Defense tests. This increase in noise level is below the 1.5 dBA threshold used by FAA for a change in noise within the 65 DNL and greater noise level to noise-sensitive uses.[22] Although the FAA threshold is defined using the DNL metric, it is an annual-average "cumulative" noise metric not suitable for characterizing impulsive noise events such as sonic booms. To further contextualize this increase in noise level, the 2000 *Environmental Assessment to Extend the Supersonic Speed Waiver for Continued Operations in the Black Mountain Supersonic Corridor and Alpha Corridor/Precision Impact Range Area* (USAF, 2000)

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[20] Based on operational data between 2019-2022 in the Black Mountain Supersonic Corridor and the Alpha Corridor/PIRA, per the 412th Operations Support Squadron.

[21] Using the equation for change in decibels = 10 * Log (Proposed activity / existing activity)
Source: Federal Aviation Administration *Noise Control Plan Development*, 1979, Page A-30.

[22] The Desk Reference guidance notes that if there is a 1.5 DNL increase in noise within the 65 DNL to noise-sensitive land uses that NEPA documents should disclosure changes of 3 dBA within 60 DNL and 5 dBA within 45 DNL. The noise change of the Proposed Action would be well under these other levels.

noted that the sound levels above 85 dBA periodically occur for a period of one hour from supersonic overflights within the R-2515 complex, with impulsive and instantaneous sound levels above 120 dBA. The noise level increase estimated from the Proposed Action of 0.5 dB would be barely noticeable given these existing sound levels from current overflights.

In conclusion, a significant increase in aircraft noise is not anticipated with the Proposed Action (which is considered in the specific context of sonic boom noise exposure). Although the Boom Technology test events would be expected to generate additional sonic boom noise, the noise increase would not be significant given the DoD's long history of supersonic test flights occurring in this area. The peak overpressure resulting from the proposed supersonic test events would only be 1 psf which is typically not associated with public reaction or structural damage.

The effects of noise on the local communities from sonic booms are abated by following the procedures as outlined in Edwards Air Force Base Instruction 13-100, by controlling the minimum allowable altitude for conducting supersonic tests in the western portions of the Black Mountain Supersonic Corridor, which are closest to California City. The Air Force indicates that California City (California City, 2023) has implemented land use plans, public notification of aircraft testing airspace, zoning, and other efforts to ensure public awareness of the corridor and the potential noise effects from aircraft flights. As no significant aircraft noise impacts are expected, no mitigation is required.

3.11 Socioeconomic, Environmental Justice, and Children's Environmental Health and Safety Risks

Socioeconomic resources include the population, income, employment, and housing conditions of a community or affected environment. This section evaluates potential socioeconomic impacts that would result from the construction of the proposed projects, including an assessment of impacts to environmental justice communities.

3.11.1 Affected Environment

Land underlying the Proposed Action area is sparsely populated. Much of the area is unincorporated, and the only city or town is California City. Other areas, such as Mojave, Boron, Aerial Acres, etc. are considered unincorporated communities or census-designated places (which are statistical geographies representing closely settled, unincorporated communities that are locally recognized and identified by name). Based upon the 2016-2020 US American Community Survey (ACS), the project area has a small population per square mile, but within that area there is a large concentration of minorities or low-income populations. Under Executive Order 12898 minority populations are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic. Low income is defined as the population whose household income is equal or less than the poverty level.

Calculations using the USEPA's EJ Screen (USEPA, 2023b) provided information on the demographics of the population within the project area. The project area overlays the following census tracts and the percentage of population that are minority, low income, and under the age of 5, as listed in **Table 11**. As is noted below, the percentage of minority populations ranges from 0% to 82%, with an average across the Proposed Action area of 54%. The percentage of population meeting the low-income designation ranges from 5% to 87%, with an average across the project area of 40%. In comparison, the minority population of the state is 64% and low income is 29%.

Table 11: *Census Tract Data for the Proposed Action Area*

Census Tract	Tract Population	Percent minority	Percent low income	Percent Population under 5 years old
60290055081	1,560	71%	30%	15%
60290055082	1,213	49%	32%	3%
60290055083	1,692	78%	57%	7%
60290055121	2,334	53%	42%	11%
60290055131	1,523	50%	5%	2%
60290055132	436	28%	43%	13%
60290055141	334	3%	15%	4%
60290055142	1,123	58%	57%	7%
60290055143	1,840	54%	27%	10%
60290056001	980	49%	36%	6%
60290056002	1,300	48%	45%	2%
60290057001	2,906	35%	36%	23%
60290058031	1,396	45%	34%	1%
60290058032	1,869	62%	51%	11%
60290058041	2,496	81%	54%	10%
60290058042	1,771	77%	87%	7%
60290058043	1,848	61%	31%	7%
60290058051	1,426	57%	40%	2%
60290058052	851	34%	19%	9%
60290058061	1,295	64%	46%	2%
60290058062	1,747	40%	18%	6%
60290058063	1,316	39%	6%	4%
60290059001	520	76%	69%	18%
60290059002	701	60%	51%	0%
60290059003	2,140	76%	44%	10%
60290060122	2,077	17%	39%	1%
60290065001	939	47%	44%	0%

Census Tract	Tract Population	Percent minority	Percent low income	Percent Population under 5 years old
60290065002	2,639	82%	51%	0%
60290065003	958	67%	51%	7%
60379009022	371	13%	55%	0%
60710089012	1,006	39%	67%	8%
60710103001	771	71%	48%	11%
60710103002	739	35%	50%	5%
60710116021	1,793	33%	11%	2%
60710116022	109	0%	24%	0%
60710119001	220	68%	50%	0%
60710119003	527	41%	25%	10%
60710119004	1,077	62%	24%	3%
60710250001	9,573	52%	40%	16%
Population in the Proposed Action area*	**59,416**	**54%**	**40%**	**8%**
State Reference Population Demographics		**64%**	**29%**	**6%**

* Note: Portion of the boundaries of some census tracts are outside the Proposed Action area.

Source: USEPA EJ Screen. Based upon the 2016-2020 American Community Survey (ACS)

With regards to children's health or safety risks, there are 18 schools in the Proposed Action area, largely concentrated in the middle of the current High Altitude Supersonic Corridor in the vicinity of Edwards Air Force Base or near Mojave Airport. These schools include Baker Junior High, Boron High School, Branch Elementary, California City Middle School, Desert Junior-Senior High, Irwin Middle School, Gephart Junior High, General Powell State Pre-school Hacienda Elementary, Lynch School, Mojave Unified School, Mojave Elementary, Mountain View High School, Muroc Joint Unified School, Robert Ulrich Elementary, Silver Valley High School, Tiefort View Intermediate School, and West Boron Elementary. As shown above, these census tracts have 8% population under the age of 5 which is not meaningfully higher than the state average of 6%. It is important to note that all of these census tracts overlay the existing High Altitude Supersonic Corridor, and experience supersonic overflights from military operations currently and historically.

3.11.2 Environmental Consequences

The FAA has not established a significance threshold for socioeconomics, environmental justice, or children's environmental health and safety risks. However, FAA Order 1050.1F identifies factors to consider when evaluating impacts, which include the following:

- Whether the Proposed Action would cause an alteration in surface traffic patterns, or cause a noticeable increase in surface traffic congestion or decrease in Level of Service;
- Whether the Proposed Action would cause induced, or secondary, socioeconomic impacts to surrounding communities, such as changes to business and economic activity in a community; impact public service demands; induce shifts in population movement and growth, etc.;
- Whether the Proposed Action would have a disproportionate impact on minority and/or low-income communities (considering human health, social, economic, and environmental issues, as outlined in DOT Order 5610.2(a)); and,
- Whether the Proposed Action would have the potential to lead to a disproportionate health or safety risk to children.

The Proposed Action would not alter any surface condition, and the only changes in surface traffic would be the addition of the staff supporting the Flight Tests that would use area roadways in the vicinity of Mojave Air and Space Port for the duration of flight testing.

Because the Proposed Action would not result in construction, the only changes in business activity associated with the Action is the temporary movement of Boom representatives to the areas during the test. Therefore, the Proposed Action would not cause material induced, or secondary, socioeconomic impacts to surrounding communities.

With regards to minority and low-income populations, as noted in the Affected Environment section, the percentage of minority and low-income population in the census tracts is high; of the census tracts in the Proposed Action area, on average 54% of the population are minority and 40% are low income. In comparison, the minority population of the State of California is 64% and low income is 29%. **Figure 6** and **Figure 7** visually present the 2016-2020 ACS information for minority populations and low income. As the figures show, there are large minority and low-income populations within the region where the High-Altitude Supersonic Corridor and Black Mountain Supersonic Corridor are located. Further, many of the census tracts are so large that part of the tract is within the Proposed Action area and part is outside.

It would not be possible to avoid overlying areas of minority or low-income populations, and schools identified in the Affected Environment section above given the airspace definitions for supersonic flight as no viable alternatives exist to conduct the Proposed Action elsewhere. Further, it is not possible to estimate where precisely the sonic boom and boom carpet would occur, as is the case with the existing supersonic activity in the corridors. However, because the Proposed Action includes a limited number of test flights, and the Proposed Action would not result in any significant impacts for any other resource area as presented in this document, there would be no disproportionately high or adverse effects on minority and low-income populations, as well as children's health and safety.

In conclusion, the Proposed Action would not have significant impacts to Socioeconomics, Environmental Justice and minority communities, and children's health and safety risks.

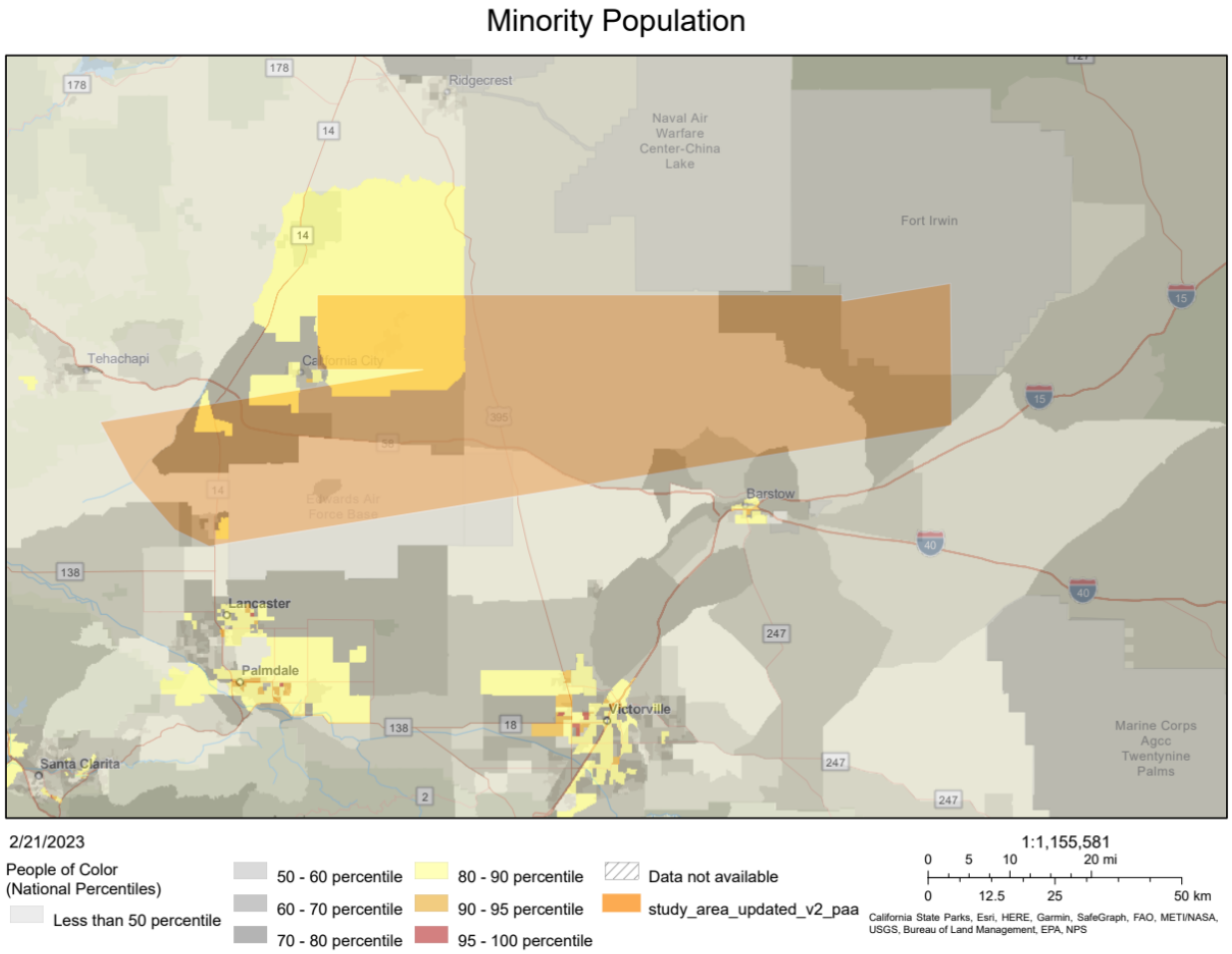

Figure 6: *Minority Population Distribution in the Proposed Action Area.*
Source: UESPA EJ Screen.

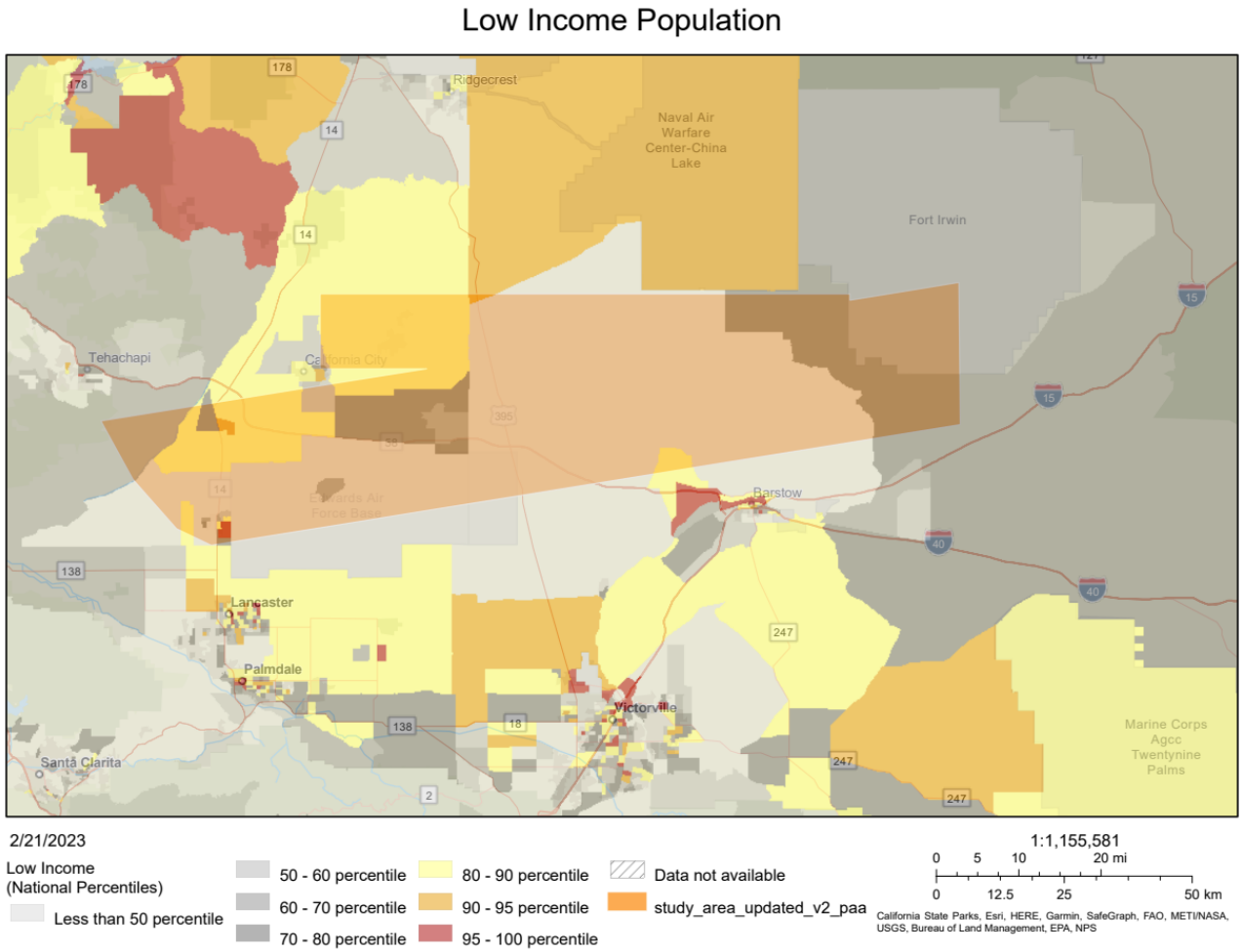

Figure 7: *Low Income Population Relative to State-Wide Low Income Population*
Source: UESPA EJ Screen.

3.11.3 Cumulative Impacts

NEPA requires that cumulative effects be evaluated along with the direct and indirect effects of the actions across the various environmental disciplines. Cumulative impacts are defined in the CEQ regulations (40 CFR §1508.7) as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions."

As required by FAA guidance, a NEPA document must consider past, present, and reasonably foreseeable actions in the Project Area. The basis for that approach is the recognition that, while the impacts of many actions may be individually minor, the cumulative effects of past, present, and reasonably foreseeable actions on populations or resources can be considerable. A description of the past, present, and reasonably foreseeable future actions is included below.

3.12 Past, Present, and Reasonably Foreseeable Future Actions

Past Actions

Because this testing would be conducted subject to the approved *Final Environmental Assessment to Extend the Supersonic Speed Waiver for Continued Operations in the Black Mountain Supersonic Corridor and Alpha Corridor/Precision Impact Range Area*, and subsequent re-evaluations and extension of the waiver, a review was conducted of past environmental analysis.

Limited public information exists about existing and planned activity in the existing supersonic corridors given their nature is military testing. In preparing the cumulative impact evaluation for this EA, prior military reports and any other public action were reviewed. During the 1980s and early 1990s, the F-4 and F-111 were the primary users of the Supersonic Corridors. From the late 1990s through 2000 the primary aircraft became the B-1, F-15, F-16, and T-38. From 2001 to 2009, the primary usage transitioned to the F-16, F-18, and T-38 with a temporary increase in F-22 supersonic flight during its initial test period of 2007 to 2008. In 2009, F-22 annual flights stabilized in the range of 20 to 25. Most aircraft anticipated to use the Black Mountain Supersonic Corridor during the period of the text would be the F-35, F-16, F-18, and T-38 with some continued use by the F-22 (USAF, 2010). Most of these aircraft are larger (bigger wingspan and heavier) than the aircraft associated with the Proposed Action and potentially fly supersonically at a lower altitude than the Proposed Action, and thus, as noted in Figure 4, produce larger sonic booms than would occur with the XB-1 and chase aircraft.

The maximum number of supersonic flight tests at below 30,000 ft MSL occurred in 2003 at 285 tests 2003 with 277 testing occurring at above 30,000 ft, and 285 supersonic flight tests below 30,000 ft MSL. By 2013, 440 supersonic tests occurred above 30,000 ft, while 266 occurred below 30,000 ft MSL. By 2017, supersonic tests above 30,000 ft were 345 events (USAF, 2010).

In 2017 an evaluation was conducted of a proposed launch system for low earth orbit rocket launches from Mojave Air and Space Port that would occur over the course of the 5-year launch license (expected 2017–2021) (FAA, 2017).

Present Actions

In recent years, the number of supersonic tests has ranged from 345 to 414 per year (with the peak occurring in 2022), although there were prior years when higher numbers of supersonic tests were conducted (USAF, 2010). Many of these tests are conducted with aircraft flying in formation, with a test aircraft and a chase aircraft. In recent years, approximately 20-25% of supersonic operations in the Black Mountain Supersonic Corridor occurred below 30,000 ft in altitude, and the majority (>80%) of these operations were conducted by F-15, F-16, F-18, F-22 and F-35 aircraft which are all larger and significantly heavier than XB-1 and the T-38 or F-5 chase aircraft, and would produce larger sonic booms than would occur with the XB-1 and chase aircraft.

Reasonably Foreseeable Future Actions

Consideration was given to actions that would occur in the next 5 years at the same time as the Proposed Action.

In their 2021 EA, the U.S. Air Force identified the following additional activities that are expected to occur within the Edwards restricted airspace within 5 years:

- On-going and/or increased testing of the B-21
- On-going and/or increased testing of the KC-46A
- A one-for-one replacement of T-38 permanently assigned aircraft (PAA) for the new T-7

They concluded that there would be less than significant impacts in all resource areas associated with these activities.

At Mojave Air and Space Port, Stratolaunch proposed to perform testing and operation of the Talon-A hypersonic research testbed vehicle beginning in 2022 and continuing for 5 years. A Finding of No Significant Impact (FONSI) was issued for this project in 2022 (USAF, 2022).

3.12.1 Environmental Consequences

There are certain environmental resources that would have no potential to create cumulative impacts in comparison to the past, the present, or the reasonably foreseeable future. Therefore, for some of the resources assessed in this EA, it can be assumed that there would be no cumulatively significant impacts.

- Given that the Proposed Action would not involve any new construction projects or earthmoving activity, there will be no direct impacts to Biological Resources, DOT Section 4(f) Lands, Historical, Architectural, Archaeological and Cultural Resources and Socioeconomic, Environmental Justice and Children's Environmental Health and Safety Risks. Indirect effects due to noise impacts from supersonic overflights are discussed in the Noise section below.
- Considering future activities at Mojave Air and Space Port described in the Future Actions section above, there are no impacts expected to occur on energy supply at Mojave Air and Space Port. Therefore, there would be no cumulatively significant impacts to energy supply from the Proposed Action.

Environmental resources that could have potential cumulative impacts associated with past, present, and foreseeable future projects include air quality, noise, climate, and hazardous materials. Following is an analysis of these potential cumulative impacts.

3.12.2 Air Quality and Climate

The increase in emissions due to the Proposed Action (both within the landing and takeoff from Mojave Air and Space Port as well as emissions associated with supersonic portion of flight testing, from both the XB-1 and chase aircraft) would not exceed the federal de minimis thresholds and are therefore not significant. While the Proposed Action would contribute to the cumulative emissions of air pollutants in Kern County, no projects or proposals have been identified that, when combined with the emissions from the Proposed Action, would result in a cumulative effect of the net air emissions that would cause or contribute to any new violation of the NAAQS, increase the frequency or severity of an existing violation, or delay timely attainment of any standard. Further, the SIP includes plans to achieve attainment in the future recognizing regional actions expected in the area. Therefore, the cumulative impact on air quality is not expected to be significant.

With regards to climate impacts, while the Proposed Action would result in GHG emissions, the emissions were deemed to be not significant in the context of U.S. wide and global GHG emissions. Further, Boom plans to minimize its potential climate effects of the Proposed Action, as discussed in the Climate section above. CEQ Interim Guidance on assessment of GHG impacts in NEPA documents indicates that "climate effects analysis is inherently cumulative in nature". While the Proposed Action would authorize 10-20 test flights during a one-year period that would result in GHG emissions, the emissions would cease once testing is complete. At this time there is no threshold of significance for greenhouse gas emissions and thus, the incremental increase in GHG emissions from the Proposed Action would be small and would not be expected to be significant in the context of US or world emissions.

Hazardous Materials and Solid Waste

The Proposed Action would generate small amounts of waste at Mojave Air and Space Port associated with aircraft fluids, aircraft parts, and paper associated with documentation. These would contribute cumulatively to waste generated by other existing and planned activities at Mojave Air and Space Port. However, all quantities are expected to be handled effectively through the existing disposal infrastructure and practices at Mojave Air and Space Port, and therefore no cumulatively significant impacts would be expected.

Noise

Today, Mojave Air and Space Port serves over 21,000 annual aircraft operations. The additional Proposed Action takeoff and landing operations at the airport would add up to 40 additional operations in total and would be a negligible increase (less than 0.2%) over past, present, and reasonably foreseeable operations. The Proposed Action by itself was shown to be less than significant with respect to aircraft landing and takeoff noise and would not be expected to have cumulatively significant noise impact.

The US Air Force conducts regular supersonic tests in the High-Altitude Supersonic corridor and Black Mountain Supersonic Corridor and has done so since the 1960s. The local land use jurisdictions are aware of the noise and sonic boom effects that the area regularly experiences. Local jurisdictions have reflected the presence of flight testing in their local land use plans. The Air Force has and is expected to continue to conduct supersonic events in the corridors subject to a waiver and has operated within that waiver since its original issuance.

The addition of the Proposed Action, the Boom test flights, would not result in the exceedance of the Air Force waiver. The minor incremental increase in aircraft noise, as discussed in the Noise impact section, Section K captured the change in noise associated with the addition of the Boom supersonic test flights. Further, the FAA's threshold of project-related noise change is measured in DNL, and the Proposed Action would be below the threshold of significance (0.5 DNL). To achieve a significant cumulative impact would require a 50% increase over the Air Force activity levels (from the Air Force past 345 to 414 sorties to 518 to 621 sorties) in addition to the Proposed Action. The Air Force supersonic sortie data remains relatively stable from year to year and there are no publicly announced new supersonic aircraft entering flight test at Edwards. Therefore, no significant increase in supersonic flights is expected and a significant cumulative noise impact in the Supersonic corridors is not expected.

While Boom Technologies is proposing to conduct supersonic tests with a demonstrator aircraft, in the long-term their objective is to develop a commercial service aircraft. It is not reasonably foreseeable to determine where that aircraft will be tested at this time; therefore, its potential environmental impacts cannot be included in the present cumulative assessment. However, if a production aircraft is tested in the same corridor as the demonstrator aircraft it would be much later in time, not to overlap with this Proposed Action.

Chapter 4
Agency and Citizen Coordination

The FAA released the Draft EA for public and agency review and comment from January 12 – February 2, 2024. The public and agencies were invited to submit comments no later than 5pm Eastern Standard time on March 2, 2024. Notices about the availability of this Draft EA were published in the Federal Register on January 12, 2024

The Draft EA was available at the following web address:
https://www.faa.gov/about/office_org/headquarters_offices/apl/aee/env_policy/sfa_supersonic

No comments were received during the public comment period. The Final EA and the Finding of Significant Impact can also be found at the website above.

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Abbreviations and Acronyms

µg/m^3	micrograms per cubic meter
AC	Advisory Circular
AEDT	Airport Environmental Design Tool
BMP	Best Management Practice
CAA	Clean Air Act
CAEP	Committee on Aviation Environmental Protection
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	methane
CNEL	Community Noise Equivalent Level
CO	Carbon Monoxide
CO_2	Carbon Dioxide
dB	Decibel
DNL	Day-Night Average Sound Level
EA	Environmental Assessment
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FONSI	Finding of No Significant Impact
FR	Federal Register
FY	fiscal year
GHG	Greenhouse Gas
GWP	Global Warming Potential
IPCC	International Panel on Climate Change
Leq	Equivalent Sound Level
Lmax	Maximum Sound Level
MHV	Mojave Air and Space Port
MT	Metric ton (also tonne)
mi^2	square miles
N_2O	Nitrous Oxide
NAA	No Action Alternative
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NHRP	National Register of Historic Places
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
NRHP	National Register of Historic Places
O_3	Ozone
Pb	Lead
PM	Particulate Matter
PM_{10}	Particulate matter with a diameter less than 10 micrometers
$PM_{2.5}$	Particulate matter with a diameter less than 2.5 micrometers
ppb	parts per billion
ppm	parts per million
SC-CH_4	Social Cost of Methane
SC-CO_2	Social Cost of Carbon Dioxide
SC-GHG	Social Cost of Greenhouse Gases
SC-N_2O	Social Cost of Nitrogen Oxides
SEL	Sound Exposure Level
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SO_2	Sulphur Dioxide
TAF	Terminal Area Forecast
tpd	tons per day
tpy	tons per year
USC	U.S. Code
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Services
VOC	Volatile Organic Compounds

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Appendix A
Mojave Air and Space Port Baseline Aircraft Inventory Development

Boom worked with Mojave Air and Space Port (MHV) to develop fleet mix assumptions for existing aircraft activity at MHV to screen LTO noise impacts in AEM. MHV tracks number of operations by operation type (local/itinerant, GA/civil/military), had previously prepared fleet mix information for the recent runway 12-30 rehabilitation program at MHV, considering FAA requirements on operations allowed to be considered for runway projects. The relative proportions of the Runway 12-30 rehabilitation fleet mix were deemed to be representative of annual operations at MHV, which was used as the basis for the inventory in Boom's AEM screening modeling.

The approach to calculating a baseline aircraft inventory for MHV is therefore as follows:

1. Calculate relative percentages of military vs. civil aircraft fleet mix from runway rehabilitation analysis (Table A-1 and Table A-2)
2. Obtain forecast operations at MHV from FAA Terminal Area Forecast (Table A-3)
3. Calculate activity at MHV by aircraft type using FAA TAF forecasts and relative percentages defined above (Table A-4)
    a. Civil vs. military forecast operations are each applied to their respective relative fleet mix distributions
    b. Daytime vs. nighttime splits is obtained from the Kern County Airport Land Use Compatibility Plan (Kern County, 2012).
4. Map aircraft fleet mix to AEDT/AEM aircraft types for modeling (Table A-5)
    a. Follows default mapping in AEM where possible
    b. Assigns aircraft by Gross Weight for general aircraft classes

Table A-1: FAARFIELD Modeling Data for Mojave Air and Space Port Runway 12-30 Rehabilitation Program

No.	Name	Gross Wt. lbs	Annual Departures	% Annual Growth
1	D-15	12,500	191	1.00
2	D-15	16,500	18	1.00
3	D-25	22,500	25	1.00
4	D-30	30,000	11	1.00
5	D-40	40,000	213	1.00
6	Falcon-900	45,500	106	1.00
7	Gulfstream-G-III	70,200	18	1.00
8	Gulfstream-G-IV	75,000	35	1.00
9	Gulfstream-G-V	90,900	18	1.00
10	S-3	3,000	216	1.00
11	S-5	4,500	149	1.00
12	S-10	6,500	35	1.00
13	S-10	9,000	28	1.00
14	S-10	10,000	7	1.00
15	S-10	11,500	142	1.00
16	S-15	16,500	32	1.00
17	F/A-18C	56,000	549	1.00
18	S-12.5	11,820	180	1.00
19	KC-10	583,000	35	0.00
20	KC-10 Belly	583,000	35	0.00
21	DC10-30/40	583,000	35	0.00
22	DC10-30/40 Belly	583,000	35	0.00

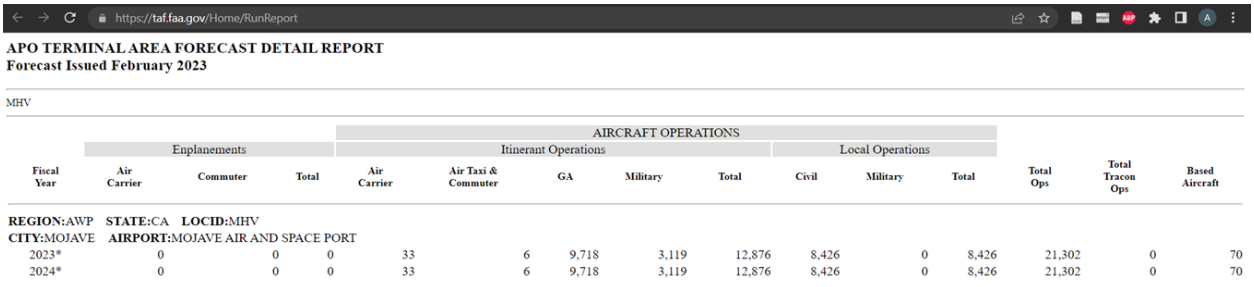
Table A-2: Relative Percentages of Fleet Mix from FAARFIELD Modeling Data

Aircraft Model	Op Type	Gross Wt (lbs)	Annual Departures	Fleet Mix	
D-15	Non-Military	12,500	191	13%	
D-15	Non-Military	16,500	18	1%	
D-25	Non-Military	22,500	25	2%	
D-30	Non-Military	30,000	11	1%	
D-40	Non-Military	40,000	213	15%	
Falcon-900	Non-Military	45,500	106	7%	100%
Gulfstream-G-III	Non-Military	70,200	18	1%	
Gulfstream-G-IV	Non-Military	75,000	35	2%	
Gulfstream-G-V	Non-Military	90,900	18	1%	
S-3	Non-Military	3,000	216	15%	
S-5	Non-Military	4,500	149	10%	

Aircraft Model	Op Type	Gross Wt (lbs)	Annual Departures	Fleet Mix	
S-10	Non-Military	6,500	35	2%	
S-10	Non-Military	9,000	28	2%	
S-10	Non-Military	10,000	7	0%	
S-10	Non-Military	11,500	142	10%	
S-15	Non-Military	16,500	32	2%	
S-12.5	Non-Military	11,820	180	13%	
F/A-18C	MIL	56,000	549	80%	
KC-10	MIL	583,000	35	5%	
KC-10 Belly	MIL	583,000	35	5%	100%
DC10-30/40	MIL	583,000	35	5%	
DC10-30/40 Belly	MIL	583,000	35	5%	

Table A-3: FAA TAF Forecast for Mojave Air and Space Port

	Military	Non-Military (incl. GA/Civil/AC/AT)	Total
2024 MHV Operations	3,119	18,183	21,302



https://taf.faa.gov/Home/RunReport

APO TERMINAL AREA FORECAST DETAIL REPORT
Forecast Issued February 2023

MHV

	AIRCRAFT OPERATIONS													
	Enplanements			Itinerant Operations					Local Operations					
Fiscal Year	Air Carrier	Commuter	Total	Air Carrier	Air Taxi & Commuter	GA	Military	Total	Civil	Military	Total	Total Ops	Total Tracon Ops	Based Aircraft
REGION:AWP **STATE:**CA **LOCID:**MHV														
CITY:MOJAVE **AIRPORT:**MOJAVE AIR AND SPACE PORT														
2023*	0	0	0	33	6	9,718	3,119	12,876	8,426	0	8,426	21,302	0	70
2024*	0	0	0	33	6	9,718	3,119	12,876	8,426	0	8,426	21,302	0	70

Table A-4: Mojave Air and Space Port Aircraft Inventory Development

Aircraft Model	Op Type	Fleet Mix	Annual Operations (2024)	Daytime (90%)	Nighttime (10%)
D-15	Non-Military	13%	2,439	2,195	244

Aircraft Model	Op Type	Fleet Mix	Annual Operations (2024)	Daytime (90%)	Nighttime (10%)
D-15	Non-Military	1%	230	207	23
D-25	Non-Military	2%	319	287	32
D-30	Non-Military	1%	140	126	14
D-40	Non-Military	15%	2,720	2,448	272
Falcon-900	Non-Military	7%	1,354	1,218	135
Gulfstream-G-III	Non-Military	1%	230	207	23
Gulfstream-G-IV	Non-Military	2%	447	402	45
Gulfstream-G-V	Non-Military	1%	230	207	23
S-3	Non-Military	15%	2,758	2,482	276
S-5	Non-Military	10%	1,903	1,712	190
S-10	Non-Military	2%	447	402	45
S-10	Non-Military	2%	358	322	36
S-10	Non-Military	0%	89	80	9
S-10	Non-Military	10%	1,813	1,632	181
S-15	Non-Military	2%	409	368	41
S-12.5	Non-Military	13%	2,298	2,069	230
Non-Military Subtotal:			*18,183*	*16,365*	*1,818*
F/A-18C	MIL	80%	2,485	2,237	249
KC-10	MIL	5%	158	143	16
KC-10 Belly	MIL	5%	158	143	16
DC10-30/40	MIL	5%	158	143	16
DC10-30/40 Belly	MIL	5%	158	143	16
MIL Subtotal:			*3,119*	*2,807*	*312*
Totals:			**21,302**	**19,172**	**2,130**

Table A-5: Aircraft Type Mapping to AEM/AEDT Model

Aircraft Model	Op Type	Gross Wt (lbs)	AEDT AcType	AEDT Aircraft Description
D-15	Non-Military	12,500	DHC6	DASH 6/PT6A-27
D-15	Non-Military	16,500	1900D	BEECH 1900D / PT6A67
D-25	Non-Military	22,500	IA1125	ASTRA 1125/TFE731-3A
D-30	Non-Military	30,000	CNA680	Cessna Model 680 Sovereign / PW306C
D-40	Non-Military	40,000	CL600	CL600/ALF502L
Falcon-900	Non-Military	45,500	CNA750	EMBRAER 145 ER/ALLISON AE3007
Gulfstream-G-III	Non-Military	70,200	GIV	GULFSTREAM GIIB/GIII - SPEY 511-8
Gulfstream-G-IV	Non-Military	75,000	GIV	GULFSTREAM GIV-SP/TAY 611-8
Gulfstream-G-V	Non-Military	90,900	GV	GULFSTREAM GV/BR 710
S-3	Non-Military	3,000	GASEPV	1985 1-ENG VP PROP
S-5	Non-Military	4,500	T34	BEECH MENTOR (BE45) PT6A-25 NM
S-10	Non-Military	6,500	T37B	CESSNA 318 J69-T-25 NM
S-10	Non-Military	9,000	CNA208	Cessna 208 / PT6A-114
S-10	Non-Military	10,000	PA42	Piper PA-42 / PT6A-41
S-10	Non-Military	11,500	PA42	Piper PA-42 / PT6A-41

Aircraft Model	Op Type	Gross Wt (lbs)	AEDT AcType	AEDT Aircraft Description
S-15	Non-Military	16,500	CNA525C	Cessna Model 525C CJ4
S-12.5	Non-Military	11,820	PA42	Piper PA-42 / PT6A-41
F/A-18C	MIL	56,000	F-18	MCDONNELL DOUGLAS HORNET F404-GE-400 NM
KC-10	MIL	583,000	DC1030	DC10-30/CF6-50C2
KC-10 Belly	MIL	583,000	DC1030	DC10-30/CF6-50C2
DC10-30/40	MIL	583,000	DC1030	DC10-30/CF6-50C2
DC10-30/40 Belly	MIL	583,000	DC1030	DC10-30/CF6-50C2

Appendix B
Boom Noise Methodology Memo

To: Don Scata, Noise Division Manager, FAA Office of Environment an Energy
From: Boom Technology
Re: Noise Methodology and Surrogate Aircraft for XB-1
Date: March 24, 2023 (Approved: June 20, 2023)

1. Introduction

Boom Technology (Boom) is preparing an Environmental Assessment (EA) to seek approval to conduct supersonic civilian aircraft test flights over land for its experimental aircraft, XB-1, and associated chase aircraft (either a Northrop T-38 Talon or Northrop F-5). Approval from the FAA is required to operate supersonically in the supersonic corridor (subsonic testing does not require a special flight authorization). As such, the scope of the noise assessment is limited to sonic boom effects. Of note, the proposed operations are limited to only up to 20 events and will occur in a military flight-testing corridor in which high-altitude supersonic flights have occurred regularly for decades.

The purpose of this memorandum is to seek approval from the FAA Office of Environment and Energy for the alternative methodology for the noise and emissions assessments used in the EA. As explained below, the two approved noise methodologies, FAA's Aviation Environmental Design Tool (AEDT) and NASA's PCBOOM, are not practical or feasible options for XB-1 sonic boom analyses. This memo presents the assessment procedure which relies on a conservative assessment based upon aircraft which are similar in environmental effects to the experimental XB-1 aircraft. The methodology proposed in this Memo provides a very conservative approach to analyzing the effects of XB-1's sonic boom.

2. Overview of the Experimental Aircraft

The XB-1 is a one-of-a-kind experimental aircraft. However, it has similarities with existing military supersonic aircraft which are noted in this memorandum. Because the XB-1 is not included in any environmental models (such as FAA's AEDT or NASA's PCBOOM) it is not directly possible to model its environmental impacts using these tools. Instead, as discussed below, the most similar existing aircraft were identified as surrogates for the purposes of the very conservative qualitative analysis used for the EA.

The XB-1 aircraft is a 3-engine supersonic demonstrator aircraft with a length of about 73 feet and wingspan of 21 feet. When assessing environmental effects, both engine and airframe noise were considered. As the following sections describe, two different reference aircraft are used, one reflecting the most comparable engine and the other the most comparable airframe.

Each XB-1 flight would have an accompanying "chase aircraft" flying alongside at the same altitude as XB- 1 (and within about 1,000 feet away laterally) during these tests to ensure safe execution of the flight test program. The chase aircraft would be expected to be a Northrop T-38 or F-5 aircraft flying at the same speed as XB-1. The chase aircraft is smaller and will have a smaller impact than the XB-1 aircraft.

2.1 Engine emissions: The J85-GE-21 is the most comparable engine available for analysis.

The XB-1 uses a J85-CAN-15 engine, which is an afterburning turbojet engine most commonly used on the Canadian variant of the Northrop F-5. Although the XB-1 aircraft is longer than the F-5, the XB-1

has a smaller wingspan and has a maximum takeoff weight that is 3,000 pounds lower than the F-5. This means that although the XB-1 aircraft has one more engine than the F-5, the thrust required for takeoff and climbout is actually less than that of the F-5. Less overall low-altitude noise would be expected for XB-1 as the throttles will not have to remain in full afterburner after landing gear retraction is complete.

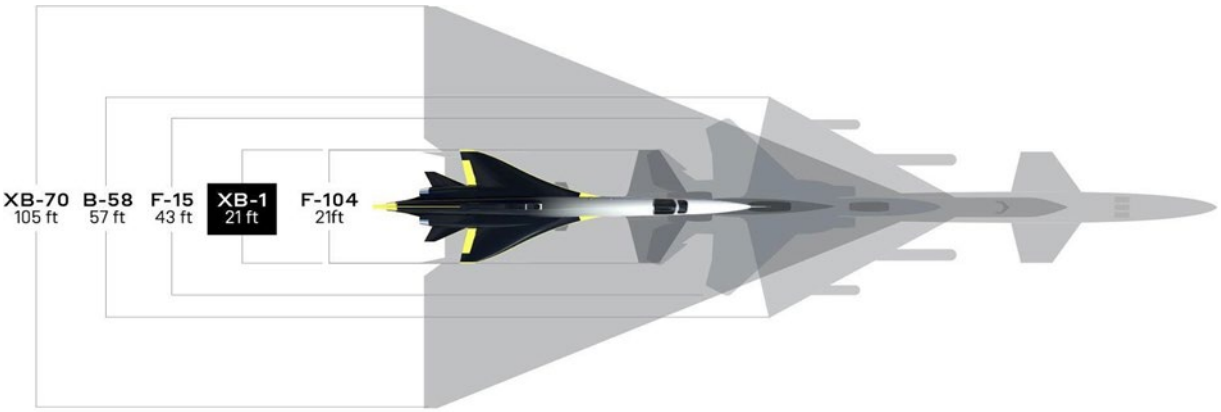
Per AEDT version 3e engine database[23], Boom has selected the J85-GE-21 as the most comparable engine available for analysis. Although the -21 version is larger and produces more emissions than the CAN-15 variant, our selection of the J85 will make the analysis conservative for both emissions and engine noise. Boom has upscaled the emissions of the J85-GE-21 engine from 2 engines in the F-5 to the 3 engines installed in the XB-1 aircraft for this analysis. The emissions from the F-5 calculated by AEDT is a **conservative estimate for emissions from the T-38 chase plane, as the T-38 engines have slightly less thrust than the Northrop F-5**.

2.2 Airframe noise: The F-104 Starfighter is the most comparable airframe available for analysis.

NASA has produced several measurement studies of sonic boom noise as detected on the ground from various aircraft (NASA, 1978), see Figure B-1. According to these measurement studies, the XB-1 and the chase aircraft fit into the class of "small fighter aircraft". The most similar aircraft in terms of the variables impacting sonic boom generation (length, wingspan, shape, sweep and operating speed) is the F-104 Starfighter. Specifically, the F-104 has a nearly identical wingspan and similar overall shape as XB-1, albeit with a shorter length, as shown in **Figure B-1.** However, as compared to the straighter wings of the F-104, the larger sweep of the wing of XB-1 is expected to decrease the overall sonic boom (which makes the F- 104 a conservative approach). Similarly, the chase aircraft (both the T-38 and F-5) have a comparable wingspan, is shorter in length and has a larger wing sweep when compared to the F-104 Starfighter. For these reasons, the F-104 Starfighter serves as the comparable aircraft from an airframe perspective to consider the sonic boom carpet for both XB-1 and the chase aircraft.

This aircraft is documented in several NASA reports in terms of its measured sonic boom noise levels while operating in similar conditions as the proposed XB-1 and chase aircraft flights. Boom Technology believes that the NASA report data is sufficient to describe the sonic boom effects of their proposed test program.

Figure B-1. Aircraft Size Comparison



Source: Boom Technology, 2020

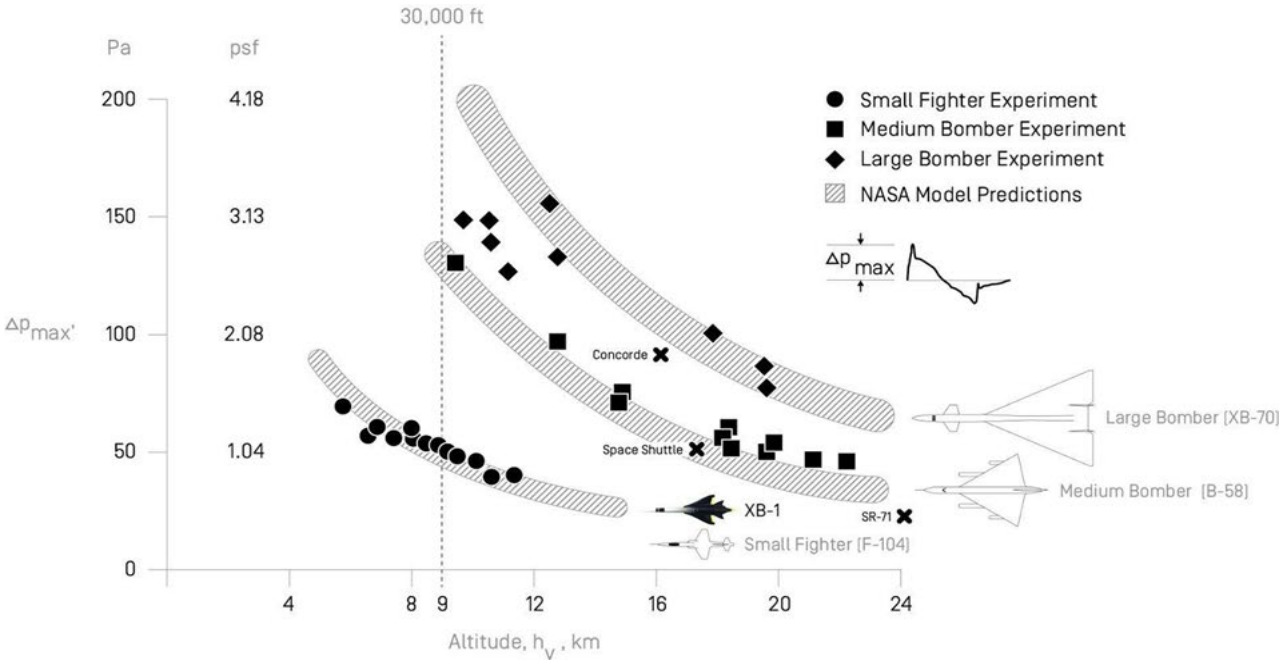
[23] AEDT is not proposed for use in noise but is used for the purpose of estimating emissions.

3. Environmental Sonic Boom Effects

Boom developed an assessment based on published flight test data of similar surrogate aircraft and engines, as existing noise models do not account for the experimental XB-1 aircraft.

Figure B-2 shows the overpressure associated with various aircraft airframe types, ranging from the small fighter, up to the larger sonic boom of the larger bomber aircraft (NASA 1978). The assessment of the sonic boom was based on published data for the F-104 conducting a sonic boom. This aircraft is classified as a "small fighter" in the NASA literature. A review of that literature indicates that an F-104 which operates at the proposed altitude of the XB-1 and chase flights (30,000 ft or 9 kilometers above ground level) would generate about 50 pascals (1.04 pounds per square foot, psf) at ground level.[24]

Figure B-2. Sonic Boom Measurement and Prediction Data



Source: NASA, 1978 (reproduced from Figure 15 on pg. 47)

4. Conclusion

The purpose of this memorandum is to present to the FAA Office of Environment and Energy the methodology for the noise assessment for the EA. **The memo presents the assessment procedure which relies on an assessment based upon surrogate aircraft which are similar in environmental effects to the experimental XB-1 and chase aircraft that will be operated for supersonic testing purposes.** The key points of our assessment are as follows:

- The noise effects from the proposed operations that require environmental approval through the NEPA process are limited to sonic boom noise only.

[24] 1 pa = 0.021 psf

- AEDT and PCBOOM are not practical options for XB-1 sonic boom analyses. The methodology proposed in this Memo provides a more conservative approach to analyzing the emissions and sonic boom impacts of XB-1, and the chase aircraft.
- Within the area of potential noise effects, ongoing, high-altitude military supersonic flight activity similar in nature to the proposed operations has been taking place for decades.
- The EA will show that given the results of our noise assessment, based on a similar aircraft using the same flight conditions and operation, the potential for impacts to people, structures, and land uses in the area of potential effects correlate with "some public reaction" and "rare, minor structural damage."

Boom seeks AEE's review of the noise methodology and approval for use in this EA. We look forward to your approval.

5. References

NASA, 1978. Technical Paper 1122, "Simplified Sonic Boom Prediction".

NASA, 2017. NASA Armstrong Fact Sheet: Sonic Booms. Accessed at: https://www.nasa.gov/centers/armstrong/news/FactSheets/FS-016-DFRC.html

U.S. Air Force, 2010. 95th Air Base Wing, Civil engineering Directorate, Extend Supersonic Airspeed Waiver 75-12 for the Black Mountain Supersonic Corridor (BMSSC) and Alpha Corridor Precision Impact
Range (AC/PIRA) Evaluation Report, February 2010

Appendix C
AEM Screening Model

AEM Screening Model

Double-click the button to the left for access to AEE's Area Equivalent Method (AEM) Version 2c SP2 Excel spreadsheet.

Appendix D
Edwards AFB Desert Tortoise Handout

Desert Tortoise
(Gopherus agassizii)

- Federally protected as Threatened by the Endangered Species Act.
- Official state reptile of California! Soft scaly body with a hard shell. Could be green, grey, tan, or brown. Only 1.5 inches in diameter after hatching, but up to 1 foot in diameter as adult.
- Desert Tortoise protection at Edwards AFB is mandated by the U.S. Fish and Wildlife Service Biological Opinion: "Operations and Activities at Edwards Air Force Base, California" (8-8-14-F-14).
- Unauthorized collection, handling or harassment can be prosecuted: Fines up to $50,000 and/or 1 year imprisonment.
- Often looks like a moving rock and hard to spot!
- Spends over 90% of its life underground in burrows.
- Most active in Spring and Fall but possible to see all year-round especially after a rain.
- Attracted to water. Often seen where puddling occurs during or after a rain (like road shoulders).
- Found throughout the Mojave and parts of the Sonoran Desert.

If tortoise found in immediate danger (on the road), and it is safe to do so, please move it:

Approach slowly from the front

Carefully lift tortoise by the sides with 2 hands and keep level

Move tortoise at least 100 feet away, in the same direction it was going.

Call
412 CEG/CEVA
661-277-1417
661-277-1401

How you can protect the Desert Tortoise

- Do not handle a tortoise unless it is on the road and in immediate danger.
- If a tortoise is on the road in immediate danger, you may move the tortoise off the road.
- Check under parked vehicles and equipment before moving or operating.
- Keep vehicles and equipment on existing or approved roads and staging areas.
- If tortoise is sighted in project area, call 412 CEG/CEVA. Observe from a distance.
- Do not attract ravens. Ravens are a major predator of the Desert Tortoise. Keep trash in raven-proof containers. Make sure lids are tightly closed. Do not feed the wildlife!
- Ensure water tanks and trucks are free of water leaks that might attract predators.

DT Handout 412 TW/PA Release #18150 20180316

Appendix E
Edwards AFB Cultural Resources Awareness Training

Cultural resources can be defined as physical evidence or place of past human activity: site, object, landscape, structure; or a site, structure, landscape, object or natural feature of significance to a group of people traditionally associated with it (https://www.nps.gov/acad/learn/management/rm_culturalresources.htm)

At EAFB cultural resources include historic-era resources (typically more than 50 years old), military resources (related to the historic and modern military use of the area), and American Indian resources (generally called *Prehistoric* resources). Some of these resources as much as 12,000 years old

It is our goal to protect these resources because once they are gone we cannot ever get them back.

LAWS

Archaeological Resources Protection Act
American Antiquities Act
Native American Graves Protection and Repatriation Act
Air Force Instruction 32-7065
National Historic Preservation Act, Sections 106 and 110
Native American Graves Protection and Repatriation Act

- If you did not drop it, do not pick it up.
- If it is not yours, leave it alone.
- The Environmental Management Group works closely with security to enforce Cultural Resources protection, including cameras near archaeological sites.

Appendix F
Section 106 Consultation

Washington, Michon (FAA)

From: Andrus, Katherine (FAA)
Sent: Tuesday, October 27, 2020 2:36 PM
To: 'calshpo.ohp@parks.ca.gov'
Subject: Section 106 review of FAA Authorization for Supersonic Test Flight
Attachments: Part 91 SFA Section 106 initiation 10272020.pdf

Please find attached a letter seeking your input on a proposed undertaking by the Federal Aviation Administration involving authorization of supersonic test flights in the
High Altitude Supersonic Corridor associated with Edwards Air Force Base, in
Kern, San Bernadino and Los Angeles Counties, CA.

Please do not hesitate to contact me if you have any questions or need additional information. I look forward to your response.

Regards,

Katherine B. Andrus
Federal Preservation Officer and
National Tribal Consultation Official
Office of Environment and Energy
Office:202-267-9548
Cell: 202-706-8124
Katherine.andrus@faa.gov

Washington, Michon (FAA)

From: Andrus, Katherine (FAA)
Sent: Monday, January 4, 2021 9:37 AM
To: 'calshpo.ohp@parks.ca.gov'
Subject: RE: Section 106 review of FAA Authorization for Supersonic Test Flight
Attachments: Part 91 SFA Section 106 initiation 10272020.pdf

Good morning: I am following up to see if your office has any comments on the attached letter. If we do not hear back from you by Monday, January 11, 2021 the FAA will proceed with a determination of no potential to affect historic properties.

Regards,

Katherine B. Andrus
Federal Preservation Officer and
National Tribal Consultation Official
Office of Environment and Energy
Office:202-267-9548
Cell: 202-706-8124
Katherine.andrus@faa.gov

From: Andrus, Katherine (FAA)
Sent: Tuesday, October 27, 2020 2:36 PM
To: calshpo.ohp@parks.ca.gov
Subject: Section 106 review of FAA Authorization for Supersonic Test Flight

Please find attached a letter seeking your input on a proposed undertaking by the Federal Aviation Administration involving authorization of supersonic test flights in the
High Altitude Supersonic Corridor associated with Edwards Air Force Base, in
Kern, San Bernadino and Los Angeles Counties, CA.

Please do not hesitate to contact me if you have any questions or need additional information. I look forward to your response.

Regards,

Katherine B. Andrus
Federal Preservation Officer and
National Tribal Consultation Official
Office of Environment and Energy
Office:202-267-9548
Cell: 202-706-8124
Katherine.andrus@faa.gov

U.S. Department
of Transportation
Federal Aviation Administration

October 27, 2020

Julianne Polanco
State Historic Preservation Officer
Office of Historic Preservation
1725 23rd Street, Suite 100
Sacramento, CA 95816

Via electronic mail to calshpo.ohp@parks.ca.gov

Authorization for Supersonic Test Flight, Kern, San Bernadino and Los Angeles Counties, CA

Dear Ms. Polanco:

The Federal Aviation Administration (FAA) is reviewing an application for a Special Flight Authorization (SFA) for tests of an experimental supersonic-capable demonstrator aircraft within the confines of the existing High Altitude Supersonic Corridor associated with Edwards Air Force Base.[1] The demonstrator aircraft would be closely accompanied by a chase aircraft (either a T38 or F-5 aircraft) during all flight test operations. The applicant plans to operate supersonically only above 30,000 feet Mean Sea Level (MSL) for these flight tests. The supersonic portion of the test program is expected to include approximately 10-30 test flights, each conducted by the demonstrator and chase aircraft, over a period of one year. The FAA's approval is limited to the supersonic portion of flight operations; FAA authorization is not required to operate the aircraft sub-sonically. The FAA has determined that approval of this SFA would be an undertaking for purposes of Section 106 of the National Historic Preservation Act and its implementing regulations at 36 CFR part 800.

Based on the limited number of operations, the high altitude of the flights, the one-year duration of the testing period and the intermittent and transient nature of impacts the FAA believes that approval of this SFA is the type of activity that has little or no potential to cause effects to historic properties, assuming that such properties are present in the area. However, due to the relative novelty of commercial supersonic technology and the limited data that we have regarding the impact of this type of operation on certain types of historic resources, we have not yet determined whether this type of operation is an activity with the potential to affect historic properties under 36 CFR § 800.3(a)(1). Therefore, the FAA is initiating consultation with you to solicit input on what, if any, potential effects this type of action may have on historic properties. We are asking the California Native American Heritage Commission to assist us in identifying tribes having ancestral ties to this area, and will initiate consultation with those tribes on the same basis.

[1] The SFA would include a waiver of provisions in 14 CFR 91.817 and Part 91 Appendix B that restrict civilian supersonic operations over land in the United States.

The FAA is preparing an Environmental Assessment (EA) for the proposed SFA under National Environmental Policy Act (NEPA). The FAA is integrating its Section 106 review with its NEPA process, but is not proposing to use the NEPA substitution procedures under 36 CFR 800.8(c).

Area of Potential Effect (APE)

The potential effects of aircraft operating supersonically at 30,000 feet MSL on historic properties are limited to the introduction of audible or visual elements and vibrations from noise-induced shock waves (sonic booms). There would not be any physical effects from ground disturbance, construction or demolition associated with this undertaking. The APE for this undertaking is an area within the existing High Altitude Supersonic Corridor that would be overflown by the proposed supersonic operations authorized under the SFA, as shown in the attached Figure 1.[2]

The APE is located approximately 10 miles northeast of Edwards AFB in the Antelope Valley region of the Mojave Desert in Southern California. The APE spans portions of Los Angeles County, Kern County, and San Bernardino County and overlies the City of California City and the unincorporated communities/census-designated places of Mojave, Rosamund, North Edwards, Boron, Kramer Junction, and Fort Irwin as well as smaller residential settlements. Overall this area is sparsely settled; most of the land is under the jurisdiction of the Bureau of Land Management (BLM) and designated for agricultural, recreational, and mining uses. Non-military land uses within the area includes agriculture, ranching, recreation, and mining.

The area is part of the R-2508 Airspace Complex used and managed by Naval Air Weapons Station China Lake National Training Center, Fort Irwin Air Force Test Center, and Edwards Air Force Base for military activities including bombing ranges, supersonic corridors, low altitude high speed maneuvers, radar intercept areas, refueling areas and various other test, evaluation, and training activities. The APE is fully within the High Altitude Supersonic Corridor, which is used for supersonic flight only above 30,000 feet MSL, and overlaps with the Black Mountain Supersonic Corridor, which is used by military aircraft for low-level flight test and training routes.

A preliminary review of the National Register of Historic Places (NRHP) database identified four listed properties within the APE:

- Rogers Dry Lake National Historic Landmark, within the boundaries of Edwards Air Force Base (reference number 85002816)
- Pioneer Goldstone Deep Space Station Communication Complex (reference number 85002813)
- Black Canyon--Inscription Canyon--Black Mountain Rock Art District (reference number 00001046)
- Fossil Canyon Petroglyph Site (reference number 02000980 – location restricted)

[2] The test flights would originate and end at the Mojave Air and Space Port, CA; however supersonic operations would not occur until the aircraft are within the High Altitude Supersonic Corridor.

The APE also includes portions of the Old Spanish National Historic Trail and the Mojave Trails National Monument. Portions of these trails may be eligible for the National Register. Other eligible properties may exist within the APE.

Preliminary Assessment of Effects

Introduction of audible or visual elements: In general, noise from activities at ground level is quite low in the APE due to the undeveloped nature of the area. However, the airspace is routinely used for military aircraft testing and training, which are part of the more recent historic character of Edwards Air Force Base and Rogers Dry Lake National Historic Landmark. Supersonic flights have occurred in this area regularly since the 1950s as part of the Air Force Flight Test Center and the Air Force Test Pilot School at Edwards Air Force Base. Potential noise and visual effects from the relatively small number of supersonic operations authorized by this undertaking would be no different in character than the ubiquitous military aircraft operations over historic properties in the APE, and based on the smaller size of the aircraft and altitude of test flights, would be less intrusive.

Sonic Boom: Aircraft traveling at or above the speed of sound (sonic velocity) produce sonic booms. Impulse noise from sonic booms is measured differently than subsonic noise and is expressed in terms of pound per square foot (psf) of "overpressure" (the pressure caused by a sonic boom or other shock wave above the normal atmospheric pressure). Preliminary analysis of the demonstrator aircraft indicates that it would produce approximately 1 psf of overpressure when flying supersonic at 30,000 feet. Most of the military aircraft operating in the High Altitude Supersonic Corridor are larger (bigger wingspan and heavier) and thus produce sonic booms of a higher psf than would occur with the demonstrator and chase aircraft.

The aircraft associated with the undertaking also would be expected to generate a smaller sonic boom footprint (also known as a "boom carpet") than other aircraft currently being tested in the High Altitude Corridor. As with other supersonic flights in the High Altitude Corridor, the sonic boom carpet theoretically could fall outside of the corridor boundaries, depending on the altitude and ground track. In general, the higher the altitude, the wider the boom carpet; however, a corresponding decrease in overpressure would also be expected to occur.

The demonstrator and chase aircraft would operate in close proximity to one another. Based on the high altitude of each test, it is anticipated that an observer on the ground could experience either a single sonic boom event or two sonic booms in rapid succession, as occurs today for aircraft testing in the corridor.[3] To the degree that the sonic boom of the demonstrator aircraft overlaps with that of the chase aircraft, the psf would be doubled to approximately 2 psf. Historic properties in the APE most sensitive to shock waves and vibrations include those with aboveground structural features, such as rock shelters and rock art, including examples identified at the Black Canyon-Inscription Canyon-Black Canyon Rock Art District.[4] Typically only supersonic shock waves or sonic booms generated by flights below 30,000 feet MSL have been found to carry enough residual

[3] Department of Defense supersonic operations in this area are operated in the same way (i.e., primary and chase aircraft flying supersonic while in close proximity).

[4] Air Force Flight Test Center, Environmental Management Directorate, Edwards AFB, *Environmental Assessment for Low Level Flight Testing, Evaluation and Training* (May 2005) at 3-71.

sonic energy to damage structures or other properties.[5] Rarely, minor structural damage to buildings may occur at 2 to 5 psf overpressure.[6] However, although damage from repeat vibrations associated with sonic booms is in theory capable of damaging resources, specific damage to cultural resources has not been documented for the High Altitude or Black Mountain Supersonic Corridors.[7] At the high altitude of the proposed test flights, with sonic energy of 1-2 psf overpressure, no damage to historic properties in the APE would be expected.

Preliminary Findings

Based on the maximum occurrence of 30 supersonic flight events under this SFA and the existing supersonic activity in this area by military aircraft, the FAA does not expect this undertaking to affect historic properties. The FAA welcomes your views on whether this type of action might affect historic properties, and if so, what the nature of those effects could be. Should you identify a potential effect on historic properties, we ask for your comments on the adequacy of the APE for the undertaking and assistance in identifying additional historic properties within the APE.

Sincerely,

Katherine B. Andrus
Federal Preservation Officer
Environmental Policy & Operations Division
Office of Environment and Energy

[5] U.S. Air Force, 95th Air Base Wing, Civil engineering Directorate, *Extend Supersonic Airspeed Waiver 75-12 for the Black Mountain Supersonic Corridor (BMSSC) and Alpha Corridor Precision Impact Range (AC/PIRA) Evaluation Report*, February 2010, p. 1-1

[6] https://www.nasa.gov/centers/armstrong/news/FactSheets/FS-016-DFRC.html.

[7] *Environmental Assessment for Low Level Flight Testing, Evaluation and Training* at 2-20.

Figure B-3. Proposed Area of Potential Effect