Draft Environmental Impact Statement

for Authorizing Changes to the

Falcon Launch Program

at

Vandenberg Space Force Base, California

Appendices (Volume II)

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Air Quality

Air Quality and Greenhouse Gas Emissions Technical Report

Falcon Program Expansion at Vandenberg Space Force Base, California

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Prepared for:

SPACE LAUNCH DELTA 30,
INSTALLATION MANAGEMENT FLIGHT
1028 Iceland Avenue, Building 11146
Vandenberg Space Force Base, California 93437

Prepared by:

DUDEK

3760 State Street, Suite 101
Santa Barbara, California 93105
Contact: Adam Poll

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Acronyms and Abbreviations

Acronym/Abbreviation	Definition
CAA	Clean Air Act
CO	carbon monoxide
EPA	U.S. Environmental Protection Agency
HAP	hazardous air pollutant
NAAQS	National Ambient Air Quality Standards
NO_2	nitrogen dioxide
NO_x	oxides of nitrogen
O_3	ozone
PM_{10}	particulate matter with an aerodynamic diameter less than or equal to 10 microns
$PM_{2.5}$	particulate matter with an aerodynamic diameter less than or equal to 2.5 microns
Proposed Action	Falcon Program Expansion at Vandenberg Space Force Base
SO_2	sulfur dioxide
SO_x	sulfur oxides
VOC	volatile organic compound

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Executive Summary

The purpose of this technical report is to assess the potential air quality emissions impacts associated with implementation of the Falcon Program Expansion (Proposed Action) and alternatives at Vandenberg Space Force Base (VSFB), California.

Project and Approach Overview

The Proposed Action is to increase the annual Falcon launch cadence at VSFB through launches at Space Launch Complex (SLC)-4 and SLC-6 and the modification of SLC-6 for Falcon launch vehicles to support future commercial and U.S. government launch service needs.

The project site is in Santa Barbara County, California but has components occurring within Ventura and Los Angeles Counties. The California Air Resources Board is responsible for maintaining air quality standards in California. The local air districts implement adopted air quality standards and regulations.

Construction, demolition, and operational criteria air pollutant emissions were estimated using the Air Conformity Applicability Model (ACAM), spreadsheet models, and the California Emissions Estimator Model (CalEEMod).

For air quality, this Proposed Action and Alternative 1 are effectively a continuation and an expansion of the previous actions associated with Falcon 9 launch cadence increases (from to ≤50 launches) at VSFB. Table ES1 summarizes the history of Falcon 9 launch cadence increase at VSFB. Based on the previous Environmental Assessment (EA) and Supplemental Environmental Assessments (SEAs), the increases in launch cadence was below DAF insignificance thresholds and the General Conformity Rule (GCR) de minimis values until the increase to up to 50 launches per year as described in the Final Environmental Assessment Falcon 9 Cadence Increase at Vandenberg Space Force Base – November 2024 (2024 EA) and the associated General Conformity Rule Determination Falcon 9 Cadence Increase Action Activities within the Los Angeles-South Coast Air Basin Ozone Extreme Nonattainment Area – January 2025 (2025 GCR Determination). Given the launch cadence prior to 2024 had insignificant impacts on air quality and were below the GCR de minimis values, reevaluation prior to the 2025 increased cadence is unwarranted.

Table ES1. History of Falcon 9 Launch Cadence at VSFB

Year	Launch Cadence (launches/yr)	Reference
2016	≤ 6	Final EA for Boost-Back and Landing of the Falcon 9 Full Thrust First Stage at SLC-4 West, Vandenberg AFB, California and Offshore Landing Contingency Option (April 2016)
2018	≤ 12	Final SEA for Launch, Boost-Back, and Landing of the Falcon 9 at Vandenberg AFB, California and Offshore Landing Contingency Options (January 2018)
2023	≤ 36	Final SEA Falcon 9 Cadence Increase at Vandenberg SFB, California and Offshore Landing Locations (May 2023)

Table ES1. History of Falcon 9 Launch Cadence at VSFB

Year	Launch Cadence (launches/yr)	Reference
2024	≤ 50 and de minimis in SCAQMD	Final EA Falcon 9 Cadence Increase at Vandenberg SFB (November 2024)
2025	≤ 50	GCR Determination Falcon 9 Cadence Increase Action Activities within the Los Angeles-South Coast Air Basin Ozone Extreme Nonattainment Area (January 2025)

The last NEPA assessment, 2024 EA, resulted in a Finding of No Significant Impact (FONSI) which allowed increased launches while maintaining annual net change in NOx emissions below the 10 ton per year (tpy) de minimis value within the Los Angeles-South Coast Air Basin Ozone Extreme Nonattainment Area which falls in the SCAQMD. The FONSI allowed increasing launches up to 50 per year while maintaining annual NOx emissions below the de minimis value for roll-on-roll-off (RORO) operations within SCAQMD until a positive GCR Determination is demonstrated. The FONSI was followed by the 2025 GCR Determination (DAF 2025) which allowed up to 50 launches and 50 RORO operations.

Additionally, the previous air quality assessment (2024 EA) was based on overly conservative assumptions on tugboat routing and operational times that have since been demonstrated to be unrealistic. Therefore, for this expanded assessment the assumptions have been revised to be more in line with operation limits expected in future permitting, while still being very conservative. As a result, this air quality assessment used the revised assumptions for estimating projected emissions.

Air Quality

Criteria air pollutants are defined as pollutants for which the federal and state governments have established ambient air quality standards, or criteria, for outdoor concentrations to protect public health. Criteria air pollutants include ozone (O_3), nitrogen dioxide (NO_2), carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter with an aerodynamic diameter less than or equal to 10 microns (PM_{10}), particulate matter with an aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$), and lead. Pollutants that were evaluated were reactive organic gases, oxides of nitrogen (NO_x), CO, sulfur oxides (SO_x), PM_{10}, and $PM_{2.5}$. Reactive organic gases and NO_x are important because they are precursors to O_3.

Insignificance Criteria

For air quality impact assessments, significance is defined by the degree to which the effects of the proposed action potentially could affect public health or safety. The U.S. Air Force (USAF) conducts National Environmental Policy Act (NEPA) and General Conformity Rule air quality impact assessments in tandem within the Environmental Impact Analysis Process (EIAP) (HQ AFCEC/CZTQ 2023a).

The USAF insignificance thresholds are EPA-established annual emission rates that, if exceeded, would trigger a regulatory requirement. Insignificance indicators are EPA-established rate thresholds that are partially applied or applied out of context to their intended use; however, can provide a direct gauge of potential impact. Although indicators do not trigger a regulatory requirement, they do provide an indication or a warning that the action is potentially approaching a threshold which would trigger a significant regulatory requirement.

The air quality impact evaluation for this action requires two separate analyses: the Clean Air Act (CAA) General Conformity Analysis and an analysis under NEPA. Impacts of air pollutants emitted by activities in the Pacific Ocean, bays, and inland locations in State waters (i.e., up to 3 nm from the coast) are assessed under the General Conformity Rule. Impacts of air pollutants emitted by activities in the Pacific Ocean, bays, and inland locations in U.S. territorial seas (i.e., up to 12 nm from the coast) are assessed under NEPA. Each coastal state may claim the territorial sea that extends seaward up to 12 nm from its shores and exercise sovereignty over its territorial sea, the air space above it, and the seabed and subsoil beneath it (National Oceanic and Atmospheric Administration [NOAA] 2017). The state jurisdictions may extend the full distance of territorial seas or may retain historical limits.

The Proposed Action's operational emissions are below the DAF insignificance thresholds within the SBCAPCD and VCAPCD jurisdictions. Operational emissions exceed the DAF insignificance threshold for NOx in the SCAQMD jurisdiction; however, the Proposed Action's operational emissions are within the SCAQMD set-aside emission budget approved in the 2016 AQMP. As such, it is expected the SCAQMD will grant the use of the NOx set aside account for the Proposed Action to conform to the latest EPA approved AQMP as the emissions from the project are accommodated within the AQMP's emissions budgets, and the Proposed Action is not expected to result in any new or additional violations of the NAAQS or impede the projected attainment of the NAAQS.

Greenhouse Gas Emissions

The Proposed Action would generate greenhouse gas (GHG) emissions during construction and operation. During construction, GHGs would be generated from offroad equipment, worker vehicles, and haul trucks. During operation, GHGs would be generated from launch and landings, boost-back, fairing recovery, roll-on-roll-off, personnel, energy use, solid waste generation, and water and wastewater.

The Proposed Action would not have an adverse effect on water, ecosystem and ecosystem services, the coast, indigenous peoples, energy, food, or human health.

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1 Introduction

1.1 Report Purpose and Scope

The purpose of this technical report is to assess the potential air emissions associated with implementation of the Falcon Program Expansion (Proposed Action) and alternatives at Vandenberg Space Force Base (VSFB), California. This assessment uses the thresholds based on the Department of the Air Force (DAF) insignificance thresholds and indicators to determine if the project would result in an adverse effect.

This introductory section provides a description of the project and the project location. Chapter 2, Air Quality, describes the air quality–related environmental setting, regulatory setting, existing air quality conditions, and threshold and analysis methodology, and presents an air quality impact analysis. Chapter 3, Greenhouse Gases, describes the greenhouse gas (GHG)–related environmental setting, regulatory setting, existing conditions, and threshold and analysis methodology, and presents a GHG impact analysis. Chapter 4, References Cited, provides a list of the references used in this report.

1.2 Regional and Local Setting

The Proposed Action would be located at Space Launch Complex #4 (SLC-4) and SLC-6 on VSFB. VSFB occupies 99,604 acres of central Santa Barbara County, California, and is approximately halfway between San Diego and San Francisco. VSFB occurs in a transitional ecological region that includes the northern and southern distributional limits for many plant and animal species. The Santa Ynez River and State Highway 246 divide VSFB into two distinct parts: North Base and South Base. SLC-4 and SLC-6 are located on South Base. SLC-4E is the existing Falcon 9 program launch facility. Delta IV launches occurred at SLC-6 from 2006 to 2022 in medium and heavy configurations, for a total of ten missions. The Proposed Action also includes marine vessel activity within the Pacific Ocean that occurs within Santa Barbara, Ventura, and Los Angeles counties.

1.3 Project Description

The Proposed Action is to increase the annual Falcon launch cadence at VSFB through launches at SLC-4 and SLC-6 and the modification of SLC-6 for Falcon 9 and Falcon Heavy launch vehicles. The Proposed Action includes the following:

- Up to 100 launches (50 launch increase over existing conditions) annually between SLC-4 and SLC-6, up to five of which could be Falcon Heavy.
- Up to 12 launches with first stage landings at SLC-4 (no increase over existing conditions).
- Up to 12 launches with first stage landings at SLC-6, up to five of which could be Falcon Heavy.
- Up to 100 downrange landings (62 landing increase over existing conditions) of first-stage boosters and fairing recovery, including transport of recovered boosters and fairings to and from the Port of Long Beach and Vandenberg Harbor.
- Refurbishment of recovered first-stages and fairings and routine pre-launch operations.

- Modification of SLC-6 to support Falcon operations, including construction and demolition.
  - As part of this Proposed Action and Alternative 1, SpaceX would demolish the Mobile Service Tower, Mobile Assembly Shelter, Fixed Umbilical Tower, and the launch crown at SLC-6.
  - Modification of an existing hangar (Proposed Action) or construction of a new hangar (Alternative 1) at SLC-6 to support Falcon operations.
- Construction of landing zones adjacent to SLC-6 and their associated firebreak.

A detailed description of the Proposed Action can be found in the Environmental Impact Statement for this action.

2 Air Quality

2.1 Environmental Setting

The project site takes place within Santa Barbara County, Ventura County, and Los Angeles County, California.

2.1.1 Meteorological and Topographical Conditions

The primary factors that determine air quality are the locations of air pollutant sources and the amounts of pollutants emitted. Meteorological and topographical conditions, however, also are important. Factors such as wind speed and direction, air temperature gradients and sunlight, and precipitation and humidity interact with physical landscape features to determine the movement and dispersal of criteria air pollutants.

VSFB occupies 99,604 acres of central Santa Barbara County, California, and is approximately halfway between San Diego and San Francisco. VSFB is located within the South-Central Coastal Air Basin (SCCAB), which includes San Luis Obispo, Santa Barbara, and Ventura counties. The Santa Barbara County Air Pollution Control District (SBCAPCD) has jurisdiction over Santa Barbara County and the Ventura County Air Pollution Control District (VCAPCD) has jurisdiction over Ventura County. The Proposed Action would also take place within Los Angeles County for fairing recovery and ocean landings. Los Angeles County is located within the South Coast Air Basin (SCAB) and the South Coast Air Quality Management District (SCAQMD). As such, additional discussion is provided for that region.

Climate

Air quality in the SCCAB is influenced by its meteorological conditions. The Mediterranean climate is characterized by warm summers and mild winters with relatively dry weather. The annual precipitation is on average 17.7 inches per year and the average maximum temperature is 70.8°F and the average minimum temperature is 50.2 °F (WRCC 2016).

The climate of the SCCAB is strongly influenced by its proximity to the Pacific Ocean and the location of the high-pressure cell in the northeastern Pacific. With a Mediterranean-type climate, the project area is characterized by warm, dry summers and cool winters with occasional rainy periods. Cool, humid marine air causes frequent fog and low clouds along the coast, generally during the night and morning hours in the late spring and early summer months. The project area is subject to a diurnal cycle in which daily onshore winds from the west and northwest are replaced by mild offshore breezes flowing from warm inland valleys during night and early morning hours. This alternating cycle can create a situation where suspended pollutants are swept offshore at night and then carried back onshore the following day. Dispersion of pollutants is further degraded when the wind velocity for both day and nighttime breezes is low. The region is also subject to seasonal “Santa Ana” winds. These are typically hot, dry northerly winds that blow offshore at 15 to 20 mph, but can reach speeds in excess of 60 mph.

Two types of temperature inversions (warmer air on top of cooler air) are created in the area: subsidence and radiational. The subsidence inversion is a regional effect created by the Pacific high in which air is heated as it is compressed when it flows from the high-pressure area to the low-pressure areas inland. This type of inversion generally forms at about 1,000 to 2,000 feet and can occur throughout the year, but it is most evident during the summer months. Radiational, or surface, inversions are formed by the more rapid cooling of air near the ground during the night, especially during winter. This type of inversion is typically lower (0 to 500 feet at VSFB, for example) and is generally accompanied by stable air. Both types of inversions limit the dispersal of air pollutants within the regional airshed, with the more stable the air (low wind speeds, uniform temperatures), the lower the amount of pollutant dispersion.

The metropolitan portions of the County are within the South Coast Air Basin (SCAB). The SCAB is a 6,745-square-mile area bounded by the Pacific Ocean to the west and the San Gabriel, San Bernardino, and San Jacinto Mountains to the north and east. Projects located within the SCAB are subject to the rules and regulations imposed by the SCAQMD, as well as the California Ambient Air Quality Standards (CAAQS) adopted by CARB and National Ambient Air Quality Standards (NAAQS) adopted by the EPA, as detailed below in Section 2.2, Regulatory Setting.

The SCAB's air pollution problems are a consequence of the combination of emissions from the nation's second-largest urban area, meteorological conditions that hinder dispersion of those emissions, and mountainous terrain surrounding the SCAB that traps pollutants as they are pushed inland with the sea breeze (SCAQMD 2017). Meteorological and topographical factors that affect air quality in the SCAB are described below.[1]

The SCAB is characterized as having a Mediterranean climate (typified as semiarid with mild winters, warm summers, and moderate rainfall). The general region lies in the semi-permanent high-pressure zone of the eastern Pacific; as a result, the climate is mild and tempered by cool sea breezes. The usually mild climatological pattern is interrupted infrequently by periods of extremely hot weather, winter storms, or Santa Ana winds.

Moderate temperatures, comfortable humidity, and limited precipitation characterize the climate in the SCAB. The average annual temperature varies little throughout the SCAB, averaging 75°F. However, with a less-pronounced oceanic influence, the eastern inland portions of the SCAB show greater variability in annual minimum and maximum temperatures. All portions of the SCAB have recorded temperatures over 100°F in recent years. Although the SCAB has a semiarid climate, the air near the surface is moist because of the presence of a shallow marine layer. Except for infrequent periods when dry air is brought into the SCAB by offshore winds, the ocean effect is dominant. Periods with heavy fog are frequent, and low stratus clouds, occasionally referred to as "high fog," are a characteristic climate feature. Annual average relative humidity is 70% at the coast and 57% in the eastern part of the SCAB (SCAQMD 1993). Precipitation in the SCAB is typically 9 to 14 inches annually and is rarely in the form of snow or hail because of typically warm weather. However, annual precipitation averages about 18.19 inches at the Project site, falling mostly from October through May (WRCC 2016).[2] Most of the rainfall in Southern California occurs between late fall and early spring, with most rain typically occurring in the months of January and February. Overall, Los Angeles's climate is characterized by relatively low rainfall, with warm summers and mild winters. Average temperatures range from a high of 92.2°F in July to a low of 40.0°F in December (WRCC 2016).

Sunlight

The presence and intensity of sunlight are necessary prerequisites for the formation of photochemical smog. Under the influence of the ultraviolet radiation of sunlight, certain primary pollutants (mainly reactive hydrocarbons and oxides of nitrogen [NO_x][3]) react to form secondary pollutants (primarily oxidants). Since this process is time dependent, secondary pollutants can be formed many miles downwind of the emission sources.

1 The discussion of meteorological and topographical conditions of the SCAB is based on information provided in the Final 2016 Air Quality Management Plan (SCAQMD 2017).
2 Local climate data for the County is based on the most-representative station measured by the Western Regional Climate Center, which is the Newhall climatological station.
3 NO_x is a general term pertaining to compounds of nitric oxide, nitrogen dioxide, and other oxides of nitrogen.

Southern California also has abundant sunshine, which drives the photochemical reactions that form pollutants such as ozone (O_3) and a substantial portion of fine particulate matter ($PM_{2.5}$ or particulate matter 2.5 microns or less in diameter). In the SCAB, high concentrations of O_3 are normally recorded during the late spring, summer, and early autumn months, when more intense sunlight drives enhanced photochemical reactions. Because of the prevailing daytime winds and time-delayed nature of photochemical smog, oxidant concentrations are highest in the inland areas of Southern California.

Temperature Inversions

Under ideal meteorological conditions and irrespective of topography, pollutants emitted into the air mix and disperse into the upper atmosphere. However, the Southern California region frequently experiences temperature inversions in which pollutants are trapped and accumulate close to the ground. The inversion, a layer of warm, dry air overlaying cool, moist marine air, is a normal condition in coastal Southern California. The cool, damp, and hazy sea air capped by coastal clouds is heavier than the warm, clear air, which acts as a lid through which the cooler marine layer cannot rise. The height of the inversion is important in determining pollutant concentration. When the inversion is approximately 2,500 feet above mean sea level, the sea breezes carry the pollutants inland to escape over the mountain slopes or through the passes. At a height of 1,200 feet above mean sea level, the terrain prevents the pollutants from entering the upper atmosphere, resulting in the pollutants settling in the foothill communities. Below 1,200 feet above mean sea level, the inversion puts a tight lid on pollutants, concentrating them in a shallow layer over the entire coastal basin. Usually, inversions are lower before sunrise than during the daylight hours.

Mixing heights for inversions are lower in the summer and inversions are more persistent, being partly responsible for the high levels of O_3 observed during summer months in the SCAB. Smog in Southern California is generally the result of these temperature inversions combining with coastal day winds and local mountains to contain the pollutants for long periods, allowing them to form secondary pollutants by reacting in the presence of sunlight. The SCAB has a limited ability to disperse these pollutants due to typically low wind speeds and the surrounding mountain ranges.

As with other regions within the SCAB, the County is susceptible to air inversions, which trap a layer of stagnant air near the ground where pollutants are further concentrated. These inversions produce haziness, which is caused by moisture, suspended dust, and a variety of chemical aerosols emitted by trucks, automobiles, furnaces, and other sources. Elevated concentrations of coarse particulate matter (PM_{10}; particulate matter 10 microns or less in diameter) and $PM_{2.5}$ can occur in the SCAB throughout the year, but they occur most frequently in fall and winter. Although there are some changes in emissions by day of the week and by season, the observed variations in pollutant concentrations are primarily the result of seasonal differences in weather conditions.

Pollutants and Effects

Criteria Air Pollutants

Criteria air pollutants are defined as pollutants for which the federal and state governments have established ambient air quality standards, or criteria, for outdoor concentrations to protect public health. The national and California standards have been set, with an adequate margin of safety, at levels above which concentrations could be harmful to human health and welfare. These standards are designed to protect the most sensitive persons from illness or discomfort. Pollutants of concern include O_3, nitrogen dioxide (NO_2), carbon monoxide (CO), sulfur dioxide,

PM_{10}, $PM_{2.5}$, and lead. In California, sulfates, vinyl chloride, hydrogen sulfide, and visibility-reducing particles are also regulated as criteria air pollutants. These pollutants, as well as toxic air contaminants (TACs), are discussed in the following paragraphs.[4]

Ozone (O3). O_3 is a strong-smelling, pale blue, reactive, toxic chemical gas consisting of three oxygen atoms. It is a secondary pollutant formed in the atmosphere by a photochemical process involving the sun's energy and O_3 precursors. These precursors are mainly NO_x and volatile organic compounds (VOCs). The maximum effects of precursor emissions on O_3 concentrations usually occur several hours after they are emitted and many miles from the source. Meteorology and terrain play major roles in O_3 formation, and ideal conditions occur during summer and early autumn on days with low wind speeds or stagnant air, warm temperatures, and cloudless skies. O_3 exists in the upper atmosphere O_3 layer (stratospheric O_3) and at the Earth's surface in the troposphere (ground-level O_3).[5] The O_3 that EPA and CARB regulate as a criteria air pollutant is produced close to the ground level, where people live, exercise, and breathe. Ground-level O_3 is a harmful air pollutant that causes numerous adverse health effects, described below, and is thus considered "bad" O_3. Stratospheric, or "good," O_3 occurs naturally in the upper atmosphere, where it reduces the amount of ultraviolet light (i.e., solar radiation) entering the Earth's atmosphere. Without the protection of the beneficial stratospheric O_3 layer, plant and animal life would be seriously harmed.

O_3 in the troposphere (near the surface) causes numerous adverse health effects; short-term exposures (lasting for a few hours) to O_3 at levels typically observed in Southern California can result in breathing pattern changes, reduction of breathing capacity, increased susceptibility to infections, inflammation of the lung tissue, and some immunological changes (EPA 2013).

Inhalation of O_3 causes inflammation and irritation of the tissues lining human airways, causing and worsening a variety of symptoms. Exposure to O_3 can reduce the volume of air that the lungs breathe in, thereby causing shortness of breath. O_3 in sufficient doses increases the permeability of lung cells, rendering them more susceptible to toxins and microorganisms. The occurrence and severity of health effects from O_3 exposure vary widely among individuals, even when the dose and the duration of exposure are the same. Research shows adults and children who spend more time outdoors participating in vigorous physical activities are at greater risk from the harmful health effects of O_3 exposure. While there are relatively few studies on the effects of O_3 on children, the available studies show that children are no more or less likely to suffer harmful effects than adults. However, there are a number of reasons why children may be more susceptible to O_3 and other pollutants. Children and teens spend nearly twice as much time outdoors and engaged in vigorous activities as adults. Children breathe more rapidly than adults and inhale more pollution per pound of their body weight than adults. Also, children are less likely than adults to notice their own symptoms and avoid harmful exposures. Further research may be able to better distinguish between health effects in children and adults. Children, adolescents, and adults who exercise or work outdoors, where O_3 concentrations are the highest, are at the greatest risk of harm from this pollutant (CARB 2019b).

Volatile Organic Compounds. Hydrocarbons are organic gases that are formed from hydrogen and carbon and sometimes other elements. Hydrocarbons that contribute to formation of O_3 are referred to and regulated as VOCs (also referred to as reactive organic gases). Combustion engine exhaust, oil refineries, and fossil-fueled power plants are the sources of hydrocarbons. Other sources of anthropogenic and bio-pedogenic hydrocarbons include evaporation from petroleum fuels, solvents, dry cleaning solutions, and paint.

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4 The descriptions of the criteria air pollutants and associated health effects are based on EPA's "Criteria Air Pollutants" (EPA 2018a), as well as CARB's "Glossary" (CARB 2019a) and "Fact Sheet: Air Pollution Sources, Effects and Control" (CARB 2009).

5 The troposphere is the layer of the Earth's atmosphere nearest to the surface of the Earth. The troposphere extends outward about 5 miles at the poles and about 10 miles at the equator.

The primary health effects of VOCs result from the formation of O_3 and its related health effects. High levels of VOCs in the atmosphere can interfere with oxygen intake by reducing the amount of available oxygen through displacement. Carcinogenic forms of hydrocarbons, such as benzene, are considered TACs. There are no separate ambient air quality standards for VOCs as a group.

Nitrogen Dioxide (NO2). NO_2 is a brownish, highly reactive gas that is present in all urban atmospheres. The major mechanism for the formation of NO_2 in the atmosphere is the oxidation of the primary air pollutant nitric oxide, which is a colorless, odorless gas. NO_x plays a major role, together with VOCs, in the atmospheric reactions that produce O_3. NO_x is formed from fuel combustion under high temperature or pressure. In addition, NO_x is an important precursor to acid rain and may affect both terrestrial and aquatic ecosystems. The two major emissions sources are transportation and stationary fuel combustion sources such as electric utility and industrial boilers.

A large body of health science literature indicates that exposure to NO_2 can induce adverse health effects. The strongest health evidence, and the health basis for the ambient air quality standards for NO_2, results from controlled human exposure studies that show that NO_2 exposure can intensify responses to allergens in allergic asthmatics. In addition, a number of epidemiological studies have demonstrated associations between NO_2 exposure and premature death, cardiopulmonary effects, decreased lung function growth in children, respiratory symptoms, emergency room visits for asthma, and intensified allergic responses. Infants and children are particularly at risk because they have disproportionately higher exposure to NO_2 than adults due to their greater breathing rate for their body weight and their typically greater outdoor exposure duration. Several studies have shown that long-term NO_2 exposure during childhood, the period of rapid lung growth, can lead to smaller lungs at maturity in children with higher levels of exposure compared to children with lower exposure levels. In addition, children with asthma have a greater degree of airway responsiveness compared with adult asthmatics. In adults, the greatest risk is to people who have chronic respiratory diseases, such as asthma and chronic obstructive pulmonary disease (CARB 2019c).

Carbon Monoxide (CO). CO is a colorless, odorless gas formed by the incomplete combustion of hydrocarbon, or fossil fuels. CO is emitted almost exclusively from motor vehicles, power plants, refineries, industrial boilers, ships, aircraft, and trains. In urban areas, such as the Project location, automobile exhaust accounts for the majority of CO emissions. CO is a nonreactive air pollutant that dissipates relatively quickly; therefore, ambient CO concentrations generally follow the spatial and temporal distributions of vehicular traffic. CO concentrations are influenced by local meteorological conditions—primarily wind speed, topography, and atmospheric stability. CO from motor vehicle exhaust can become locally concentrated when surface-based temperature inversions are combined with calm atmospheric conditions, which is a typical situation at dusk in urban areas from November to February. The highest levels of CO typically occur during the colder months of the year, when inversion conditions are more frequent.

CO is harmful because it binds to hemoglobin in the blood, reducing the ability of blood to carry oxygen. This interferes with oxygen delivery to the body's organs. The most common effects of CO exposure are fatigue, headaches, confusion and reduced mental alertness, light-headedness, and dizziness due to inadequate oxygen delivery to the brain. For people with cardiovascular disease, short-term CO exposure can further reduce their body's already compromised ability to respond to the increased oxygen demands of exercise, exertion, or stress. Inadequate oxygen delivery to the heart muscle leads to chest pain and decreased exercise tolerance. Unborn babies whose mothers experience high levels of CO exposure during pregnancy are at risk of adverse developmental effects. Unborn babies, infants, elderly people, and people with anemia or with a history of heart or respiratory disease are most likely to experience health effects with exposure to elevated levels of CO (CARB 2019d).

Sulfur Dioxide (SO2). SO_2 is a colorless, pungent gas formed primarily from incomplete combustion of sulfur-containing fossil fuels. The main sources of SO_2 are coal and oil used in power plants and industries; as such, the highest levels of SO_2 are generally found near large industrial complexes. In recent years, SO_2 concentrations have been reduced by the increasingly stringent controls placed on stationary source emissions of SO_2 and limits on the sulfur content of fuels.

Controlled human exposure and epidemiological studies show that children and adults with asthma are more likely to experience adverse responses with SO_2 exposure, compared with the non-asthmatic population. Effects at levels near the 1-hour standard are those of asthma exacerbation, including bronchoconstriction accompanied by symptoms of respiratory irritation such as wheezing, shortness of breath, and chest tightness, especially during exercise or physical activity. Also, exposure at elevated levels of SO_2 (above 1 part per million [ppm]) results in increased incidence of pulmonary symptoms and disease, decreased pulmonary function, and increased risk of mortality. Older people and people with cardiovascular disease or chronic lung disease (such as bronchitis or emphysema) are most likely to experience these adverse effects (CARB 2019e).

SO_2 is of concern both because it is a direct respiratory irritant and because it contributes to the formation of sulfate and sulfuric acid in particulate matter (NRC 2005). People with asthma are of particular concern, both because they have increased baseline airflow resistance and because their SO_2-induced increase in airflow resistance is greater than in healthy people, and it increases with the severity of their asthma (NRC 2005). SO_2 is thought to induce airway constriction via neural reflexes involving irritant receptors in the airways (NRC 2005).

Particulate Matter*.* Particulate matter pollution consists of very small liquid and solid particles floating in the air, which can include smoke, soot, dust, salts, acids, and metals. Particulate matter can form when gases emitted from industries and motor vehicles undergo chemical reactions in the atmosphere. $PM_{2.5}$ and PM_{10} represent fractions of particulate matter. Coarse particulate matter (PM_{10}) consists of particulate matter that is 10 microns or less in diameter, which is about 1/7 the thickness of a human hair. Major sources of PM_{10} include crushing or grinding operations; dust stirred up by vehicles traveling on roads; wood-burning stoves and fireplaces; dust from construction, landfills, and agriculture; wildfires and brush/waste burning; industrial sources; windblown dust from open lands; and atmospheric chemical and photochemical reactions. Fine particulate matter ($PM_{2.5}$) consists of particulate matter that is 2.5 microns or less in diameter, which is roughly 1/28 the diameter of a human hair. $PM_{2.5}$ results from fuel combustion (e.g., from motor vehicles and power generation and industrial facilities), residential fireplaces, and woodstoves. In addition, $PM_{2.5}$ can be formed in the atmosphere from gases such as sulfur oxides (SO_x), NO_x, and VOCs.

$PM_{2.5}$ and PM_{10} pose a greater health risk than larger-size particles. When inhaled, these tiny particles can penetrate the human respiratory system's natural defenses and damage the respiratory tract. $PM_{2.5}$ and PM_{10} can increase the number and severity of asthma attacks, cause or aggravate bronchitis and other lung diseases, and reduce the body's ability to fight infections. Very small particles of substances such as lead, sulfates, and nitrates can cause lung damage directly or be absorbed into the bloodstream, causing damage elsewhere in the body. Additionally, these substances can transport adsorbed gases such as chlorides or ammonium into the lungs, also causing injury. Whereas PM_{10} tends to collect in the upper portion of the respiratory system, $PM_{2.5}$ is so tiny that it can penetrate deeper into the lungs and damage lung tissue. Suspended particulates also damage and discolor surfaces on which they settle and produce haze and reduce regional visibility.

A number of adverse health effects have been associated with exposure to both $PM_{2.5}$ and PM_{10}. For $PM_{2.5}$, short-term exposures (up to 24-hour duration) have been associated with premature mortality, increased hospital admissions for heart or lung causes, acute and chronic bronchitis, asthma attacks, emergency room visits, respiratory symptoms, and restricted activity days. These adverse health effects have been reported primarily in infants, children, and older adults with preexisting heart or lung diseases. In addition, of all of the common air pollutants, $PM_{2.5}$ is associated with the greatest proportion of adverse health effects related to air pollution, both in the United States and worldwide based on the World Health Organization's Global Burden of Disease Project. Short-term exposures to PM_{10} have been associated primarily with worsening of respiratory diseases, including asthma and chronic obstructive pulmonary disease, leading to hospitalization and emergency department visits (CARB 2017a).

Long-term exposure (months to years) to $PM_{2.5}$ has been linked to premature death, particularly in people who have chronic heart or lung diseases, and reduced lung function growth in children. The effects of long-term exposure to PM_{10} are less clear, although several studies suggest a link between long-term PM_{10} exposure and respiratory mortality. The International Agency for Research on Cancer published a review in 2015 that concluded that particulate matter in outdoor air pollution causes lung cancer (CARB 2017a).

Lead. Lead in the atmosphere occurs as particulate matter. Sources of lead include leaded gasoline; the manufacturing of batteries, paints, ink, ceramics, and ammunition; and secondary lead smelters. Prior to 1978, mobile emissions were the primary source of atmospheric lead. Between 1978 and 1987, the phaseout of leaded gasoline reduced the overall inventory of airborne lead by nearly 95%. With the phaseout of leaded gasoline, secondary lead smelters, battery recycling, and manufacturing facilities are becoming lead-emissions sources of greater concern.

Prolonged exposure to atmospheric lead poses a serious threat to human health. Health effects associated with exposure to lead include gastrointestinal disturbances, anemia, kidney disease, and in severe cases, neuromuscular and neurological dysfunction. Of particular concern are low-level lead exposures during infancy and childhood. Such exposures are associated with decrements in neurobehavioral performance, including intelligence quotient (IQ) performance, psychomotor performance, reaction time, and growth. Children are highly susceptible to the effects of lead.

Sulfates. Sulfates are the fully oxidized form of sulfur, which typically occur in combination with metals or hydrogen ions. Sulfates are produced from reactions of SO_2 in the atmosphere and can result in respiratory impairment, as well as reduced visibility.

Vinyl Chloride. Vinyl chloride is a colorless gas with a mild, sweet odor, which has been detected near landfills, sewage plants, and hazardous waste sites, due to the microbial breakdown of chlorinated solvents. Short-term exposure to high levels of vinyl chloride in air can cause nervous system effects, such as dizziness, drowsiness, and headaches. Long-term exposure through inhalation can cause liver damage, including liver cancer (CARB 2021a).

Hydrogen Sulfide. Hydrogen sulfide is a colorless and flammable gas that has a characteristic odor of rotten eggs. Sources of hydrogen sulfide include geothermal power plants, petroleum refineries, sewers, sewage treatment plants, and stagnant runoff from clogged water basins. Exposure to hydrogen sulfide can result in nuisance odors, as well as headaches and breathing difficulties at higher concentrations.

Visibility-Reducing Particles. Visibility-reducing particles are any particles in the air that obstruct the range of visibility. Effects of reduced visibility can include obscuring the viewshed of natural scenery, reducing airport safety, and discouraging tourism. Sources of visibility-reducing particles are the same as for $PM_{2.5}$.

Non-Criteria Air Pollutants

Toxic Air Contaminants (TACs). A substance is considered toxic if it has the potential to cause adverse health effects in humans, including increasing the risk of cancer upon exposure, or acute and/or chronic non-cancer health effects. A toxic substance released into the air is considered a TAC. TACs are identified by federal and state agencies based on a review of available scientific evidence. In the state of California, TACs are identified through a two-step process that was established in 1983 under the Toxic Air Contaminant Identification and Control Act. This two-step process of risk identification and risk management and reduction was designed to protect residents from the health effects of toxic substances in the air. In addition, the California Air Toxics "Hot Spots" Information and Assessment Act, AB 2588, was enacted by the legislature in 1987 to address public concern over the release of TACs into the atmosphere. The law requires facilities emitting toxic substances to provide local air pollution control districts with information that will allow an assessment of the air toxics problem, identification of air toxics emissions sources, location of resulting hotspots, notification of the public exposed to significant risk, and development of effective strategies to reduce potential risks to the public over 5 years.

Examples include diesel particulate matter, certain aromatic and chlorinated hydrocarbons, certain metals, and asbestos. TACs are generated by a number of sources, including stationary sources, such as dry cleaners, gas stations, combustion sources, and laboratories; mobile sources, such as automobiles; and area sources, such as landfills and oil and gas facilities. Adverse health effects associated with exposure to TACs may include carcinogenic (i.e., cancer-causing) and non-carcinogenic effects. Non-carcinogenic effects typically affect one or more target organ systems and may be experienced on either short-term (acute) or long-term (chronic) exposure to a given TAC.

Diesel Particulate Matter (DPM). DPM is part of a complex mixture that makes up diesel exhaust. Diesel exhaust is composed of two phases, gas and particle, both of which contribute to health risks. More than 90% of DPM is less than 1 micrometer in diameter (about 1/70 the diameter of a human hair), and thus is a subset of $PM_{2.5}$ (CARB 2019f). DPM is typically composed of carbon particles ("soot," also called black carbon) and numerous organic compounds, including over 40 known cancer-causing organic substances. Examples of these chemicals include polycyclic aromatic hydrocarbons, benzene, formaldehyde, acetaldehyde, acrolein, and 1,3-butadiene (CARB 2019f). The CARB classified "particulate emissions from diesel-fueled engines" (i.e., DPM) (17 CCR 93000) as a TAC in August 1998. DPM is emitted from a broad range of diesel engines: on-road diesel engines, including trucks, buses, and cars, and off-road diesel engines, including locomotives, marine vessels, and heavy-duty construction equipment, among others. Approximately 70% of all airborne cancer risk in California is associated with DPM (Propper et al. 2015). To reduce the cancer risk associated with DPM, CARB adopted a diesel risk reduction plan in 2000 (CARB 2000). Because it is part of $PM_{2.5}$, DPM also contributes to the same non-cancer health effects as $PM_{2.5}$ exposure. These effects include premature death; hospitalizations and emergency department visits for exacerbated chronic heart and lung disease, including asthma; increased respiratory symptoms; and decreased lung function in children. Several studies suggest that exposure to DPM may also facilitate development of new allergies (CARB 2019f). Those most vulnerable to non-cancer health effects are children, whose lungs are still developing, and older people, who often have chronic health problems.

Odorous Compounds. Odors are generally regarded as an annoyance or a quality of life impact, rather than a health hazard. Manifestations of a person's reaction to odors can range from psychological (e.g., irritation, anger, or anxiety) to physiological (e.g., circulatory and respiratory effects, nausea, vomiting, and headache). The ability to detect odors varies considerably among the population and overall is quite subjective. People may have different reactions to the same odor. An odor that is offensive to one person may be perfectly acceptable to another (e.g., coffee roaster). An unfamiliar odor is more easily detected and is more likely to cause complaints than a familiar one. In a phenomenon known as odor fatigue, a person can become desensitized to almost any odor, and recognition may only occur with an alteration in the intensity. The occurrence and severity of odor impacts depend on the nature, frequency, and intensity of the source; wind speed and direction; microclimate; relative humidity; temperature; topography; and the sensitivity of receptors.

Ambient Air Quality

CARB, air districts, and other agencies monitor ambient air quality at approximately 250 air quality monitoring stations across the state. The SBCAPCD monitors local ambient air quality within the County. Air quality monitoring stations usually measure pollutant concentrations 10 feet above ground level; therefore, air quality is often referred to in terms of ground-level concentrations. The most recent background ambient air quality data from 2020 to 2022 are presented in Table 1

The ambient data presented in Table 1 reflect the highest concentrations reported at the monitoring station located at 128 South H Street, Lompoc. Of the available monitoring stations within the SCCAB, the Lompoc station is considered representative of the air quality experienced in the Proposed Action's vicinity. The ambient concentrations and number of days exceeding the ambient air quality standards is also shown in Table 1.

Table 1. Local Ambient Air Quality Data

Averaging Time	Unit	Agency/ Method	Ambient Air Quality Standard	Measured Concentration by Year			Exceedances by Year		
				2020	2021	2022	2020	2021	2022
Ozone (O_3)									
Maximum 1-hour concentration	ppm	California	0.12	0.038	0.040	0.067	0	0	0
Maximum 8-hour concentration	ppm	California	0.070	0.034	0.035	0.055	0	0	0
		National	0.070	0.030	0.035	0.055	0	0	0
Nitrogen Dioxide (NO_2)									
Maximum 1-hour concentration	ppm	California	0.18	0.028	0.027	0.024	0	0	0
		National	0.100	0.028	0.027	0.024	0	0	0
Annual concentration	ppm	California	0.030	0.003	0.003	0.003	0	0	0
		National	0.053	0.003	0.003	0.003	0	0	0
Carbon Monoxide (CO)									
Maximum 1-hour concentration	ppm	California	20	2.5	1.9	0.9	0	0	0
		National	35	2.5	1.9	0.9	0	0	0
Maximum 8-hour concentration	ppm	California	9.0	0.7	0.8	0.7	0	0	0
		National	9	0.7	0.8	0.7	0	0	0

Table 1. Local Ambient Air Quality Data

Averaging Time	Unit	Agency/ Method	Ambient Air Quality Standard	Measured Concentration by Year			Exceedances by Year		
						2022	2020		
Sulfur Dioxide (SO_2)									
Maximum 1-hour concentration	ppm	National	0.075	0.026	0.002	0.002	0	0	0
Maximum 24-hour concentration	ppm	National	0.14	0.003	0.001	0.001	0	0	0
Annual concentration	ppm	National	0.030	0.0003	0.0002	0.0003	0	0	0
Coarse Particulate Matter (PM_{10})[a]									
Maximum 24-hour concentration	μg/m³	California	50	110.8	76.0	53.6	(17) 17.1	(1) ND	(1) 1.0
		National	150	106.7	73.1	50.9	(0) 0.0	(0) 0.0	(0) 0.0
Annual concentration	μg/m³	California	20	21.7	ND	17.1	0	0	0
Fine Particulate Matter ($PM_{2.5}$)[a]									
Maximum 24-hour concentration	μg/m³	National	35	85.6	18.4	20.7	(8) 8.5	(0) 0.0	(0) 0.0
Annual concentration	μg/m³	California	12	6.5	5.8	5.6	0	0	0
		National	12.0	6.5	5.7	5.6	0	0	0

Sources: CARB 2022a; EPA 2022.

Notes: ppm = parts per million by volume; — = not available; μg/m³ = micrograms per cubic meter; ND = insufficient data available to determine the value.

Data taken from CARB iADAM (http://www.arb.ca.gov/adam) and EPA AirData (http://www.epa.gov/airdata/) represent the highest concentrations experienced over a given year.

Exceedances of national and California standards are only shown for O_3 and particulate matter. Daily exceedances for particulate matter are estimated days because PM_{10} and $PM_{2.5}$ are not monitored daily. All other criteria pollutants did not exceed national or California standards during the years shown. There is no national standard for 1-hour O_3, annual PM_{10}, or 24-hour SO_2, nor is there a California 24-hour standard for $PM_{2.5}$.

[a] Measurements of PM_{10} and $PM_{2.5}$ are usually collected every 6 days and every 1 to 3 days, respectively. Number of days exceeding the standards is a mathematical estimate of the number of days concentrations would have been greater than the level of the standard had each day been monitored. The numbers in parentheses are the measured number of samples that exceeded the standard.

2.2 Regulatory Setting

2.2.1 Federal Regulations

2.2.1.1 Criteria Air Pollutants

The federal Clean Air Act (CAA), passed in 1970 and last amended in 1990, forms the basis for the national air pollution control effort. The U.S. Environmental Protection Agency (EPA) is responsible for implementing most aspects of the CAA, including setting National Ambient Air Quality Standards (NAAQS) for major air pollutants; setting hazardous air pollutant (HAP) standards; approving state attainment plans; setting motor vehicle emission standards; issuing stationary source emission standards and permits; and establishing acid rain control measures, stratospheric ozone (O_3) protection measures, and enforcement provisions. Under the CAA, NAAQS are established for the following criteria pollutants: O_3, carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter 10 microns in size or smaller (PM_{10}), and particulate matter 2.5 microns in size or smaller ($PM_{2.5}$), and lead.

The NAAQS describe acceptable air quality conditions designed to protect the health and welfare of the citizens of the United States. The NAAQS (other than for O_3, NO_2, SO_2, PM_{10}, $PM_{2.5}$, and those based on annual averages or arithmetic mean) are not to be exceeded more than once per year. NAAQS for O_3, NO_2, SO_2, PM_{10}, and $PM_{2.5}$ are based on statistical calculations over 1- to 3-year periods, depending on the pollutant. The CAA requires the EPA to reassess the NAAQS at least every 5 years to determine whether adopted standards are adequate to protect public health based on current scientific evidence. States with areas that exceed the NAAQS must prepare a state implementation plan that demonstrates how those areas will attain the NAAQS within mandated time frames. The NAAQS are presented in Table 2.

The CAA contains milestones for states to develop air pollution control plans. Areas within states that do not meet the NAAQS, usually identified at the county level, are designated as nonattainment areas. For areas designated as nonattainment areas, the state must develop a plan to implement pollution control strategies to attain the NAAQS. Once attainment is achieved, a state must develop a plan to maintain air quality.

Ozone is not emitted directly to the atmosphere by industrial or combustion processes. Rather, O_3 is formed through the reaction between volatile organic compounds (VOCs) and oxides of nitrogen (NO_x). VOCs and NO_x are known as O_3 precursors, and these precursor emissions are regulated by the EPA to achieve O_3 reductions.

Airborne particulate matter is not a single pollutant, but rather a mixture of many chemical species. PM_{10}, and $PM_{2.5}$ are derived from different emission sources, and also have different chemical compositions. Emissions from the combustion of gasoline, oil, diesel fuel, and wood produce much of the $PM_{2.5}$ pollution found in outdoor air, as well as a significant portion of PM_{10}. PM_{10} also includes dust from construction sites, landfills, and agriculture; wildfires and brush/waste burning; industrial sources; wind-blown dust from open lands; pollen; and fragments of bacteria. Particulate matter may be either directly emitted from sources (primary particles) or formed in the atmosphere through chemical reactions of gases (secondary particles) such as SO_2, NOx, VOCs, and ammonia. These organic compounds can be emitted by both natural sources, such as trees and vegetation, and anthropogenic sources, such as industrial processes and motor vehicle exhaust. Particulate matter emissions are regulated to achieve ambient $PM_{2.5}$ reductions.

Table 2. State and National Ambient Air Quality Standards (NAAQSs)

Pollutant	Averaging Time	California Standards[a]	National Standards[b]	
		Concentration[c]	Primary[c,d]	Secondary[c,e]
O_3	1 hour	0.09 ppm (180 μg/m³)	—	Same as Primary Standard[f]
	8 hours	0.070 ppm (137 μg/m³)	0.070 ppm (137 μg/m³)[f]	
NO_2[g]	1 hour	0.18 ppm (339 μg/m³)	0.100 ppm (188 μg/m³)	Same as Primary Standard
	Annual Arithmetic Mean	0.030 ppm (57 μg/m³)	0.053 ppm (100 μg/m³)	
CO	1 hour	20 ppm (23 mg/m³)	35 ppm (40 mg/m³)	None
	8 hours	9 ppm (10 mg/m³)	9 ppm (10 mg/m³)	
SO_2[h]	1 hour	0.25 ppm (655 μg/m³)	0.075 ppm (196 μg/m³)	—
	3 hours	—	—	0.5 ppm (1,300 μg/m³)
	24 hours	0.04 ppm (105 μg/m³)	0.14 ppm (for certain areas)[g]	—
	Annual	—	0.030 ppm (for certain areas)[g]	—
PM_{10}[i]	24 hours	50 μg/m³	150 μg/m³	Same as Primary Standard
	Annual Arithmetic Mean	20 μg/m³	—	
$PM_{2.5}$[i]	24 hours	—	35 μg/m³	Same as Primary Standard
	Annual Arithmetic Mean	12 μg/m³	9.0 μg/m³	15.0 μg/m³
Lead[j,k]	30-day Average	1.5 μg/m³	—	—
	Calendar Quarter	—	1.5 μg/m³ (for certain areas)[k]	Same as Primary Standard
	Rolling 3-Month Average	—	0.15 μg/m³	
Hydrogen sulfide	1 hour	0.03 ppm (42 μg/m³)	—	—
Vinyl chloride[j]	24 hours	0.01 ppm (26 μg/m³)	—	—
Sulfates	24 hours	25 μg/m³	—	—

Table 2. State and National Ambient Air Quality Standards (NAAQSs)

Pollutant	Averaging Time	California Standards[a]	National Standards[b]	
		Concentration[c]	Primary[c,d]	Secondary[c,e]
Visibility reducing particles	8 hour (10:00 a.m. to 6:00 p.m. PST)	Insufficient amount to produce an extinction coefficient of 0.23 per kilometer due to the number of particles when the relative humidity is less than 70%	—	—

Source: CARB 2023; EPA 2023.

Notes: O_3 = ozone; ppm = parts per million by volume; μg/m³ = micrograms per cubic meter; NO_2 = nitrogen dioxide; CO = carbon monoxide; mg/m³= milligrams per cubic meter; SO_2 = sulfur dioxide; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 microns; $PM_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 microns.

[a] California standards for O_3, CO, SO_2 (1-hour and 24-hour), NO_2, suspended particulate matter (PM_{10}, $PM_{2.5}$), and visibility-reducing particles are values that are not to be exceeded. All others are not to be equaled or exceeded. California Ambient Air Quality Standards are listed in the Table of Standards in Section 70200 of Title 17 of the California Code of Regulations.

[b] National standards (other than O_3, NO_2, SO_2, particulate matter, and those based on annual averages or annual arithmetic mean) are not to be exceeded more than once per year. The O_3 standard is attained when the fourth highest 8-hour concentration measured at each site in a year, averaged over three years, is equal to or less than the standard. For PM_{10}, the 24-hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration above 150 μg/m³ is equal to or less than one. For $PM_{2.5}$, the 24-hour standard is attained when 98% of the daily concentrations, averaged over 3 years, are equal to or less than the standard.

[c] Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based on a reference temperature of 25°C and a reference pressure of 760 torr. Most measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 torr; ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

[d] National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health.

[e] National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

[f] On October 1, 2015, the national 8-hour O_3 primary and secondary standards were lowered from 0.075 to 0.070 ppm.

[g] To attain the national 1-hour standard, the three-year average of the annual 98th percentile of the one-hour daily maximum concentrations at each site must not exceed 100 parts per billion (ppb). Note that the national 1-hour standard is in units of ppb. California standards are in units of ppm. To directly compare the national 1-hour standard to the California standards, the units can be converted from ppb to ppm. In this case, the national standard of 100 ppb is identical to 0.100 ppm.

[h] On June 2, 2010, a new 1-hour SO_2 standard was established, and the existing 24-hour and annual primary standards were revoked. To attain the national 1-hour standard, the three-year average of the annual 99th percentile of the one-hour daily maximum concentrations at each site must not exceed 75 ppb. The 1971 SO_2 national standards (24-hour and annual) remain in effect until one year after an area is designated for the 2010 standard, except that in areas designated nonattainment of the 1971 standards, the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standards are approved.

[i] On December 14, 2012, the national annual $PM_{2.5}$ primary standard was lowered from 15 μg/m³ to 12 μg/m³. The existing national 24-hour $PM_{2.5}$ standards (primary and secondary) were retained at 35 μg/m³, as was the annual secondary standard of 15 μg/m³. The existing 24-hour PM_{10} standards (primary and secondary) of 150 μg/m³ were also retained. The form of the annual primary and secondary standards is the annual mean averaged over three years.

[j] California Air Resources Board has identified lead and vinyl chloride as toxic air contaminants with no threshold level of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.

[k] The national standard for lead was revised on October 15, 2008, to a rolling three-month average. The 1978 lead standard (1.5 μg/m³ as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978 standard, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

2.2.1.2 Hazardous Air Pollutants

The 1977 federal CAA amendments required the EPA to identify national emission standards for HAPs to protect public health and welfare. HAPs include certain volatile organic chemicals, pesticides, herbicides, and radionuclides that present a tangible hazard based on scientific studies of exposure to humans and other mammals. Under the 1990 federal CAA Amendments, which expanded the control program for HAPs, 187 substances and chemical families were identified as HAPs.

2.2.1.3 General Conformity Determination

The General Conformity Rule applies to all federal actions for projects except highway and transit programs. Title I, Section 176(c)(1) of the CAA defines conformity as the upholding of “an implementation plan’s purpose of eliminating or reducing the severity and number of violations of the NAAQS and achieving expeditious attainment of such standards.” According to 40 CFR 93.152, “Federal action means any activity engaged in by a department, agency, or instrumentality of the Federal government, or any activity that a department, agency or instrumentality of the Federal government supports in any way, provides financial assistance for, licenses, permits, or approves, other than activities related to transportation plans, programs, and projects developed, funded, or approved under title 23 U.S.C. or the Federal Transit Act (49 U.S.C. 1601 et seq.).” The Proposed Action has activities within NAAQS nonattainment areas and entails support from the U.S. Space Force and permitting from the FAA; consequently, the action is a federal action and general conformity applies. Therefore, whether a General Conformity determination would apply for portions of the action within nonattainment/maintenance areas must be ascertained through a General Conformity applicability analysis. Finally, according to 40 CFR 93(e), “if an action would result in emissions originating in more than one nonattainment or maintenance area, the conformity must be evaluated for each area separately.” As the Proposed Action occurs within more than one nonattainment or maintenance area, the conformity must be evaluated within each area.

2.2.2 State Regulations

California Clean Air Act of 1988

The federal CAA delegates the regulation of air pollution control and the enforcement of the NAAQS to the states. In California, the task of air quality management and regulation has been legislatively granted to CARB, with subsidiary responsibilities assigned to air quality management districts and air pollution control districts at the regional and county levels. CARB, which became part of the California Environmental Protection Agency in 1991, is responsible for ensuring implementation of the California Clean Air Act of 1988, responding to the CAA and regulating emissions from motor vehicles and consumer products.

CARB’s CAAQS are generally more restrictive than the NAAQS. The CAAQS describes adverse conditions; therefore, monitored ambient air quality concentrations must be below these standards before a basin can demonstrate attainment. The California Clean Air Act requires air quality management districts to adopt and enforce regulations to achieve and maintain air quality that is within state air quality standards. The act also requires preparation of a Clean Air Plan (CAP).

Toxic Air Contaminants

A TAC is defined by California law as an air pollutant that may cause or contribute to an increase in mortality or an increase in serious illness, or which may pose a present or potential hazard to human health. Federal laws use the hazardous air pollutants to refer to the same types of compounds that are referred to as TACs under state law. California regulates TACs primarily through the Tanner Air Toxics Act (Assembly Bill [AB] 1807) and the Air Toxics Hot Spots Information and Assessment Act of 1987 (AB 2588).

AB 1807 sets forth a formal procedure for CARB to designate substances as TACs. This includes research, public participation, and scientific peer review before CARB can designate a substance as a TAC. Pursuant to AB 2588, existing facilities that emit air pollutants above specified levels were required to (1) prepare a TAC emission inventory plan and report; (2) prepare a risk assessment if TAC emissions were significant; (3) notify the public of significant risk levels; and (4) if health impacts were above specified levels, prepare and implement risk reduction measures.

The following regulatory measures pertain to the reduction of DPM and criteria pollutant emissions from off-road equipment and diesel-fueled vehicles.

Idling of Commercial Heavy Duty Trucks (13 CCR 2485)

In July 2004, CARB adopted an Airborne Toxic Control Measure (ATCM) to control emissions from idling trucks. The ATCM prohibits idling for more than 5 minutes for all commercial trucks with a gross vehicle weight rating over 10,000 pounds. The ATCM contains an exception that allows trucks to idle while queuing or involved in operational activities.

In-Use Off-Road Diesel-Fueled Fleets (13 CCR 2449 et seq.)

In July 2007, CARB adopted an ATCM for in-use off-road diesel vehicles. This regulation requires that specific fleet average requirements be met for NO_x emissions and for particulate matter emissions. Where average requirements cannot be met, best available control technology requirements apply. The regulation also includes several recordkeeping and reporting requirements.

In response to AB 8 2X, the regulations were revised in July 2009 (effective December 3, 2009) to allow a partial postponement of the compliance schedule in 2011 and 2012 for existing fleets. On December 17, 2010, CARB adopted additional revisions to further delay the deadlines reflecting reductions in diesel emissions due to the poor economy and overestimates of diesel emissions in California. The revisions delayed the first compliance date until no earlier than January 1, 2014, for large fleets, with final compliance by January 1, 2023. The compliance dates for medium fleets were delayed until an initial date of January 1, 2017, and final compliance date of January 1, 2023. The compliance dates for small fleets were delayed until an initial date of January 1, 2019, and final compliance date of January 1, 2028. Correspondingly, the fleet average targets were made more stringent in future compliance years. The revisions also accelerated the phaseout of older equipment with newer equipment added to existing large and medium fleets over time, requiring the addition of Tier 2 or higher engines starting on March 1, 2011, with some exceptions; Tier 2 or higher engines on January 1, 2013, without exception; and Tier 3 or higher engines on January 1, 2018 (January 1, 2023, for small fleets). SpaceX shall adhere to the CARB In-Use Off-Road Diesel-Fueled Fleets Regulation (CARB 2024) for fleet management and fuel selection.

On October 28, 2011 (effective December 14, 2011), the executive officer approved amendments to the regulation. The amendments included revisions to the applicability section and additions and revisions to the definition. The initial date for requiring the addition of Tier 2 or higher engines for large and medium fleets, with some exceptions, was revised to January 1, 2012. New provisions also allow for the removal of emission control devices for safety or visibility purposes. The regulation also was amended to combine the particulate matter and NO_x fleet average targets under one, instead of two, sections. The amended fleet average targets are based on the fleet's NO_x fleet average, and the previous section regarding particulate matter performance requirements was deleted completely. The best available control technology requirements, if a fleet cannot comply with the fleet average requirements, were restructured and clarified. Other amendments to the regulations included minor administrative changes to the regulatory text.

In-Use On-Road Diesel-Fueled Vehicles (13 CCR 2025)

On December 12, 2008, CARB adopted an ATCM to reduce NO_x and particulate matter emissions from most in-use on-road diesel trucks and buses with a gross vehicle weight rating greater than 14,000 pounds. The original ATCM regulation required fleets of on-road trucks to limit their NO_x and particulate matter emissions through a combination of exhaust retrofit equipment and new vehicles. The regulation limited particulate matter emissions for most fleets by 2011, and limited NO_x emissions for most fleets by 2013. The regulation did not require any vehicle to be replaced before 2012 and never required all vehicles in a fleet be replaced.

In December 2009, the CARB Governing Board directed staff to evaluate amendments that would provide additional flexibility for fleets adversely affected by the struggling California economy. On December 17, 2010, CARB revised this ATCM to delay its implementation along with limited relaxation of its requirements. Starting on January 1, 2015, lighter trucks with a gross vehicle weight rating of 14,001 to 26,000 pounds with 20-year-old or older engines need to be replaced with newer trucks (2010 model year emissions equivalent as defined in the regulation). Trucks with a gross vehicle weight rating greater than 26,000 pounds with 1995 model year or older engines needed to be replaced as of January 1, 2015. Trucks with 1996 to 2006 model year engines must install a Level 3 (85% control) diesel particulate filter starting on January 1, 2012, to January 1, 2014, depending on the model year, and then must be replaced after 8 years. Trucks with 2007 to 2009 model year engines have no requirements until 2023, at which time they must be replaced with 2010 model year emissions-equivalent engines, as defined in the regulation. Trucks with 2010 model year engines would meet the final compliance requirements. The ATCM provides a phase-in optio2n under which a fleet operator would equip a percentage of trucks in the fleet with diesel particulate filters, starting at 30% as of January 1, 2012, with 100% by January 1, 2016. Under each option, delayed compliance is granted to fleet operators who have or will comply with requirements before the required deadlines.

On September 19, 2011 (effective December 14, 2011), the Executive Officer approved amendments to the regulations, including revisions to the compliance schedule for vehicles with a gross vehicle weight rating of 26,000 pounds or less to clarify that all vehicles must be equipped with 2010 model year emissions equivalent engines by 2023. The amendments included revised and additional credits for fleets that have downsized; implemented early particulate matter retrofits; incorporated hybrid vehicles, alternative-fueled vehicles, and vehicles with heavy-duty pilot ignition engines; and implemented early addition of newer vehicles. The amendments included provisions for additional flexibility, such as for low-usage construction trucks, and revisions to previous exemptions, delays, and extensions. Other amendments to the regulations included minor administrative changes to the regulatory text, such as recordkeeping and reporting requirements related to other revisions.

Control Measure for Ocean-Going Vessels at Berth (13 CCR 2299.1 and 17 CCR 93118)

The original Ocean-Going Vessel At-Berth Regulation was approved in December 2007 with compliance requirements that began in 2014. The 2007 At-Berth Regulation affects the following three vessel categories: container ships, passenger ships, and refrigerated-cargo ships at six California ports: Los Angeles, Long Beach, Oakland, San Diego, San Francisco, and Hueneme. Compliance requirements for vessels include visit requirements and emission or power reduction requirements both which were phased in over time to the current 80% reduction requirement.

CARB's State Implementation Plan, AB 617, Mobile Source Strategy, and California Sustainable Freight Action Plan (Executive Order B-32-15) include commitments to evaluate the existing 2007 At-Berth Regulation for opportunities to further reduce emissions from vessels. These actions include developing a new At-Berth Regulation to achieve further emission reductions by including smaller fleets, additional vessel types (such as roll-on/roll-off vehicle carriers and tankers), and additional operations. The new regulatory efforts will help achieve much needed public health protection for Californians living nearby port communities, reduce exposure to toxic air emissions in disadvantaged communities and meet 2023 and 2031 emission reduction goals for NOx.

Control Measure for Stationary Compression Ignition Engines (17 CCR 93115)

The amended Airborne Toxic Control Measure for Stationary Compression Ignition Engines (ATCM) (effective May 19, 2011) includes requirements for stationary and portable diesel-fueled engines used exclusively in agriculture. Typically, these engines are used to pump water or provide power for growing crops or raising livestock. The amended ATCM affects the sale, purchase, installation, and use of new/used and in-use stationary and portable agricultural engines. The amended ATCM does not affect agricultural wind machines or motive (self-propelled) agricultural equipment with engines, such as tractors or harvesters; however, diesel engines not affected by the ATCM may be subject to other air quality regulations. Diesel engines used in agricultural production are a source of emissions for diesel exhaust particulate matter (diesel PM) and other pollutants that have known health effects.

California Health and Safety Code Section 41700

Section 41700 of the California Health and Safety Code states that a person shall not discharge from any source whatsoever quantities of air contaminants or other material that cause injury, detriment, nuisance, or annoyance to any considerable number of persons or to the public, or that endanger the comfort, repose, health, or safety of any of those persons or the public, or that cause, or have a natural tendency to cause, injury or damage to business or property. This section also applies to sources of objectionable odors.

2.3 Regional and Local Air Quality Conditions

2.3.1 Attainment Designation

Pursuant to the 1990 federal CAA Amendments, the EPA classifies air basins (or portions thereof) as “attainment” or “nonattainment” for each criteria air pollutant based on whether the NAAQS have been achieved. Generally, if the recorded concentrations of a pollutant are lower than the standard, the area is classified as “attainment” for that pollutant. If an area exceeds the standard, the area is classified as “nonattainment” for that pollutant. If there is not enough data available to determine whether the standard is exceeded in an area, the area is designated as “unclassified” or “unclassifiable.” The designation of “unclassifiable/attainment” means that the area meets the standard or is expected to meet the standard despite a lack of monitoring data. Areas that achieve the standards after a nonattainment designation are re-designated as maintenance areas and must have approved Maintenance Plans to ensure continued attainment of the standards.

Santa Barbara County (where the action will occur) is within the Santa Barbara County Air Pollution Control District (SBCAPCD) and is in attainment for all NAAQSs; however, the county is nonattainment for the state 8-hour O_3 and 24-hour and annual PM_{10} standards.

Ventura County (where the action will occur) is within the Ventura County Air Pollution Control District (VCAPCD) and is in serious nonattainment for the 2008 and 2015 8-hour O_3 NAAQS. Additionally, the county is nonattainment for O_3 and the 24-hour and annual state PM_{10} standard and attainment for all other state and federal standards.

Los Angeles County (where the action will occur) is within the South Coast Air Quality Management District (SCAQMD) is extreme nonattainment for the 2008 and 2015 8-hour O_3 NAAQSs; maintenance for the 1971 CO NAAQS; nonattainment for the 2008 Pb NAAQS; maintenance for the 1987 PM_{10} NAAQS with a classification of serious; and nonattainment for the 1997, 2006, and 2012 $PM_{2.5}$ NAAQSs with a classification of serious. Additionally, the SCAQMD is nonattainment for the 1-hour O_3, 8-hour O_3, 24-hour and annual PM_{10}, and annual $PM_{2.5}$ state standards.

2.4 Insignificance Criteria and Methodology

2.4.1 Insignificance Thresholds and Indicators

For air quality impact assessments, significance is defined by the degree to which the effects of the proposed action potentially could affect public health or safety. The U.S. Air Force (USAF) conducts National Environmental Policy Act (NEPA) and General Conformity Rule air quality impact assessments in tandem within the Environmental Impact Analysis Process (EIAP) (HQ AFCEC/CZTQ 2023a). The air quality EIAP process is broken into three progressive levels of assessment: Level I, Exempt Action Screening (determine if a formal Air Quality Assessment is required); Level II, Quantitative Air Quality Assessment (a formal emissions quantifying assessment to eliminate insignificant air impacts from further assessment); and Level III, Advanced Air Quality Assessment (part science and part art, both quantitative and qualitative assessments of air impact). These levels are designed to ensure completion of an air quality assessment at the lowest level possible; with each level of assessment having a specific significance threshold or indicator that, if not exceeded, allows exiting the assessment.

If an action is not exempt for Air Quality EIAP, it must proceed to a Level II, Quantitative Assessment. A Level II assessment is a quantification of annual net change in emissions that are compared against levels of annual emissions (i.e., thresholds or indicator) that are known to have de minimis (insignificant) effects on public health or safety. De minimis values were established in the General Conformity Rule (40 CFR 93 Subpart B) as definitive insignificance thresholds for actions occurring within areas designated as nonattainment or maintenance for one or more National Ambient Air Quality Standard (NAAQS). However, for Level II NEPA air impact assessments, the USAF had to establish legally defensible insignificance values (indicators) for actions occurring within attainment areas. Insignificance thresholds are EPA-established annual emission rates that, if exceeded, would trigger a regulatory requirement. Insignificance indicators are EPA-established rate thresholds that are partially applied or applied out of context to their intended use; however, can provide a direct gauge of potential impact. Although indicators do not trigger a regulatory requirement, they do provide an indication or a warning that the action is potentially approaching a threshold which would trigger a significant regulatory requirement.

The air quality impact evaluation for this action requires two separate analyses: the Clean Air Act (CAA) General Conformity Analysis and an analysis under NEPA. Impacts of air pollutants emitted by activities in the Pacific Ocean, bays, and inland locations in State waters (i.e., up to 3 nm from the coast) are assessed under the General Conformity Rule. Impacts of air pollutants emitted by activities in the Pacific Ocean, bays, and inland locations in U.S. territorial seas (i.e., up to 12 nm from the coast) are assessed under NEPA. Each coastal state may claim the territorial sea that extends seaward up to 12 nm from its shores and exercise sovereignty over its territorial sea, the air space above it, and the seabed and subsoil beneath it (National Oceanic and Atmospheric Administration [NOAA] 2017). The state jurisdictions may extend the full distance of territorial seas or may retain historical limits.

Table 3 presents the air quality DAF insignificance thresholds and indicators that would be applied to the proposed action's and alternatives' emissions.

Table 3. DAF Insignificance Thresholds/Indicators

Pollutant	Santa Barbara County (SBCAPCD)	Ventura County (VCAPCD)	Los Angeles County (SCAQMD)
	Tons Per Year		
Ozone (NO_x or VOC)	250	50*	10*
Carbon Monoxide (CO)	250	250	100*
SO_2 or NOx	250	250	250
PM_{10}	250	250	100*
$PM_{2.5}$ (NOx, VOC, SOx, or NH_3)	250	250	70*
Lead (Pb)	25	25	25*

Source: HQ AFCEC/CZTQ 2023a.
Notes: * Indicates a General Conformity Threshold.
NOx = oxides of nitrogen; SO_2 = sulfur dioxide; NO_2 = nitrogen dioxide; VOC = volatile organic compound; CO = carbon monoxide; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 microns; $PM_{2.5}$ = particulate matter with an aerodynamic diameter less than or equal to 2.5 microns; NH_3 = ammonia; Pb = lead; SBCAPCD = Santa Barbara County Air Pollution Control District; VCAPCD = Ventura County Air Pollution Control District; SCAQMD = South Coast Air Quality Management District.

2.5 Approach and Methodology

An air quality impact assessment is accomplished with a net-change in emissions analyses for each nonattainment/maintenance area the action will occur within. In accordance with DAF guidance, NEPA (40 CFR 1508), and the General Conformity Rule (40 CFR 93 Subpart B), an annual net-change in emissions analyses is an evaluation of the total action-related annual increased emissions (direct and indirect emissions) of the criteria pollutant (or their precursors) combined with the total action-related annual decreased emissions results in an overall annual net change in emissions for the entire action. The proposed action's worst-year (highest emission year) annual net change in emissions for each pollutant (or precursors) are screened against the applicable insignificance indicators or thresholds (de minimis values). If the results of an annual net-change in emissions analyses indicate all criteria pollutant (or precursors) are below the insignificance indicators or thresholds, the action is considered to have an insignificant impact on air quality for both NEPA and General Conformity. If the results of an annual net-change in emissions analyses indicate one or more criteria pollutant (or precursors) are equal to or above the insignificance indicators or thresholds, the action is considered to have a potentially significant impact on air quality and further assessment is required and a General Conformity determination is required if a threshold is exceeded.

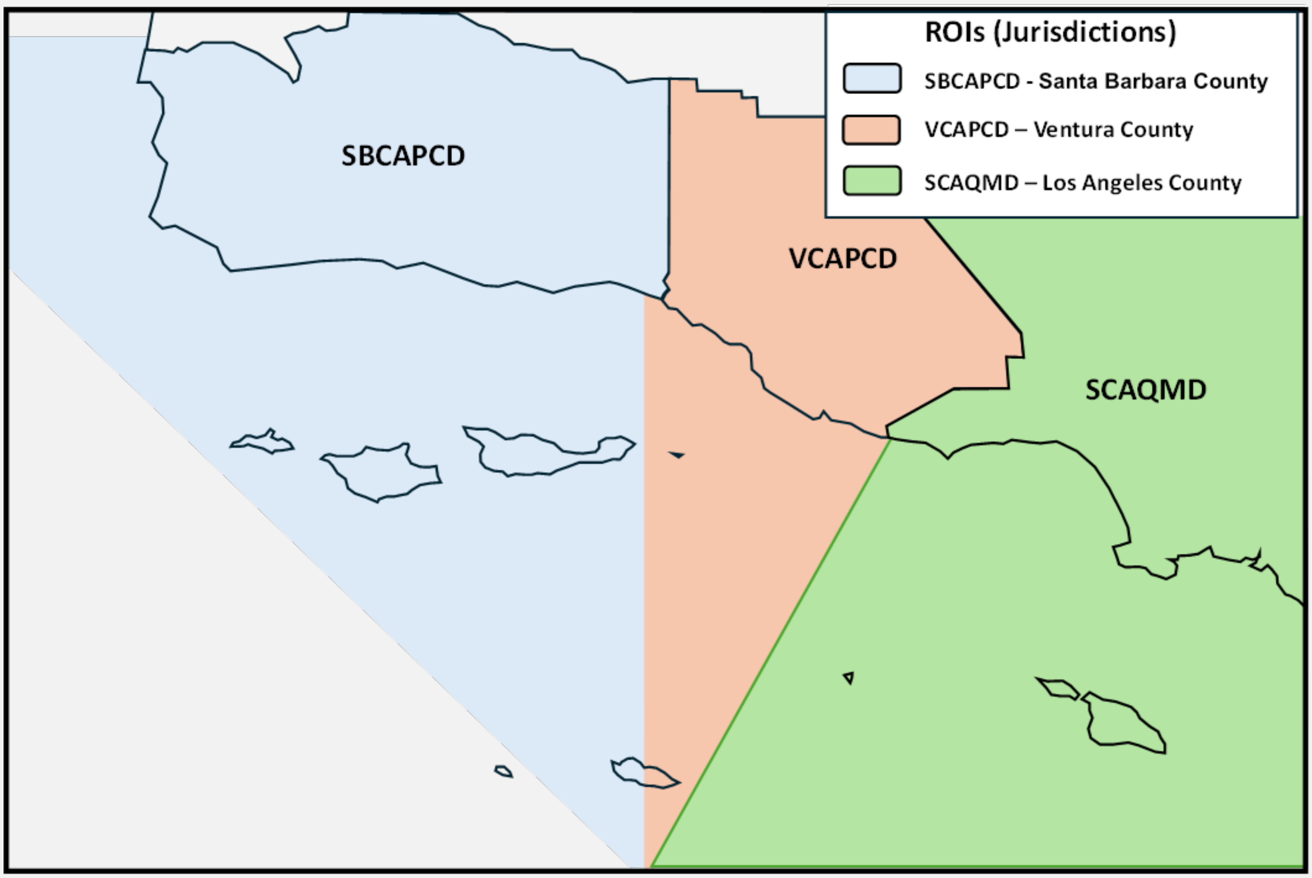
The Proposed Action and Alternative 1 differ only in the construction activities. The operational activities for the Proposed Action and Alternative 1 are identical. Therefore, the Proposed Action's operational emissions are only identified as the Proposed Action.

For air quality, DAF considers this Proposed Action and Alternative 1 as effectively a continuation and an expansion of the previous action for up to 50 launches as described in the 2024 EA (≤ 50 Launches) and the associated 2025 GCR Determination (for action related activities within the Los Angeles-South Coast Air Basin Ozone Extreme Nonattainment Area). Additionally, the previous air quality assessment (2024 EA) was based on overly conservative assumptions on tugboat routing and operational times that have since been demonstrated to be unrealistic. Therefore, for this expanded assessment the assumptions, while still very conservative, have been revised to be more in line with operation limits expected in future permitting. As a result, this air quality assessment starts with revising the 2024 projected emissions (for up to 50 launches, per the 2024 EA) with the revised assumptions, evaluate the projected emissions beyond 2024, and reevaluate the 2025 GCR Determination.

In accordance with 40 CFR 1506.4, where appropriate, DAF combined NEPA and General Conformity assessment under one air quality EIAP assessment to reduce duplication and paperwork. In areas where General Conformity is applicable (i.e., action occurring within a nonattainment or maintenance area), the air quality EIAP assessment is a General Conformity assessment as it is the worst-case air quality scenario (i.e., already classified nonattainment or maintenance). As such, in accordance with DAF procedures and guidance, Regions Of Influence (ROIs) for air quality assessments for NEPA are the same as the ROIs for General Conformity (where appropriate) assessments as dictated by the ROI requirements under the General Conformity Rule (40 CFR 93 Subpart B). In accordance with DAF guidance and the General Conformity Rule, each nonattainment or maintenance area that the action (or portions of the action) will occur within is considered a separate ROI and each separate ROI must have a separate air quality EIAP assessment.

The Santa Barbara County Air Pollution Control District (SBCAPCD) has jurisdiction over Santa Barbara County, which is in attainment for all NAAQSs. The Ventura County Air Pollution Control District (VCAPCD) has jurisdiction over Ventura County which is mostly in serious nonattainment for the eight-hour ozone NAAQS, including the area where the action will take place. The South Coast Air Quality Management District (SCAQMD) has jurisdiction over Los Angeles County which is in extreme nonattainment for the eight-hour ozone NAAQS, maintenance for CO, nonattainment for Pb, nonattainment for PM2.5, and maintenance for PM10. Therefore, for criteria pollutants, there are three distinct ROIs (which apply to both NEPA and General Conformity assessments): SBCAPCD which includes all activities occurring within Santa Barbara County, VCAPCD which includes all activities occurring within Ventura County, and SCAQMD which includes all activities occurring within Los Angeles County. Figure 1 shows the boundaries of each of these ROIs.

Figure 1. Criteria Pollutant ROIs.



Source: SBCAPCD Authority to Construct Permit 16293

Table 4 provides a timeline of action-related activities by year for each ROI. This timeline is important because an annual net change in emission analysis must be performed for each ROI and each ROI's analysis must include criteria pollutant emission estimations for each year (must include all activities happening wholly or partially within the specified year).

Table 4. Timeline of Action-Related Activities

ROI (Jurisdiction)	Action Related Activities for Specified Yeas		
	2025		≥ 2027
SBCAPCD (Santa Barbara County)	Existing Operational (at ≤50 launches)	83% Existing Operational (at ≤50 launches)	83% Existing Operational (at ≤50 launches)
		17% New Operational (at ≤100 launches)	
	Construction	Construction	

Table 4. Timeline of Action-Related Activities

<table>
<tr><th rowspan="2">ROI (Jurisdiction)</th><th colspan="3">Action Related Activities for Specified Yeas</th></tr>
<tr><th>2025</th><th></th><th>≥ 2027</th></tr>
<tr><td rowspan="2">VCAPCD (Ventura County)</td><td rowspan="2">Existing Roll-On-Roll-Off (at ≤50 launches)</td><td>83% Existing Roll-On-Roll-Off (at ≤50 launches)</td><td rowspan="2">New Roll-On-Roll-Off (at ≤100 launches)</td></tr>
<tr><td>17% New Roll-On-Roll-Off (at ≤100 launches)</td></tr>
<tr><td rowspan="4">SCAQMD (Los Angeles County)</td><td rowspan="2">Existing Roll-On-Roll-Off (at ≤50 launches)</td><td>83% Existing Roll-On-Roll-Off (at ≤50 launches)</td><td rowspan="2">17% New Booster/ Payload Fairing Recovery (at ≤100 launches)</td></tr>
<tr><td>17% New Roll-On-Roll-Off (at ≤100 launches)</td></tr>
<tr><td rowspan="2">Existing Booster/Payload Fairing Recovery (at ≤50 launches)</td><td>83% Existing Booster/ Payload Fairing Recovery (at ≤50 launches)</td><td rowspan="2">New Booster/ Payload Fairing Recovery (at ≤100 launches)</td></tr>
<tr><td>17% New Booster/ Payload Fairing Recovery (at ≤100 launches)</td></tr>
</table>

Source: Description of Proposed Action in the Draft Environmental Impact Statement for Authorizing Changes to the Falcon Launch Program at Vandenberg Space Force Base, California (February 2025)

2.5.1 Construction Activities – Proposed Action

Emissions from the construction phase of the project were estimated using the Air Conformity Applicability Model (ACAM) 5.0.23a. Construction scenario assumptions, including phasing, equipment mix, and vehicle trips, were based on information provided by the project applicant and relevant experience with similar projects when project specifics were not known. For informational purposes only, the California Emissions Estimator Model (CalEEMod) was used to model construction emissions under the same scenario and is included in Attachment A.

For purposes of estimating project emissions, and based on information provided by the project applicant, it is assumed that construction of the project would commence in November 2025 and would last approximately 12 months, ending in October 2026. The analysis contained herein is based on the construction schedule shown in Table 5.

Table 5. Construction Schedule – Proposed Action

Phase	Start Date	End Date	Total Workdays
Demolition[1]	11/1/2025	4/30/2026	130
Grading	11/1/2025	11/30/2025	20
Building Construction	12/1/2025	9/29/2026	220
Paving	10/1/2026	10/30/2026	20
Architectural Coating	10/1/2026	10/30/2026	20

Note: [1] Demolition includes the MAS, FUT, Crown, and MST at SLC-6.

The construction equipment required for project construction was provided by ACAM defaults. Table 6 provides the anticipated construction equipment list. All of the equipment was assumed to be diesel-powered. All vehicle emissions during construction assumed defaults from ACAM.

Table 6. Construction Off-Road Equipment – Proposed Action

Phase	Equipment List	Quantity	Hours Per Day
Demolition1	Concrete/Industrial Saws	4	8
	Rubber Tired Dozers	4	1
	Tractors/Loaders/Backhoes	8	6
Grading	Grader	1	8
	Other Construction Equipment	1	8
	Rubber Tired Dozer	1	8
	Tractor/Loader/Backhoes	2	7
Building Construction	Cranes	1	6
	Forklifts	2	6
	Generator Sets	1	8
	Tractors/Loaders/Backhoes	1	8
	Welders	3	8
Paving	Cement and Mortar Mixers Composite	4	6
	Pavers Composite	1	7
	Paving Equipment Composite	2	6
	Rollers Composite	1	7
Architectural Coating	NA	NA	NA

Source: AFCEC 2013.
Note: [1] Demolition includes the MAS, FUT, Crown, and MST at SLC-6.

2.5.2 Construction Activities – Alternative 1

Emissions from the construction phase of the project were estimated using the ACAM 5.0.23a. Construction scenario assumptions, including phasing, equipment mix, and vehicle trips, were based on information provided by the project applicant and relevant experience with similar projects when project specifics were not known. For informational purposes only, the CalEEMod was used to model construction emissions under the same scenario and is included in Attachment A.

For purposes of estimating project emissions, and based on information provided by the project applicant, it is assumed that construction of the project would commence in November 2025 and would last approximately 12 months, ending in October 2026. The analysis contained herein is based on the construction schedule shown in Table 7.

Table 7. Construction Schedule – Alternative 1

Phase	Start Date	End Date	Total Workdays
Demolition[1]	11/1/2025	4/30/2026	130
Grading	11/1/2025	11/30/2025	20
Building Construction	12/1/2025	9/29/2026	220
Paving	10/1/2026	10/30/2026	20
Architectural Coating	10/1/2026	10/30/2026	20

Note: [1] Demolition includes the MAS, FUT, Crown, and MST at SLC-6.

The construction equipment required for project construction was provided by ACAM defaults. Table 8 provides the anticipated construction equipment list. All of the equipment was assumed to be diesel-powered. All vehicle emissions during construction assumed defaults from ACAM.

Table 8. Construction Off-Road Equipment – Alternative 1

Phase	Equipment List	Quantity	Hours Per Day
Demolition[1]	Concrete/Industrial Saws	4	8
	Rubber Tired Dozers	4	1
	Tractors/Loaders/Backhoes	8	6
Grading	Excavator	1	8
	Grader	1	8
	Other Construction Equipment	1	8
	Rubber Tired Dozer	1	8
	Tractor/Loader/Backhoes	3	8
Building Construction	Cranes	1	6
	Forklifts	2	6
	Generator Sets	1	8
	Tractors/Loaders/Backhoes	1	8
	Welders	3	8
Paving	Cement and Mortar Mixers Composite	4	6
	Pavers Composite	1	7
	Paving Equipment Composite	2	6
	Rollers Composite	1	7
Architectural Coating	NA	NA	NA

Source: AFCEC 2013.
Note: [1] Demolition includes the MAS, FUT, Crown, and MST at SLC-6.

2.5.3 Operational Activities

Proposed Action

The Proposed Action would generate criteria air pollutant emissions during operation from launches and landings, payload fairing recovery, booster roll-on roll-off, and operation of SLC-4 and SLC-6. Operational emissions are anticipated to be identical for the Proposed Action and Alternative 1. The following section discusses the emission calculation methodology for each activity.

Falcon 9 Launch

SpaceX would launch Falcon up to 100 times per year from VSFB (70 Falcon 9 from SLC-4 and 25 Falcon 9 and 5 Falcon Heavy from SLC-6). The Proposed Action would result in an increase in 20 Falcon 9 Launches from SLC-4, 25 Falcon 9 launches from SLC-6, and 5 Falcon Heavy launches from SLC-6 over the existing conditions. It is estimated that it takes a Falcon 9 23 seconds to reach 3,000 feet elevation after a launch and a Falcon Heavy 21 seconds. Each takeoff may be preceded by a static fire test of the engines, which lasts 7 seconds. The need to conduct a static fire test is mission dependent, but there would be no more than 50 static fire events per year (45 Falcon 9 and 5 Falcon Heavy), which is an increase of 15 Falcon 9 and 5 Falcon Heavy static fires compared to existing conditions.

The emission factors for estimating emissions from Falcon 9 and Falcon Heavy launches were taken from the *Exhaust Plume Calculations for SpaceX Merlin5 Booster Engine* by Sierra Engineering & Software, Inc. (included as Attachment B). The analysis was done using a single engine firing into a stable environment within 516 feet of the engine exhaust. This assumes the gas generator exhaust is efficiently entrained into the rocket exhaust. The analysis from the single engine was then extrapolated to estimate the emissions for all 9 engines for the Falcon 9 and 27 engines for the Falcon Heavy. The Performance Correlation Program (PERCORP) is a model that uses known engine performance to estimate mixing and vaporization efficiencies in liquid rocket engines and provide a simple method of predicting nozzle exit-plane flow constituents and properties. The PERCORP analysis model was used to estimate the oxidizer/fuel mixture ratio variations that exist within the M1D thrust chamber. The fuel-rich combustion model in PERCORP was also used to estimate the gas generator exhaust constituents. PERCORP was run iteratively with VIPER (version 4.5 Beta Apr-2018) until the VIPER output specific impulse matched the target value. The VIPER output includes details of the pressure, temperature, velocity and species concentration across the nozzle exit plane. The SPF III code (Version 4.2.3a Patch 2) was used to predict the flow structure of the free exhaust plume and the entrainment of ambient air. The M8 chemical system was augmented with CH_4, C_2H_2 and C_2H_4. However, there were several species in the PERCORP-generated GG exhaust ($C_{12}H_{23}$, C_7H_{14}, C_3H_6, C_2H_6) that were not included in the SPF DATABANK. Rather than trying to add the species, Sierra's kerosene cracking reactions, plus some judicious chemistry analogs, were used to convert these species into simpler constituents the code can handle. The subsequent TDK simulation of the plume chemistry requires an approximate fit of the air entrainment rate. The SPF air entrainment profile was fit to an "availability profile" for the two-dimensional kinetics simulations, allowing ambient air to be "mixed" into the plume flow. Achieving a good fit of the entrainment with the simple availability model within TDK requires running the 1-D analysis in 3-pieces, restarting the simulation with temperature and species information from the previous analysis and updating the air availability rate parameters. The one-dimensional kinetic model (ODK) in the TDK code was used to model chemical reactions within the evolving plume flow field. The pollutant flow rates were calculated in terms of lb_m generated per second of steady engine operation.

Although the exhaust is fuel-rich and contains high concentrations of CO, subsequent entrainment of ambient air results in complete conversion of the CO into CO_2 and oxidation of the soot from the gas generator exhaust. A small amount of thermal NOx is formed as NO. Emissions were estimated using a spreadsheet model.

Payload Fairing Recovery

After each launch, the fairing is recovered from the Pacific Ocean via a support marine vessel. The fairing and parafoil would be recovered by a salvage ship stationed in the Proposed Landing Area near the anticipated splashdown site, but no closer than 12 nm offshore. Emissions from the support vessel were calculated using a spreadsheet model and emission factors based on the engine tier and the activity data for the recovery. There would be an increase of 50 fairing recovery operations per year over existing conditions.

Landings

Similar to launch operations, there are emissions of NOx during the landing of the Falcon first stage. Landings occur both on land and on water in the Pacific Ocean. For water landings, the first stage and barge are towed using a marine vessel back to the Port of Long Beach. Emissions were estimated using a spreadsheet model with emission factors based on the engine tier and activity data. During landing, only 3 of the 9 engines are used in a Falcon 9 booster. Two boosters land from each Falcon Heavy. The engines burn 18 seconds during a landing below 3,000 feet. There is no proposed increase in land-landings at SLC-4 with the proposed action. There would be an increase of 12 land-landings at SLC-6 and 62 water landings associated with the proposed action over existing conditions.

Booster Roll-On-Roll-Off

SpaceX proposes to transport first stages and fairings from the Port of Long Beach to the VSFB Harbor via a “roll-on-roll-off” (RORO) barge. The first stage would be transferred from the droneship to SpaceX’s Self-Propelled Modular Transport (SPMT) that is positioned on a small, low draft barge. The first stage would be pulled by a tug using a Tier 3 (or better) engine from the Port of Long Beach into the VSFB Harbor. The first stage would then be driven off the barge by the SPMT and travel from VSFB Harbor to the hangar at SLC-4E, where it would be unloaded. A support tug would be launched from the Port of Hueneme or Port of Long Beach and travel up the coast to assist the barge and primary tug in maneuvering into and out of the VSFB Harbor, the exact arrival time would depend on tide. The SPMT would then be loaded back on to the barge and travel back to the Port of Long Beach. The support tug would then return to the Port of Hueneme or Port of Long Beach. The Proposed Action would include up to 100 events per year utilizing the RORO barge and tugs (an increase of 62 RORO events over existing conditions). Emissions were estimated using a spreadsheet model with emission factors based on the engine tier and activity data.

The 2024 EA (existing conditions) assumed that the marine vessels would operate up to 24 hours per day in each jurisdiction. Based on actual data from operations, these assumptions were not realistic and overly conservative. The route up the Santa Barbara Channel from POLB to VSFB Harbor is approximately 128 nautical miles. The primary tugboat is limited to 8 knots (for safety) when towing the barge and thus the trip up the Santa Barbara Channel would take at a minimum 16 hours. It is therefore not possible for the primary tugboat and barge to operate within Los Angeles County on the return leg in the same day (not accounting for offload time at VSFB harbor). As such, the marine vessels will be limited to 10.7 hours per day within Los Angeles County and 20 hours per day within Ventura County for the proposed action.

Payload Processing, Refurbishment, and Operations

Payloads and their associated materials/fuels/volumes are mission dependent but would be similar to current commercial and government payloads. In November 2011, NASA, with the USAF as a cooperating agency, prepared an EA for Launch of NASA Routine Payloads on Expendable Launch Vehicles (NASA 2011). SpaceX would continue to process payloads at existing SpaceX facilities, including Building 398, the SLC-4 hangar, and the SLC-6 hangar. Operations include refurbishing the recovered first stage and fairing for reuse in future missions. Up to four boosters and six fairings may be refurbished concurrently. With 70 Falcon 9 launches from SLC-4 and 25 Falcon 9 and 5 Falcon Heavy launches from SLC-6, up to 110 boosters and 100 fairings would be refurbished each year. Solvents such as isopropyl alcohol, isopar, and Simple Green would be used during these operations, as well for launch pad operations, facility maintenance, and system flushing. SpaceX recovers solvents in accordance with a solvent recovery plan and thus not all solvents used are emitted. There will be no increase in solvent use ROC emissions for the Proposed Action compared to existing conditions due to the recovery efforts in place. There will be offroad equipment used during operation to support launch operations. The equipment for the Proposed Action in excess of the existing conditions is shown in Table 9.

Table 9. Operational Off-Road Equipment – Proposed Action

Equipment List	Quantity	Hours Per Day
Aerial Lift	2	1
Forklifts	7	1
Off-Highway Trucks	2	1
Rough Terrain Forklifts	2	1

Source: AFCEC 2013.

2.6 Construction and Operation Emissions

Construction and operational emissions were estimated for the project and are discussed separately below. The proposed action will occur within three counties: Santa Barbara, Ventura, and Los Angeles. Santa Barbara County falls within the SBCAPCD's jurisdiction and has no nonattainment/maintenance areas. Construction under the Proposed Action and Alternative 1 takes place in Santa Barbara County while operation occurs within all three counties. Ventura County falls within the VCAPCD's jurisdiction and has only one nonattainment area. Los Angeles County falls within the SCAQMD's jurisdiction; however, Los Angeles County has multiple nonattainment and maintenance areas for the same criteria pollutant with differing severity classifications and boundaries. It was determined that the portion of Los Angeles County where the action will occur encompasses five nonattainment areas and two maintenance areas. Therefore, the air quality impact assessment is divided into three independent assessments (one for each county) to ensure that each nonattainment or maintenance area is evaluated separately as required under 40 CFR 93(e). For information purposes only, the total operational emissions for 100 launches is included.

2.6.1 SBCAPCD (Santa Barbara County)

Proposed Action

Construction of the Proposed Action would result in the temporary addition of pollutants to the local airshed caused by on-site sources (i.e., off-road construction equipment, soil disturbance) and off-site sources (i.e., haul trucks and worker vehicle trips). Construction emissions can vary substantially from day to day, depending on the level of activity; the specific type of operation; and, for dust, the prevailing weather conditions. Therefore, such emission levels can only be approximately estimated with a corresponding uncertainty in precise ambient air quality impacts.

As discussed previously, criteria air pollutant emissions associated with temporary construction activities were quantified using the ACAM. Annual construction emissions were calculated for the Proposed Action. Construction schedule assumptions, including phase type, duration, and sequencing, were based on information provided by the project applicant and are intended to represent a reasonable scenario based on the best information available.

Implementation of the Proposed Action would generate air pollutant emissions from entrained dust, off-road equipment, vehicle emissions, architectural coatings, and asphalt pavement application. Entrained dust results from the exposure of earth surfaces to wind from the direct disturbance and movement of soil, resulting in PM_{10} and $PM_{2.5}$ emissions.

Table 10 presents the estimated annual construction emissions generated during construction of the Proposed Action. Details of the emission calculations are provided in Attachment A (see ACAM Detail Report-Proposed Action).

Table 10. Estimated Annual Construction Criteria Air Pollutant Emissions, SBCAPCD – Proposed Action

Year	VOC	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$	Pb	NH_3
	Tons Per Year							
2025	0.10	1.07	1.03	<0.01	4.02	0.04	0.00	0.03
2026	1.95	3.07	2.69	0.01	1.87	0.10	0.00	0.10

Notes:
VOC = volatile organic compound; NO_x = oxides of nitrogen; CO = carbon monoxide; SO_x = sulfur oxides; PM_{10} = coarse particulate matter; $PM_{2.5}$ = fine particulate matter; Pb = lead; NH_3 = ammonia
See Attachment A for complete results. <0.01 = less than 0.005
Totals may not sum due to rounding.

Operation of the Proposed Action would generate criteria pollutant and HAP emissions from mobile sources, including vehicle trips from passenger vehicles and heavy-duty trucks, marine vessels, booster launches and landings, launch vehicle processing, and off-road equipment used for maintenance. Table 11 presents the annual operational emissions associated with up to 50 launches per year as described in Section 2.4.2.3 within Santa Barbara County. Details of the emission calculations are provided in Attachment A (see ACAM Detail Report-Proposed Action, Launch Emissions, SLC-4&6 – Emission Calculations – Proposed Action, SpaceX Marine Emissions Workbook SCCAB – Elizabeth C – Proposed Action, and SpaceX Marine Emissions Workbook SCCAB – Kelly C – Proposed Action). The Annual 50 Launch Operational Emissions scenario includes emergency generators, fleet vehicle use, vendor-contractor vehicles, and off-road equipment. The construction module within ACAM was used to indirectly estimate these emissions associated with these Operational Emissions for 50 launches per year.

Table 11. Annual ≤ 50 Launch Operational Emissions, SBCAPCD – Proposed Action

Emission Source	VOC	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$	Pb	NH_3
	Tons Per Year							
Emergency Generator	0.05	1.68	0.45	<0.01	0.05	0.05	0.00	0.00
Fleet Vehicle Use	0.08	0.04	0.46	<0.01	<0.01	<0.01	0.00	0.01
Vendor-Contractor Vehicles	0.10	0.05	0.62	<0.01	0.01	<0.01	0.00	0.01
Off-Road Equipment	0.79	6.59	9.31	0.02	0.22	0.21	0.00	0.00
RP-1, RSV Loading, and Payload Fueling	0.09	0.11	0.00	0.00	0.00	0.00	0.00	0.00
Roll-On-Roll-Off	2.35	28.14	41.75	0.56	0.60	0.60	0.01	0.00
Launch	0.00	7.35	0.00	0.00	0.00	0.00	0.00	0.00
Landings	0.00	0.34	0.00	0.00	0.00	0.00	0.00	0.00
Total	**3.46**	**44.30**	**52.59**	**0.58**	**0.88**	**0.86**	**0.01**	**0.02**

Notes:
VOC = volatile organic compound; NO_x = oxides of nitrogen; CO = carbon monoxide; SO_x = sulfur oxides; PM_{10} = coarse particulate matter; $PM_{2.5}$ = fine particulate matter; <0.01 = reported value less than 0.01; Pb = lead; NH_3 = ammonia
See Attachment A for complete results.
Totals may not sum due to rounding.

Table 12 presents the annual operational emissions associated with 100 launches within SBCAPCD. Details of the emission calculations are provided in Attachment C. The Annual 100 Launch Operational Emissions scenario starts after December 2026 and includes increases in solvent use, emergency generators, worker vehicles, fleet vehicle use, vendor-contractor vehicles, and off-road equipment due to increased personnel, additional standby power, and maintenance activities. The construction module within ACAM was used to indirectly estimate these emissions associated with these Operational Emissions for 100 launches per year.

Table 12. Annual ≤ 100 Launch Operational Emissions, SBCAPCD – Proposed Action

Emission Source	VOC	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$	Pb	NH_3
	Tons Per Year							
Solvent Use	5.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emergency Generators	1.35	13.29	5.37	0.93	1.27	1.27	0.00	0.00
Worker Vehicles	1.09	0.51	6.46	0.01	0.07	0.02	0.00	0.14
Fleet Vehicle Use	0.16	0.07	0.92	0.00	0.01	0.00	0.00	0.02
Vendor-Contractor Vehicles	0.21	0.10	1.24	0.00	0.01	0.00	0.00	0.03
Off-Road Equipment	2.10	17.92	25.26	0.06	0.53	0.49	0.00	0.00
RP-1, RSV Loading, and Payload Fueling	0.15	0.22	0.00	0.00	0.00	0.00	0.00	0.00
Roll-On-Roll-Off	4.72	56.60	83.95	1.13	1.20	1.20	0.01	0.00

Table 12. Annual ≤ 100 Launch Operational Emissions, SBCAPCD – Proposed Action

Emission Source	VOC	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$	Pb	NH_3
	Tons Per Year							
Launch	0.00	13.76	0.00	0.00	0.00	0.00	0.00	0.00
Landings	0.00	1.10	0.00	0.00	0.00	0.00	0.00	0.00
Total	**15.71**	**103.57**	**123.20**	**2.13**	**3.09**	**2.98**	**0.01**	**0.19**

Notes:
VOC = volatile organic compound; NO_x = oxides of nitrogen; CO = carbon monoxide; SO_x = sulfur oxides; PM_{10} = coarse particulate matter; $PM_{2.5}$ = fine particulate matter; <0.01 = reported value less than 0.01; Pb = lead; NH_3 = ammonia.
See Attachment C for complete results.
Totals may not sum due to rounding.

Alternative 1

Construction of Alternative 1 would result in the temporary addition of pollutants to the local airshed caused by on-site sources (i.e., off-road construction equipment, soil disturbance) and off-site sources (i.e., haul trucks and worker vehicle trips). Construction emissions can vary substantially from day to day, depending on the level of activity; the specific type of operation; and, for dust, the prevailing weather conditions. Therefore, such emission levels can only be approximately estimated with a corresponding uncertainty in precise ambient air quality impacts.

As discussed previously, criteria air pollutant emissions associated with temporary construction activities were quantified using the ACAM. Annual construction emissions were calculated for Alternative 1. Construction schedule assumptions, including phase type, duration, and sequencing, were based on information provided by the project applicant and are intended to represent a reasonable scenario based on the best information available.

Implementation of Alternative 1 would generate air pollutant emissions from entrained dust, off-road equipment, vehicle emissions, architectural coatings, and asphalt pavement application. Entrained dust results from the exposure of earth surfaces to wind from the direct disturbance and movement of soil, resulting in PM_{10} and $PM_{2.5}$ emissions.

Table 13 presents the estimated annual construction emissions generated during construction of Alternative 1. Details of the emission calculations are provided in Attachment A (see ACAM Detail Report-Alternative 1).

Table 13. Estimated Annual Construction Criteria Air Pollutant Emissions, SBCAPCD – Alternative 1

Year	VOC	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$	Pb	NH_3
	Tons Per Year							
2025	0.11	1.17	1.09	<0.01	4.19	0.04	0.00	0.03
2026	1.97	3.43	2.77	0.01	1.89	0.01	0.00	0.13

Notes:
VOC = volatile organic compound; NO_x = oxides of nitrogen; CO = carbon monoxide; SO_x = sulfur oxides; PM_{10} = coarse particulate matter; $PM_{2.5}$ = fine particulate matter; Pb = lead; NH_3 = ammonia
See Attachment A for complete results. <0.01 = less than 0.005
Totals may not sum due to rounding.

Operation of Alternative 1 would generate VOCs, NO_x, CO, SO_x, PM_{10}, and $PM_{2.5}$ emissions from mobile sources, including vehicle trips from passenger vehicles and heavy-duty trucks, marine vessels, booster launches and landings, launch vehicle processing, and off-road equipment used for maintenance. The operational emissions from Alternative 1 are identical to the Proposed Action shown in Tables 11 and Table 12.

2.6.2 VCAPCD (Ventura County)

Operation of the Proposed Action would generate criteria pollutant and HAP emissions from marine vessels. Table 14 presents the annual operational emissions associated with up to 50 launches per year as estimated as described in Section 2.4.2.3 within VCAPCD. Operational emissions for the Proposed Action and Alternative 1 are identical within Ventura County. See VCAPCD Summary – Elizabeth C – Proposed Action and VCAPCD Summary – Kelly C – Proposed Action in Attachment A for more details.

Table 14. Annual ≤ 50 Launch Operational Emissions, VCAPCD – Proposed Action and Alternative 1

Emission Source	VOC	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$	Pb	NH_3
	Tons Per Year							
Roll-On-Roll-Off	1.76	20.98	31.17	0.42	0.45	0.45	0.00	0.00

Notes: VOC = volatile organic compound; NO_x = oxides of nitrogen; CO = carbon monoxide; SO_x = sulfur oxides; PM_{10} = coarse particulate matter; $PM_{2.5}$ = fine particulate matter; <0.01 = reported value less than 0.01; Pb = lead; NH_3 = ammonia
See Attachment A for complete results.
Totals may not sum due to rounding.

Table 15 presents the annual operational emissions associated with 100 launches per year within VCAPCD. Details of the emission calculations are provided in Attachment C.

Table 15. Annual ≤ 100 Launch Operational Emissions, VCAPCD – Proposed Action and Alternative 1

Emission Source	VOC	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$	Pb	NH_3
	Tons Per Year							
Roll-On-Roll-Off	3.51	41.96	62.33	0.84	0.90	0.90	0.00	0.00

Notes:
VOC = volatile organic compound; NO_x = oxides of nitrogen; CO = carbon monoxide; SO_x = sulfur oxides; PM_{10} = coarse particulate matter; $PM_{2.5}$ = fine particulate matter; <0.01 = reported value less than 0.01; Pb = lead; NH_3 = ammonia.
See Attachment C for complete results.
Totals may not sum due to rounding.

2.6.3 SCAQMD (Los Angeles County)

Operation of the Proposed Action would generate VOCs, NO_x, CO, SO_x, PM_{10}, and $PM_{2.5}$ emissions from marine vessels, booster landing, and recovery operations within Los Angeles County. Table 16 presents the annual operational emissions associated with up to 50 launches per year as estimated as described in Section 2.4.2.3 within SCAQMD. Operational emissions for the Proposed Action and Alternative 1 are identical within Los Angeles County. See Launch Emissions-Proposed Action, SpaceX Marine Emissions Workbook SCAB – Elizabeth C – Proposed Action, and SpaceX Marine Emissions Workbook SCAB – Kelly C – Proposed Action in Attachment A for more details.

Table 16. Annual ≤ 50 Launch Operational Emissions, SCAQMD – Proposed Action and Alternative 1

Emission Source	VOC	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$	Pb	NH_3
	Tons Per Year							
Roll-On-Roll-Off	1.07	12.96	19.18	0.25	0.28	0.28	0.00	0.00
Booster and Payload Fairing Recovery	0.21	1.05	0.44	0.17	0.08	0.08	0.00	0.00
Total	**1.28**	**14.01**	**19.62**	**0.42**	**0.36**	**0.36**	**0.00**	**0.00**

Notes:
VOC = volatile organic compound; NO_x = oxides of nitrogen; CO = carbon monoxide; SO_x = sulfur oxides; PM_{10} = coarse particulate matter; $PM_{2.5}$ = fine particulate matter; <0.01 = reported value less than 0.01; Pb = lead; NH_3 = ammonia;
See Attachment A for complete results.
Totals may not sum due to rounding. Emissions shown in parentheses represent net negative values.

Table 17 presents the annual operational emissions associated with 100 launches per year within SCAQMD. Details of the emission calculations are provided in Attachment C.

Table 17. Annual ≤ 100 Launch Operational Emissions, SCAQMD – Proposed Action and Alternative 1

Emission Source	VOC	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$	Pb	NH_3
	Tons Per Year							
Roll-On-Roll-Off	2.19	26.81	39.52	0.51	0.59	0.59	0.00	0.00
Booster and Payload Fairing Recovery	0.35	1.77	0.74	0.27	0.13	0.13	0.00	0.00
Total	**2.54**	**28.58**	**40.26**	**0.78**	**0.72**	**0.72**	**0.00**	**0.00**

Notes:
VOC = volatile organic compound; NO_x = oxides of nitrogen; CO = carbon monoxide; SO_x = sulfur oxides; PM_{10} = coarse particulate matter; $PM_{2.5}$ = fine particulate matter; <0.01 = reported value less than 0.01; Pb = lead; NH_3 = ammonia.
See Attachment C for complete results.
Totals may not sum due to rounding. Emissions shown in parentheses represent net negative values.

2.7 Air Quality Impact Assessment

The air quality impact assessment is an annual net-change in emissions analysis for each ROI for the year before (pre-Proposed Action) through the completion of the Proposed Action. An annual net-change in emissions analysis (which is a GCR Applicability Analysis for actions occurring within nonattainment/maintenance areas) is an evaluation of the total action-related annual increased emissions (direct and indirect emissions) of criteria pollutant (or their precursors) combined with the total action-related annual decreased emissions, resulting in an overall annual net change in emissions for the entire action. The Proposed Action's worst-year (highest emission year) annual net change in emissions for each criteria pollutant (or precursors) are screened against the applicable insignificance indicators or thresholds (GCR de minimis values). If the results of all of the annual net-change in emissions analyses indicate all criteria pollutants (or precursors) are below the insignificance indicators or thresholds, the action is considered to have an insignificant impact on air quality for both NEPA and General Conformity. If the results of any of the annual net-change emissions analyses indicate one or more criteria pollutants (or precursors) are equal to or above the insignificance indicators or thresholds, the action is considered to have a potentially significant impact on air quality and further assessment is required and a GCR Determination is required if a de minimis threshold is exceeded.

For air quality, DAF considers this Proposed Action as effectively an expansion of the previous action for up to 50 launches as described in the 2024 EA (≤ 50 Launches) and the associated 2025 GCR Determination for action related activities within the Los Angeles-South Coast Air Basin Ozone Extreme Nonattainment Area. Therefore, the air quality impact assessments for each ROI will be based on up to 100 launches (≤ 100 Launches, 50 previous and 50 new with this action) and will be evaluated from ≤ 2024 (pre-Proposed Action) through ≥ 2027 (completed Proposed Action).

As of the 2024 EA and 2025 GCR Determination, SpaceX can perform up to 50 launches per year. According to the Draft EIS, the estimated future launch frequency associated with the Proposed Action is up to 70 launches in 2025, up to 82 launches in 2026, and up to 100 launches in 2027. Therefore, given the frequency of launches increases each year, there will be an increase in emissions each year; therefore, the annual net-change in emissions analysis for each ROI was conducted for ≤ 2024, 2025, 2026, and ≥ 2027.

Note that due to construction timelines projected to be complete in November 2026 (10 months of 2026), a more likely estimated future launch frequency associated with the Proposed Action is up to 50 launches in 2025, up to 58 (10 months at 50/yr and 2 months at 100/yr) launches in 2026, and up to 100 launches in 2027; however, the estimated future launch frequency (70 in 2025, ≥82 in 2026, and ≥100 in 2027) as stated in the Draft EIS was used in this analysis because it provides a worse-case scenario that is more conservative toward protection of human health and the environment.

2.7.1 SBCAPCD (Santa Barbara County)

Proposed Action

Projected criterial pollutant (or precursor) emissions within the SBCAPCD for the Proposed Action are summarized in Table 18. None of the annual action-related projected criterial pollutant (or precursor) emissions for the Proposed Action would exceed the DAF insignificance thresholds; accordingly, within SBCAPCD (Santa Barbara County) the Proposed Action impact on air quality would be insignificant and would not have an adverse effect on air quality.

Table 18. SBCAPCD Annual Net Change in Emission – Proposed Action

Year	Emission Source	VOC	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$	Pb	NH_3
		Tons Per Year (tpy)							
2025	Existing Operational (at ≤50 launches)	3.46	44.3	52.59	0.58	0.88	0.86	0.01	0.02
	Construction	0.10	1.067	1.029	0.003	4.02	0.035	0	0.026
	Total	**3.56**	**45.37**	**53.62**	**0.58**	**4.90**	**0.90**	**0.01**	**0.05**
2026	83% Existing Operational (at ≤50 launches)[a]	2.88	36.92	43.83	0.48	0.73	0.72	0.01	0.02
	17% New Operational (at ≤100 launches) [b]	2.62	17.26	20.53	0.36	0.52	0.50	0.00	0.03
	Construction	1.95	3.07	2.69	0.01	1.87	0.10	0.00	0.10

Year	Emission Source	VOC	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$	Pb	NH_3
		Tons Per Year (tpy)							
	Total	**7.46**	**57.25**	**67.05**	**0.85**	**3.11**	**1.31**	**0.01**	**0.15**
≥ 2027	New Operational (at ≤100 launches)	15.71	103.57	123.2	2.13	3.09	2.98	0.01	0.19
DAF Insignificance Thresholds (tpy)		**250**	**250**	**250**	**250**	**250**	**250**	**25**	**250**
Year/s Threshold Exceeded		**None**	**None**	**None**	**None**	**None**	**None**	**None**	**None**

Notes:
VOC = volatile organic compound; NOx = oxides of nitrogen; CO = carbon monoxide; SOx = sulfur oxides; PM10 = coarse particulate matter; PM2.5 = fine particulate matter; <0.01 = reported value less than 0.01; Pb = lead; NH3 = ammonia; DAF = Department of the Air Force
Totals may not sum due to rounding.
Construction Emissions taken from Table 10
Existing (≤50 launches) and New (≤100 launches) Operational Emissions taken from Tables 11 and 12
[a] Emissions extrapolated from ≤50 launches scenarios for 10 out of 12 months (83%)
[b] Emissions extrapolated from ≤100 launches scenarios for 2 out of 12 months (17%)

Alternative 1

Projected criteria pollutant (or precursor) emissions within the SBCAPCD for Alternative 1 are summarized in Table 19. The annual action-related emissions (or precursor) for Alternative 1 would not exceed any of the DAF insignificance thresholds; therefore, within SBCAPCD (Santa Barbara County) the impact of Alternative 1 on air quality would be insignificant and would not result in adverse effect on air quality.

Table 19. SBCAPCD Annual Net Change in Emission – Alternative 1

Year	Emission Source	VOC	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$	Pb	NH_3
		Tons Per Year (tpy)							
2025	Existing Operational (at ≤50 launches)	3.46	44.3	52.59	0.58	0.88	0.86	0.01	0.02
	Construction	0.11	1.17	1.09	0.00	4.19	0.04	0.00	0.03
	Total	**3.57**	**45.47**	**53.68**	**0.58**	**5.07**	**0.90**	**0.01**	**0.05**
2026	83% Existing Operational [a] (at ≤50 launches)	2.88	36.92	43.83	0.48	0.73	0.72	0.01	0.02
	17% New Operational [b] (at ≤100 launches)	2.62	17.26	20.53	0.36	0.52	0.50	0.00	0.03
	Construction	1.97	3.43	2.77	0.01	1.89	0.10	0.00	0.13
	Total	**7.47**	**57.61**	**67.13**	**0.85**	**3.13**	**1.32**	**0.01**	**0.18**
≥ 2027	New Operational (at ≤100 launches)	15.71	103.57	123.2	2.13	3.09	2.98	0.01	0.19
DAF Insignificance Thresholds (tpy)		**250**	**250**	**250**	**250**	**250**	**250**	**25**	**250**
Year/s Threshold Exceeded		**None**	**None**	**None**	**None**	**None**	**None**	**None**	**None**

Notes:
VOC = volatile organic compound; NOx = oxides of nitrogen; CO = carbon monoxide; SOx = sulfur oxides; PM10 = coarse particulate matter; PM2.5 = fine particulate matter; <0.01 = reported value less than 0.01; Pb = lead; NH3 = ammonia; DAF = Department of the Air Force

Totals may not sum due to rounding.
Construction Emissions taken from Table 13
Existing and New Operational Emissions taken from Tables 14 and 15
[a] Emissions extrapolated from ≤50 launches scenarios for 10 out of 12 months (83%)
[b] Emissions extrapolated from ≤100 launches scenarios for 2 out of 12 months (17%)

2.7.2 VCAPCD (Ventura County)

Projected criteria (or precursor) emissions within the VCAPCD for the Proposed Action and Alternative 1 are summarized in Table 20. The annual action-related criteria pollutant (or precursor) emissions for the Proposed Action or Alternative 1 would not exceed the DAF insignificance thresholds, Therefore, within VCAPCD (Ventura County) the impact of the Proposed Action or Alternative 1 on air quality would be insignificant and would not have an adverse effect on air quality.

Table 20. VCAPCD Annual Net Change in Emission – Proposed Action and Alternative 1

Year	Emission Source	VOC	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$	Pb	NH_3
		Tons Per Year (tpy)							
2025	Existing Roll-On-Roll-Off (at ≤50 launches)	1.76	20.98	31.17	0.42	0.45	0.45	0.00	0.00
2026	83% Existing Roll-On-Roll-Offa (at ≤50 launches)	1.47	17.48	25.98	0.35	0.38	0.38	0.00	0.00
	17% New Roll-On-Roll-Offb (at ≤100 launches)	0.70	6.99	10.39	0.14	0.15	0.15	0.00	41.67
	Total	2.17	24.48	36.36	0.49	0.53	0.53	0.00	41.67
≥ 2027	New Roll-On-Roll-Off (≤100 launches)	3.51	41.96	62.33	0.84	0.9	0.9	0	0
DAF Insignificance Thresholds (tpy)		**50***	**50***	**250**	**250**	**250**	**250**	**25**	**250**
Year/s Threshold Exceeded		**None**	**None**	**None**	**None**	**None**	**None**	**None**	**None**

Notes:
VOC = volatile organic compound; NOx = oxides of nitrogen; CO = carbon monoxide; SOx = sulfur oxides; PM10 = coarse particulate matter; PM2.5 = fine particulate matter; <0.01 = reported value less than 0.01; Pb = lead; NH3 = ammonia; DAF = Department of the Air Force
Totals may not sum due to rounding.
Existing and New Rol-On-Roll-Off Emissions taken from Tables 16 and 17
[a] Emissions extrapolated from ≤50 launches scenarios for 10 out of 12 months (83%)
[b] Emissions extrapolated from ≤100 launches scenarios for 2 out of 12 months (17%)

2.7.3 SCAQMD (Los Angeles County)

Projected criteria pollutant (or precursor) emissions within the SCAQMD (Los Angeles County) for the Proposed Action and Alternative 1 are summarized in Table 21. The annual action-related criteria pollutant (or precursor) emissions for the Proposed Action or Alternative 1 would not exceed the DAF insignificance thresholds for VOC, CO, SOx, PM10, PM2.5, Pb, or NH3. However, emissions of NOx would exceed the DAF insignificance threshold for every year of the action. Given the area is a nonattainment area for NOx, the DAF insignificance threshold for NOx is actually a GCR de minimis value; as such, a GCR Determination is necessary to demonstrate if the Proposed Action and Alternative 1 would have an adverse effect on air quality within SCAQMD (Los Angeles County).

Table 21. SCAPCD Annual Net Change in Emission – Proposed Action and Alternative 1

Year	Emission Source	VOC	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$	Pb	NH_3
		Tons Per Year (tpy)							
2025	Existing Roll-On-Roll-Off (at ≤50 launches)	1.07	12.96	19.18	0.25	0.28	0.28	0.00	0.00
	Existing Booster/Payload Fairing Recovery (at ≤50 launches)	0.21	1.05	0.44	0.17	0.08	0.08	0.00	0.00
	Total	**1.28**	**14.01**	**19.62**	**0.42**	**0.36**	**0.36**	**0.00**	**0.00**
2026a	83% Existing Roll-On-Roll-Offa (at ≤50 launches)	0.89	10.80	15.98	0.21	0.23	0.23	0.00	0.00
	17% New Roll-On-Roll-Offb (at ≤100 launches)	0.37	4.47	6.59	0.09	0.10	0.10	0.00	0.00
	83% Existing Booster/ Payload Fairing Recoverya (at ≤50 launches)	0.18	0.88	0.37	0.14	0.07	0.07	0.00	0.00
	17% New Booster/ Payload Fairing Recoveryb (at ≤100 launches)	0.06	0.30	0.12	0.05	0.02	0.02	0.00	0.00
	Total	**1.49**	**16.44**	**23.06**	**0.48**	**0.42**	**0.42**	**0.00**	**0.00**
≥ 2027	New Roll-On-Roll-Off (at ≤100 launches)	2.19	26.81	39.52	0.51	0.59	0.59	0	0
	New Booster/ Payload Fairing Recovery (at ≤100 launches)	0.35	1.77	0.74	0.27	0.13	0.13	0.00	0.00
	Total	**2.54**	**28.58**	**40.26**	**0.78**	**0.72**	**0.72**	**0.00**	**0.00**
DAF Insignificance Thresholds (tpy)		**10***	**10***	**100***	**250**	**100***	**70***	**25***	**70***
Year/s Threshold Exceeded		**None**	**ALL**	**None**	**None**	**None**	**None**	**None**	**None**

Notes:
VOC = volatile organic compound; NOx = oxides of nitrogen; CO = carbon monoxide; SOx = sulfur oxides; PM10 = coarse particulate matter; PM2.5 = fine particulate matter; <0.01 = reported value less than 0.01; Pb = lead; NH3 = ammonia
DAF = Department of the Air Force
* Indicate the DAF Insignificance Threshold or actually a GCR de minimis value
Totals may not sum due to rounding.
Existing and New Roll-On-Roll-Off and Booster/Payload Fairing Recovery Emissions taken from Tables 18 and 19
[a] Emissions extrapolated from ≤50 launches scenarios for 10 out of 12 months (83%)
[b] Emissions extrapolated from ≤100 launches scenarios for 2 out of 12 months (17%)

2.8 General Conformity Analysis

There are two progressive levels of GCR assessments and documentation under a General Conformity Evaluation: an Applicability Analysis and a Determination. A GCR Applicability Analysis is first an exemption review and then, if the Proposed Action is not exempt, a quantitative net-change in emissions analysis. The net-change in emissions analysis is used to determine if the Federal action must be supported by a GCR Determination. A GCR Determination is an extensive evaluation (made after a GCR Applicability Analysis indicates a Determination is needed) to ensure a proposed action "conforms" to the applicable State Implementation Plan (SIP) and meets all GCR requirements. Additionally, a GCR Reevaluation is required if any modification to the action would result in emissions above one or more GCR de minimis values (40 CFR 93.157).

2.8.1 GCR Reevaluation

A GCR Reevaluation is required if any modification to the action would result in emissions above one or more GCR de minimis values (40 CFR 93.157). A Revised GCR Applicability Analysis is performed to evaluate if GCR de minimis values would be exceeded.

For air quality, DAF considers this Proposed Action and Alternative 1 as effectively a continuation and an expansion of the previous actions associated with Falcon 9 launch cadence increases at VSFB. Based on the previous EAs and SEAs, the increases in launch cadence emissions were below the GCR de minimis values until the increase was up to 50 launches per year as described in the 2024 EA and the associated 2025 GCR Determination. Given the launch cadence prior to 2024 had insignificant impacts on air quality and were below the GCR de minimis value, reevaluation prior to the 2024 increased cadence is unwarranted.

A GCR Determination was already established for the action in the 2024 EA (2025 GCR Determination) through allowances provided by SCAQMD of 31.26 tpy of NOx for 2025 through 2030 and accommodated within the 2016 AQMP budget. The requirement of 31.26 tpy of NOx was based on the uncertainty and best available information at the time; however, with additional data collected for tugboat routing and operational times, it has since been demonstrated that the assumptions used were unrealistic and excessively conservative. Given this Proposed Action and Alternative 1 are effectively a continuation and an expansion of the previous actions associated with Falcon 9 launch cadence increases at VSFB, the following GCR Reevaluation was performed.

2.8.2 Revised GCR Applicability Analysis

The USEPA's General Conformity Rule (40 CFR part 93, Subpart B, and 40 CFR Part 51, Subpart W, as adopted by reference in SCAQMD Rule 1901, September 1994) establishes a GCR Applicability Analysis for ascertaining which Federal actions are subject to the General Conformity requirements for nonattainment or maintenance areas.

Applicability analysis is the process of determining if a Federal action must be supported by a GCR Determination. A GCR Applicability Analysis is the first of two progressive levels of a GCR evaluation which starts with an exemption review and (if no exceptions apply) followed by a quantitative emission net-change analysis. If the proposed action is exempt from or is already presumed to conform under the GCR, no further action is required. If there is no exemption, a formal quantitative GCR Applicability Analysis is required. The GCR Applicability Analysis is a quantitative annual net change in emissions assessment, where the projected net emissions are compared against regulatory thresholds (GCR de minimis value) which, if exceeded, triggers a GCR Determination (the second progressive level of a GCR evaluation).

GCR de minimis emission levels are criteria pollutant (or its precursors) emission rates (levels) that are too low to cause or contribute to exceeding one or more NAAQS. NAAQSs are the maximum amount of a criteria pollutant (or its precursors), averaged over a specified regional area and period of time (year), that can be present in outdoor air without harming public health and the environment. Therefore, any action resulting in annual net change emissions (direct and indirect) below the de minimis levels is considered clearly insignificant to public health and the environment locally, regionally, and cumulatively.

Table 22. Revised GCR Applicability Analysis Results for Worst-Case Year

Designated Area		Annual Net Change in Emissions (tpy)	De Minimis Value (tpy)	Analysis Results
SBCAPCD (Santa Barbara Co.)	None	N/A	N/A	In Attainment
VCAPCD (Ventura Co.)	Ventura County Serious 8-Hour Ozone (2008 & 2015 NAAQSs)	VOC = 3.51 NOx = 41.96	50 50	De Minimis
SCAQMD (Los Angeles Co.)	Los Angeles-South Coast Air Basin 8-Hour Ozone Extreme Nonattainment Area (2008 and 2015 NAAQSs)	VOC = 2.54 NOx = 28.58	10 10	Exceeds De Minimis for NOx (O_3 precursor)
	Los Angeles-South Coast Air Basin PM-2.5 Serious Nonattainment Area (2006 & 2012 NAAQSs)	PM-10 = 0.72	100	De Minimis
	Los Angeles-South Coast Air Basin PM-10 Serious Maintenance Area (1987 NAAQS)	PM-10 = 0.72	70	De Minimis
	Los Angeles-South Coast Air Basin Pb Nonattainment Area (2008 NAAQS)	Pb = 0.00	25	De Minimis
	Los Angeles-South Coast Air Basin CO Maintenance Area (1971 NAAQS)	CO = 40.26	100	De Minimis

Notes:
GCR de minimis values from 40 CFR 51.853 and 40 CFR 93.153(b)(1).
Table includes ozone precursors (i.e., VOC and NOx).
Data Source: *Draft Environmental Impact Statement for Authorizing Changes to the Falcon Launch Program at Vandenberg Space Force Base, California* (February 2025)

As part of the air quality analysis in section 2.7 of this Technical Report, a GCR Applicability Analysis was reperformed for each nonattainment and maintenance area where the Proposed Action will occur within. The previous air quality assessment (2024 EA and 2025 GCR Determination) was based on overly conservative assumptions on tugboat routing and operational times that have since been demonstrated to be unrealistic. Therefore, for this expanded assessment the assumptions have been revised to be more in line with operation limits expected in future permitting, while still being very conservative. As a result, this air quality assessment used the revised assumptions for estimating projected emissions.

Based on the revised GCR Applicability Analyses results, only one nonattainment area, Los Angeles-South Coast Air Basin 8-Hour Ozone Extreme Nonattainment Area (2008 & 2015 NAAQSs), exceeded the GCR de minimis levels (see Table 22). Therefore, only the Los Angeles-South Coast Air Basin 8-Hour Ozone Extreme Nonattainment Area requires a GCR Determination.

As shown in Table 23 the net change in annual emissions of the Proposed Action will not exceed the GCR de minimis levels for VOC, CO, PM10, or PM2.5 in the Los Angeles-South Coast Air Basin (within the SCAQMD). However, due to increased harbor operations, NOx emissions would exceed the GCR de minimis threshold value. As such, a revised look at the 2025 GCR Determination is necessary to determine if the Proposed Action would have an adverse effect on air quality within the Los Angeles-South Coast Air Basin 8-Hour Ozone Extreme Nonattainment Area.

Table 23. Net Change in Emission Analysis for Activities within the Los Angeles-South Coast Air Basin

Source	Annual Emissions (tons per year)						
	VOC	NO_x	CO	SO_x	PM10	PM2.5	Pb
Proposed Action (≤ 100 operations)	2.54	28.58	40.26	0.78	0.72	0.72	0.00
De Minimis Value or DAF Insignificance Indicator*	10	10	100	250*	100	70	25
Threshold Exceeded	**No**	**Yes**	**No**	**No**	**No**	**No**	**No**

Notes:
Table includes ozone precursors (i.e., VOC and NOx).
* indicates the value is a DAF Insignificance Indicator (not a GCR de minimis value).
GCR de minimis values from 40 CFR 51.853 and 40 CFR 93.153(b)(1).
Environmental Impact Statement for Authorizing Changes to the Falcon Launch Program at Vandenberg Space Force Base, California (February 2025)

2.8.3 GCR Determination

The USEPA's General Conformity Rule (40 CFR part 93, Subpart B, and 40 CFR Part 51, Subpart W, as adopted by reference in SCAQMD Rule 1901, September 1994) also establishes a GCR Determination evaluation (made after a GCR Applicability Analysis is completed) for ascertaining if a Federal action conforms to the applicable SIP and meets the requirements of the GCR.

In accordance with 40 CFR 51.850(b) "a Federal agency must make a Determination that a Federal action conforms to the applicable implementation plan." Additionally, as defined in 40 CFR 51.852, an "applicable implementation plan or applicable SIP means the portion (or portions) of the SIP or most recent revision thereof, which has been approved under section 110 of the Act, or promulgated under section 110(c) of the Act (Federal implementation plan), or promulgated or approved pursuant to regulations promulgated under section 301(d) of the Act and which implements the relevant requirements of the Act."

For any criteria pollutant, conformity to the applicable SIP can be demonstrated by showing (through existing documentation) that the total direct and indirect emissions caused by the action are specifically identified and accounted for in the applicable SIP. Where the actions are specifically identified and accounted for in the SIP, the GCR demonstration can be easy and straightforward – the Federal agency would only have to document the information in the SIP. In the cases where the emissions caused by the action are not specifically identified in the SIP, but are included in an emission budget category, the Federal agency can demonstrate conformity by having the applicable State or local air quality agency provide a written Statement documenting that the emissions caused by the action along with all other emissions in the area will not exceed the budget for those emissions in the SIP.

Specifically for ozone, as is the case for this Proposed Action, where USEPA has approved a revision to the applicable SIP, 40 CFR 51.858(a)(5)(i)(A) and 40 CFR 93.158(a)(5)(i)(A) enable a GCR Determination with documentation by the State when the result in a level of emissions which, together with all other emissions in the nonattainment (or maintenance) area, would not exceed the emissions budgets specified in the applicable SIP.

2.8.4 GCR Determination Need

Within the SCAQMD's ozone nonattainment area, the Proposed Action exceeds the GCR Applicability Analysis de minimis threshold for NOx beginning in the year of 2025 at 10.84 tpy and increasing in 2027 to a steady-state of 28.58 tpy for the lifetime of the project. Given the GCR Applicability Analysis indicated the annual net change in NOx emissions will exceed the 10 tpy de minimis value, a GCR Determination reevaluation was required for NOx emissions within the Los Angeles-South Coast Air Basin Extreme Ozone Nonattainment Area. The GCR Determination was completed in accordance with CAA Sec. 176(c) [42 U.S.C. Sec. 7506(c)], as implemented in the SCAQMD Rule 1901.

2.8.5 SCAQMD Determination Documentation

As stated earlier, for ozone, 40 CFR 51.858(a)(5)(i)(A), and 40 CFR 93.158(a)(5)(i)(A), enable a GCR Determination with documentation by the State when the result in a level of emissions which, together with all other emissions in the nonattainment (or maintenance) area, would not exceed the emissions budgets specified in the applicable SIP.

The 2016 AQMP, which is the latest plan approved by USEPA, established set-aside budgets to accommodate emissions subject to GCR requirements. The set-aside accounts include 730 tpy of NOx each year starting in 2017 through 2030 and 182.5 tpy of NOx each year in 2031 and thereafter. The SCAQMD reviewed the emissions anticipated from the 2024 EA (≤50 launches per year) based on the overly-conservative emissions calculations used at that time and information provided by SLD-30. Upon review of the provided overly-conservative emissions information, on September 26, 2024, the SCAQMD provided a letter to SLD-30 (SCAQMD 2024) documenting their GCR Determination for the 2024 EA's Proposed Action. SCAQMD "determined that the NOx emissions (31.26 tpy) exceeding the de minimis thresholds can be accommodated within the general conformity budgets established in the 2016 AQMP." SCAQMD concluded that the 2024 EA's Proposed Action "will conform to the latest EPA approved AQMP as the project's emissions are accommodated within the AQMP's emissions budgets, and the proposed project is not expected to result in any new or additional violations of the NAAQS or impede the projected attainment of the NAAQS in the years 2025 through 2030." Therefore, SCAQMD determined and documented the 2024 EA's Proposed Action conforms with the applicable SIP, as defined in 40 CFR 51.852, in the years 2025 through 2030.

Table 24. 2024 EA's Proposed Action NOx Emissions Accommodated within the 2016 AQMP Emissions Budgets (tpy)

2025	2026	2027	2028	2029	2030	2031
31.26	31.26	31.26	31.26	31.26	31.26	Attainment Year*

* 2016 AQMP Table ES-1

2.8.6 Reevaluation of GCR Determination

As stated previously, the previous air quality assessment (2024 EA and 2025 GCR Determination) was based on overly conservative assumptions on tugboat routing and operational times that have since been demonstrated to be unrealistic. Therefore, for this reevaluation the assumptions have been revised to be more in line with operation limits expected in future permitting, while still being very conservative. As a result, this air quality assessment used the revised assumptions for estimating projected emissions for this reevaluation of the GCR Determination.

Table 25. Net Change in Emissions within the Los Angeles-South Coast Air Basin with the 2016 AQMP Allocation (Starting in 2025)

Source	Annual Emissions (tons per year)						
	VOC	NO_x	CO	SO_x	PM10	PM2.5	Pb
Proposed Action (100 operations)	2.54	28.58	40.26	0.78	0.72	0.72	0.00
2016 AQMP General Conformity Budget Emissions from SCAQMD	0.00	-31.26	0.00	0.00	0.00	0.00	0.00
Net Change Delta (Proposed Action – 2016 AQMP Budget)	2.54	-2.68	40.26	0.78	0.72	0.72	0.00
De Minimis Value or DAF Insignificance Indicator*	10	10	100	250*	100	70	25
Threshold Exceeded	No	No	No	No	No	No	No

Notes:
Table includes ozone precursors (i.e., VOC and NOx).
* indicates the value is a DAF Insignificance Indicator (not a GCR de minimis value).
Data Source: Environmental Assessment for the Falcon 9 Cadence Increase at Vandenberg Space Force Base (DAF 2024)

Based on the allowances provided by SCAQMD of 31.26 tpy of NOx for 2025 through 2030 accommodating the Proposed Action within the 2016 AQMP budget and the 2016 AQMP's attainment year of 2031, the net change in NOx emissions within the Los Angeles-South Coast Air Basin 8-Hour Ozone Extreme Nonattainment Area is deemed to be -2.86 tpy. The proposed NOx emissions are still fully accounted for within the 2016 AQMP (see Table 25). Therefore, the Proposed Action would still be in compliance with 42 U.S.C. § 7506(c) and the applicable implementing rules and regulations in the Los Angeles non-attainment area.

2.8.7 GCR Findings and Conclusion

Based on SCAQMD's documented 31.26 tpy of NOx allowance for 2025 through 2030 accommodating the Proposed Action within the 2016 AQMP budget and the 2016 AQMP's attainment year of 2031, in accordance with 40 CFR 51.850(b) the Proposed Action will conform with the applicable SIP and will not have a significant adverse impact on air quality. The Proposed Action conforms to the applicable SIP for NOx (as an ozone precursor) because the net emissions associated with the action, taken together with all other NOx emissions in the SCAB, would not exceed the emissions budgets in the approved SIP for the years subject to the GCR evaluation.

Therefore, DAF herewith concludes that the Proposed Action complies with the requirements of the GCR regulations and conforms to applicable SIP based on the NOx emissions are accommodated in the set-aside emission budgets in the 2016 AQMP.

2.8.8 GCR Reporting

To support a decision concerning the Proposed Action, the DAF is amending the 2025 GCR Determination demonstrating that the net annual increase in NOx emissions associated with up to 100 launches conforms to applicable SIP based on the NOx emissions are accommodated in the set-aside emission budgets in the 2016 AQMP. DAF will issue a draft Amended GCR Determination for public review and comment. The DAF will also make public its final Amended GCR Determination for the Proposed Action.

Draft GCR Determination:

The DAF will be providing copies of the draft GCR Determination to the appropriate regional offices of USEPA, CARB, SCAQMD, and tribes, providing an opportunity for a 30-day review. The DAF will also place a notice in the Los Angeles Times, a daily newspaper of general circulation in the area affected by the action, announcing the availability of this draft Amended GCR Determination and requesting written public comments for a 30-day period. Additionally, the DAF will provide a copy of the draft Amended GCR Determination to any member of the public requesting a copy.

Final GCR Determination:

The DAF will provide copies of its final Amended GCR Determination to the appropriate regional offices of USEPA, CARB, SCAQMD, and tribes, within 30 days of its promulgation. The DAF will also place a notice in the Los Angeles Times, a daily newspaper of general circulation in area affected by the action, announcing the availability of its final Amended GCR Determination within 30 days of such determination. As part of the GCR evaluation, the DAF will document its responses to all comments received on the draft Amended GCR Determination in the final Amended GCR Determination.

2.9 No Action Alternative

Under the No Action Alternative, modifications of SLC-6 and increased Falcon launch would not occur, resulting in no impacts on air quality, beyond those described in the 2024 EA.

3 Greenhouse Gases

3.1 Environmental Setting

A greenhouse gas (GHG) is any gas that absorbs infrared radiation in the atmosphere; in other words, GHGs trap heat in the atmosphere. Some GHGs, such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), occur naturally and are emitted into the atmosphere through natural processes and human activities. Of these gases, CO_2 and CH_4 are emitted in the greatest quantities from human activities. Manufactured GHGs, which have a much greater heat-absorption potential than CO_2, include fluorinated gases, such as hydrochlorofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6), which are associated with certain industrial products and processes. While there are many other GHGs, for the purpose of NEPA GHG assessments, the only speciated GHGs accounted for are CO_2, CH_4, and N_2O. These three speciated GHGs account for greater than 97% of U.S. total GHG emissions; therefore, using only these three GHGs allows for making a reasoned choice among alternatives.

CO_2 is the primary anthropogenic (human-caused) GHG and has been established as the reference gas to demonstrate the relative effect of different GHGs of equal mass. The effect that each of the GHGs has on global warming is the product of the mass of their emissions and their global warming potential (GWP). GWP indicates how much a gas is predicted to contribute to global warming relative to how much warming would be predicted to be caused by the same mass of CO_2. For example, methane and nitrous oxide are substantially more potent GHGs than CO_2, with GWPs of 28 and 265 times that of CO_2 respectively, which has a GWP of 1, as the reference gas.

In emissions inventories, GHG emissions are typically reported as metric tons (MT) of CO_2 equivalent (CO_2e). CO_2e is calculated as the product of the mass emitted of a given GHG and its specific GWP.

$$CO_2e = (\text{metric tons of a GHG}) \times (\text{GWP of the GHG})$$

Rocket Launch GHG Emissions

An emerging area of study of rocket launches is the potential effects to ozone and emissions in the upper atmosphere. Scientific literature on this topic is limited and the science itself is poorly understood, and in some cases not yet studied (World Meteorological Organization 2022). Much of the body of literature concerning potential environmental impacts of rockets relates to solid rocket motors, which Falcon 9 and Falcon Heavy do not use. The limited studies of emissions from rocket engines using liquid propellent reveal that while they do result in some stratospheric ozone loss, solid rocket motors are responsible for orders of magnitude greater loss (Dallas et al 2020). The World Meteorological Organization's 2022 Scientific Assessment of Ozone Depletion noted rocket launches presently have a small effect on total stratospheric ozone (much less than 0.1% (World Meteorological Organization 2022). This report also states that "Many of the impacts of rocket activity involve chemistry and radiative interactions that are poorly understood and, in some cases, not yet studied. The uncertainties in these processes and in any potential new emission sources limit the confidence level of predictions of present and future impacts of space industry emissions on stratospheric ozone."

A paper titled Impact of Rocket Launch and Space Debris Air Pollutant Emissions on Statospheric Ozone and Global Climate (Ryan et al 2022) analyzed potential impacts of space tourism that included daily suborbital launches by

Virgin Galactic and Blue Origin and weekly orbital launches by SpaceX (782 annual launches). The paper concluded the following

- The greatest impact of a decade of emissions on ozone in this scenario would be in the upper stratosphere in northern high latitudes. Loss rates of ozone based on 2019 emissions are due mostly to NOx from reentry heating (51%) and chlorine from solid rocket motors (49%).
- Black carbon injected into the upper atmosphere has a greater climate forcing efficiency than other sources.
- Large uncertainties need to be addressed to further enhance our understanding of the true impact of contemporary rocket launch and re-entry heating emissions on atmospheric composition and climate.

In September 2022, the United States Government Accountability Office ("GAO") released a Technology Assessment that includes discussion of the black carbon emissions (GAO 2022). The GAO relied on extensive scientific outreach to compile its report. To conduct this technology assessment, GAO reviewed technical studies, agency documents, and other key reports; interviewed government officials, industry representatives, and researchers; and convened a 2-day meeting of 15 experts from government, industry, academia, and a federally funded research and development center. The GAO Technical Assessment relies on older studies to note the potential harm from black carbon emissions but cautions the studies cited "had to make assumptions about the amount and physical processes of black carbon emissions released from rockets," and "scientific understanding of atmospheric effects is nascent." The report repeatedly notes the science is poorly understood, illustrating the lack of data that would be necessary to draw conclusions about the emissions and the effect of those emissions from rockets.

Therefore, there is neither a generally accepted method for analyzing these impacts because the necessary data and tools do not exist to accurately estimate emissions of black carbon from rockets and any associated radiative forcing effects nor a way to identify potential mitigation measures to address such emissions if effects were foreseeable.

Sources of Greenhouse Gas Emissions

Per the EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2019 (EPA 2021), total United States GHG emissions were approximately 6,558.3 million metric tons (MMT) CO_2e in 2019 (EPA 2021). The primary GHG emitted by human activities in the United States was CO_2, which represented approximately 80.1% of total GHG emissions (5,255.8 MMT CO_2e). The largest source of CO_2, and of overall GHG emissions, was fossil-fuel combustion, which accounted for approximately 92.4% of CO_2 emissions in 2019 (4,856.7 MMT CO_2e). Relative to 1990, gross United States GHG emissions in 2019 were 1.8% higher; however, the gross emissions were down from a high of 15.6% above 1990 levels in 2007. GHG emissions decreased from 2018 to 2019 by 1.7% (113.1 MMT CO_2e) and overall, net emissions in 2019 were 13% below 2005 levels (EPA 2021).

According to California's 2000–2019 GHG emissions inventory (2021 edition), California emitted 418 MMT CO_2e in 2019, including emissions resulting from out-of-state electrical generation (CARB 2021b). The sources of GHG emissions in California include transportation, industry, electric power production from both in-state and out-of-state sources, residential and commercial activities, agriculture, high GWP substances, and recycling and waste.

3.2 Regulatory Setting

3.2.1 Federal Regulations

Greenhouse Gas Endangerment

On April 2, 2007, in Massachusetts v. USEPA, 549 US 497, the Supreme Court found that GHGs are air pollutants covered by the Clean Air Act (CAA). The Court held that EPA must determine whether emissions of GHGs from new motor vehicles cause or contribute to air pollution, which may reasonably be anticipated to endanger public health or welfare, or whether the science is too uncertain to make a reasoned decision. In making these decisions, EPA is required to follow the language of Section 202(a) of the CAA.

On April 17, 2009, EPA Administrator signed proposed “endangerment” and “cause or contribute” findings for GHGs under Section 202(a) of the CAA. EPA held a 60-day public comment period, considered public comments, and issued final findings. EPA found that six GHGs taken in combination endanger both the public health and the public welfare of current and future generations. EPA also found that the combined emissions of these GHGs from new motor vehicles and new motor vehicle engines contribute to the greenhouse effect as air pollution that endangers public health and welfare under CAA Section 202(a).

Mandatory Reporting of Greenhouse Gases

The Consolidated Appropriations Act of 2008, passed in December 2007, requires the establishment of mandatory GHG reporting requirements. On September 22, 2009, EPA issued the Final Mandatory Reporting of Greenhouse Gases Rule, which became effective January 1, 2010. The rule requires reporting of GHG emissions from large sources and suppliers in the U.S. and is intended to collect accurate and timely emissions data to inform future policy decisions. Under the rule, suppliers of fossil fuels or industrial GHGs, manufacturers of vehicles and engines, and facilities that emit 25,000 MT CO_2e or more per year of GHG emissions are required to submit annual reports to EPA.

Inflation Reduction Act

The Inflation Reduction Act was signed into law in August 2022. The bill is projected to reduce GHG emissions within the United States by 40% as compared to 2005 levels by 2030. The bill allocates funds to boost renewable energy infrastructure (e.g., solar panels and wind turbines), includes tax credits for the purchase of electric vehicles, and includes measures that will make homes more energy efficient.

The Inflation Reduction Act authorized the EPA to implement the Greenhouse Gas Reduction Fund (GGRF) program, which is a historic, $27 billion investment to mobilize financing and private capital to combat the climate crisis and ensure American economic competitiveness. The GGRF will be designed to achieve the following program objectives: reduce GHG emissions and other air pollutants; deliver the benefits of GHG- and air-pollution-reducing projects to American communities, particularly low-income and disadvantaged communities; and mobilize financing and private capital to stimulate additional deployment of greenhouse gas and air pollution reducing projects (EPA 2023).

3.2.2 State Regulations

The Statewide GHG emissions regulatory framework is summarized as follows by category: building energy, renewable energy and energy procurement, mobile sources, solid waste, water, and other State regulations and goals. The following text describes regulations and plans that would directly or indirectly reduce GHG emissions.. Of importance, the Project and/or users of the Project would be required to comply with the various regulatory measures that would reduce GHG emissions, which would reduce the Project's contribution to cumulative GHG emissions.

Building Energy

Title 24, Part 6

Title 24 of the California Code of Regulations was established in 1978 and serves to enhance and regulate California's building standards. While not initially promulgated to reduce GHG emissions, Part 6 of Title 24 specifically established Building Energy Efficiency Standards that are designed to ensure new and existing buildings in California achieve energy efficiency and preserve outdoor and indoor environmental quality. These regulations are carefully scrutinized and analyzed for technological and economic feasibility (California Public Resources Code, Section 25402(d)) and cost effectiveness (California Public Resources Code, Sections 25402(b)(2) and (b)(3)). As a result, these standards save energy, increase electricity supply reliability, increase indoor comfort, avoid the need to construct new power plants, and help preserve the environment.

The Title 24 standards that CalEEMod incorporates are the 2019 Title 24 Building Energy Efficiency Standards, which became effective January 1, 2020. In general, single-family residences built to the 2019 standards are anticipated to use approximately 7% less energy due to energy efficiency measures than those built to the 2016 standards; once rooftop solar electricity generation is factored in, single-family residences built under the 2019 standards will use approximately 53% less energy than those under the 2016 standards (CEC 2018a). Nonresidential buildings built to the 2019 standards are anticipated to use an estimated 30% less energy than those built to the 2016 standards (CEC 2018a).

On August 11, 2021, the CEC adopted the 2022 Building Energy Efficiency Standards (Energy Code). In December 2021, the 2022 Energy Code was approved by the California Building Standards Commission for inclusion into the California Building Standards Code. The 2022 Energy Code encourages efficient electric heat pumps, establishes electric-ready requirements for new homes, expands solar photovoltaic and battery storage standards, strengthens ventilation standards, and more. Buildings whose permit applications are applied for on or after January 1, 2023, must comply with the 2022 Energy Code. Under the 2022 amendments, California buildings would consume approximately 198,600 GWh of electricity and 6.14 billion therms of fossil fuel natural gas in 2023 compared to approximately 199,500 GWh and 6.17 billion therms of electricity and fossil fuel natural gas, respectively, under the 2019 Energy Code (CEC 2021). On a statewide basis throughout 2023, all measures for newly constructed buildings and altered components of existing buildings collectively would save approximately 33 million therms of fossil fuel natural gas and 1.3 billion kWh of electricity (CEC 2021).

Title 24, Part 11

In addition to the CEC's efforts, in 2008, the California Building Standards Commission adopted the nation's first green building standards. The California Green Building Standards Code (Part 11 of Title 24) is commonly referred to as CALGreen and establishes minimum mandatory standards as well as voluntary standards pertaining to the planning and design of sustainable site development, energy efficiency (in excess of the California Energy Code requirements), water conservation, material conservation, and interior air quality. The 2019 CALGreen standards are the current applicable standards. For nonresidential projects (which the nonresidential portion of the Project is subject to), some of the key mandatory CALGreen 2019 standards involve requirements related to bicycle parking, designated parking for clean air vehicles, electric vehicle (EV) charging stations, shade trees, water conserving plumbing fixtures and fittings, outdoor potable water use in landscaped areas, recycled water supply systems, construction waste management, excavated soil and land clearing debris, and commissioning (24 CCR Part 11).

Title 20

Title 20 of the California Code of Regulations requires manufacturers of appliances to meet State and federal standards for energy and water efficiency. The CEC certifies an appliance based on a manufacturer's demonstration that the appliance meets the standards.

Renewable Energy and Energy Procurement

Senate Bill 1078, Executive Order-14-08, Senate Bill X1-2, Senate Bill 350, and Senate Bill 100

SB 1078 (Sher) (September 2002) established the Renewable Portfolio Standard (RPS) program, which required an annual increase in renewable generation by the utilities equivalent to at least 1% of sales, with an aggregate goal of 20% by 2017. EO S-14-08 (November 2008) required that all retail suppliers of electricity in California serve 33% of their load with renewable energy by 2020. SB X1 2 expanded the RPS by establishing a renewable energy target of 20% of the total electricity sold to retail customers in California per year by December 31, 2013, and 33% by December 31, 2020, and in subsequent years. SB 350 (October 2015) further expanded the RPS by establishing a goal of 50% of the total electricity sold to retail customers in California per year by December 31, 2030. SB 100 (2018) increased the standards set forth in SB 350 establishing that 44% of the total electricity sold to retail customers in California per year by December 31, 2024, 52% by December 31, 2027, and 60% by December 31, 2030, be secured from qualifying renewable energy sources. SB 100 states that it is the policy of the State that eligible renewable energy resources and zero-carbon resources supply 100% of the retail sales of electricity to California. On April 30, 2022 California supplied 100% of its statewide demand with renewables at 2:45 pm (Electrek 2022).

Mobile Sources

State Vehicle Standards (Assembly Bill 1493 and Executive Order B-16-12)

AB 1493 (July 2002) was enacted in a response to the transportation sector accounting for more than half of California's CO_2 emissions. AB 1493 required CARB to set GHG emission standards for passenger vehicles, light-duty trucks, and other vehicles determined by the State board to be vehicles that are primarily used for noncommercial personal transportation in the State. The bill required that CARB set GHG emission standards for motor vehicles manufactured in 2009 and all subsequent model years. CARB adopted the standards in September 2004. EO B-16-12 (March 2012) required that State entities under the governor's direction and control support and facilitate the rapid commercialization of zero-emissions vehicles. It ordered CARB, CEC, California Public Utilities Commission, and other relevant agencies to work with the Plug-in Electric Vehicle Collaborative and the California Fuel Cell Partnership to establish benchmarks to help achieve benchmark goals by 2015, 2020, and 2025. On a

Statewide basis, EO B-16-12 established a target reduction of GHG emissions from the transportation sector equaling 80% less than 1990 levels by 2050. This directive did not apply to vehicles that have special performance requirements necessary for the protection of the public safety and welfare. As explained under the “Federal Vehicle Standards” description above, EPA and NHTSA approved the SAFE Vehicles Rule Part One and Two, which revoked California’s authority to set its own GHG emissions standards and set zero-emission vehicle mandates in California. As President Biden issued EO 13990 to review Part One and Part Two of the SAFE Vehicles Rule, this analysis continues to utilize the best available information at this time, as set forth in EMFAC and assumed in CalEEMod.

Heavy Duty Diesel (Title 13, Division 3, Chapter 1, Section 2025)

CARB adopted the final Heavy Duty Truck and Bus Regulation, Title 13, Division 3, Chapter 1, Section 2025, on December 31, 2014, to reduce particulate matter and NO_x emissions from heavy-duty diesel vehicles. The rule requires particulate matter filters be applied to newer heavier trucks and buses by January 1, 2012, with older vehicles required to comply by January 1, 2015. The rule will require nearly all diesel trucks and buses to be compliant with the 2010 model year engine requirement by January 1, 2023. CARB also adopted an Airborne Toxic Control Measure to limit idling of diesel-fueled commercial vehicles on December 12, 2013. This rule requires diesel-fueled vehicles with gross vehicle weights greater than 10,000 pounds to idle no more than 5 minutes at any location (13 CCR 2485).

Executive Order S-1-07

EO S-1-07 (January 2007, implementing regulation adopted in April 2009) sets a declining low carbon fuel standard (LCFS) for GHG emissions measured in CO_2e grams per unit of fuel energy sold in California. The initial target of the LCFS was to reduce the carbon intensity of California passenger vehicle fuels by at least 10% by 2020 (17 CCR 95480 et seq.). In September 2018, CARB approved amendments for the LCFS that require a 20% reduction in carbon intensity by year 2030.

Senate Bill 375

SB 375 (Steinberg) (September 2008) addresses GHG emissions associated with the transportation sector through regional transportation and sustainability plans. SB 375 requires CARB to adopt regional GHG reduction targets for the automobile and light-truck sector for 2020 and 2035 and to update those targets every 8 years. SB 375 requires the State’s 18 regional metropolitan planning organizations (MPOs) to prepare a Sustainable Communities Strategy (SCS) as part of their Regional Transportation Plan (RTP) that will achieve the GHG reduction targets set by CARB.

Advanced Clean Cars Program and Zero-Emissions Vehicle Program

The Advanced Clean Cars (ACC) I program (January 2012) is an emissions-control program for model years 2015 through 2025. The program combines the control of smog- and soot-causing pollutants and GHG emissions into a single coordinated package of regulations: the Low-Emission Vehicle (LEV) regulation for criteria air pollutant and GHG emissions and a technology forcing regulation for zero-emission vehicles (ZEV) that contributes to both types of emission reductions (CARB 2021c). The package includes elements to reduce smog-forming pollution, reduce GHG emissions, promote clean cars, and provide the fuels for clean cars. To improve air quality, CARB has implemented new emission standards to reduce smog-forming emissions beginning with 2015 model year vehicles. It is estimated that in 2025 cars will emit 75 percent less smog-forming pollution than the average new car sold in

2015 (CARB 2021c). The ZEV program will act as the focused technology of the ACC I program by requiring manufacturers to produce increasing numbers of ZEVs and plug-in hybrid EVs in the 2018 to 2025 model years.

The ACC II program is currently in development to establish the next set of LEV and ZEV requirements for model years after 2025 to contribute to meeting federal ambient air quality ozone standards and California's carbon neutrality standards (CARB 2021c). The main objectives of ACC II are:

1. Maximize criteria and GHG emission reductions through increased stringency and real-world reductions.
2. Accelerate the transition to ZEVs through both increased stringency of requirements and associated actions to support wide-scale adoption and use.

An ACC II rulemaking package, which will consider technological feasibility, environmental impacts, equity, economic impacts, and consumer impacts, is anticipated to be presented to CARB for consideration in August 2022.

Executive Order-79-20

EO N-79-20 (September 2020) requires CARB to develop regulations as follows: (1) Passenger vehicle and truck regulations requiring increasing volumes of new ZEVs sold in the State towards the target of 100% of in-State sales by 2035; (2) medium- and heavy-duty vehicle regulations requiring increasing volumes of new zero-emission trucks and buses sold and operated in the State towards the target of 100% of the fleet transitioning to zero-emission vehicles by 2045 everywhere feasible and for all drayage trucks to be zero emission by 2035; and (3) strategies, in coordination with other State agencies, the EPA and local air districts, to achieve 100% zero-emissions from off-road vehicles and equipment operations in the State by 2035. EO N-79-20 called for the development of a Zero-Emissions Vehicle Market Development Strategy, which was released February 2021, to be updated every 3 years, that ensures coordination and implementation of the EO and outlines actions to support new and used ZEV markets. In addition, the EO specifies identification of near-term actions, and investment strategies, to improve clean transportation, sustainable freight, and transit options; and calls for development of strategies, recommendations, and actions by July 15, 2021, to manage and expedite the responsible closure and remediation of former oil extraction sites as the State transitions to a carbon-neutral economy.

Advanced Clean Trucks (ACT) Regulation

The purpose of the ACT Regulation (June 2020) is to accelerate the market for zero-emission vehicles in the medium- and heavy-duty truck sector and to reduce emissions NO_x, fine particulate matter, TACs, GHGs, and other criteria pollutants generated from on-road mobile sources (CARB 2021d). Requiring medium- and heavy-duty vehicles to transition to zero-emissions technology will help California meet established near- and long-term air quality and climate mitigation targets.

Water

Executive Order B-29-15

In response to the ongoing drought in California, EO B-29-15 (April 2015) set a goal of achieving a Statewide reduction in potable urban water usage of 25% relative to water use in 2013. The term of the EO extended through February 28, 2016, although many of the directives have become permanent water-efficiency standards and requirements. The EO includes specific directives that set strict limits on water usage in the State.

Executive Order B-37-16

Issued May 2016, EO B-37-16 directed the State Water Resources Control Board (SWRCB) to adjust emergency water conservation regulations through the end of January 2017 to reflect differing water supply conditions across the State. The SWRCB also developed a proposal to achieve a mandatory reduction of potable urban water usage that builds off the mandatory 25% reduction called for in EO B-29-15. The SWRCB and Department of Water Resources will develop new, permanent water use targets that build upon the existing State law requirements that the State achieve 20% reduction in urban water usage by 2020. EO B-37-16 also specifies that the SWRCB permanently prohibit water-wasting practices such as hosing off sidewalks, driveways, and other hardscapes; washing automobiles with hoses not equipped with a shut-off nozzle; using non-recirculated water in a fountain or other decorative water feature; watering lawns in a manner that causes runoff, or within 48 hours after measurable precipitation; and irrigating ornamental turf on public street medians.

Executive Order N-10-21

In response to a state of emergency due to severe drought conditions, EO N-10-21 (July 2021) called on all Californians to voluntarily reduce their water use by 15% from their 2020 levels. Actions suggested in EO N-10-21 include reducing landscape irrigation, running dishwashers and washing machines only when full, finding and fixing leaks, installing water-efficient showerheads, taking shorter showers, using a shut-off nozzle on hoses, and taking cars to commercial car washes that use recycled water.

Executive Order N-7-22

On March 28, 2022, Governor Newsom directed the State Water Board to consider adopting emergency regulations focused on urban water suppliers under EO N-7-22. If adopted, the potential regulations would require the vast majority of urban water suppliers to enact Level 2 of their water shortage contingency plans. Those plans are developed by the suppliers and provide actions they will take if their water supplies are cut to certain levels. Here, Level 2 would represent the suppliers acting as if their water supply had been reduced by 20%. The executive order also directs the State Water Board to consider adopting emergency regulations defining “non-functional turf” by May 25, 2022. Both the executive order and corresponding press release confirm that the definition should only apply to ornamental turf that is not functional, excluding turf such as school fields, sports fields and parks from the definition. If the definition is adopted, the State Water Board must then consider banning irrigation of the non-functional turf in the commercial, industrial and institutional sectors (with limited exceptions). The proposed ban is anticipated to save several hundred thousand acre-feet of water per year.

Solid Waste

Assembly Bill 939, Assembly Bill 341, Assembly Bill 1826, and Senate Bill 1383

In 1989, AB 939, known as the Integrated Waste Management Act (California Public Resources Code, Sections 40000 et seq.), was passed because of the increase in waste stream and the decrease in landfill capacity. AB 939 mandated a reduction of waste being disposed where jurisdictions were required to meet diversion goals of all solid waste through source reduction, recycling, and composting activities of 25% by 1995 and 50% by the year 2000. AB 341 (Chapter 476, Statutes of 2011) amended the California Integrated Waste Management Act of 1989 to include a provision declaring that it is the policy goal of the State that not less than 75% of solid waste generated be source-reduced, recycled, or composted by the year 2020, and annually thereafter. AB 1826 (Chapter 727, Statutes of 2014, effective 2016) requires businesses to recycle their organic waste (i.e., food waste, green waste, landscape and pruning waste, nonhazardous wood waste, and food-soiled paper waste that is mixed in with food waste) depending on the amount of waste they generate per week. SB 1383 (Chapter 395, Statutes of 2016) establishes targets to achieve a 50% reduction in the level of the Statewide disposal of organic waste from the 2014 level by 2020 and a 75% reduction by 2025. CalRecycle was granted the regulatory authority required to achieve the organic waste disposal reduction targets and establishes an additional target that not less than 20% of currently disposed edible food is recovered for human consumption by 2025 (CalRecycle 2019).

3.3 Insignificance Criteria and Methodology

3.3.1 Insignificance Thresholds and Indicators

The DAF has adopted the Prevention of Significant Deterioration (PSD) threshold for GHG of 75,000 ton per year (tpy) of CO_2e (or 68,039 metric ton per year, mtpy) as an indicator or threshold of insignificance for NEPA air quality impacts in all areas (HQ AFCEC/CZTQ. 2023b). This indicator does not define a significant impact; however, it provides a threshold to identify actions that are insignificant (de minimis, too trivial or minor to merit consideration). Actions with a net change in GHG (CO_2e) emissions below the insignificance indicator (threshold) are considered too insignificant on a global scale to warrant any further analysis beyond what is produced in the ACAM GHG Report. Note that actions (or alternatives) with a net change in GHG (CO_2e) emissions above the insignificance indicator (threshold) are only considered potentially significant and require further assessment (usually qualitative) to determine if the action poses a significant impact.

3.3.2 Approach and Methodology

Emissions of GHGs were estimated for construction and operation of the Proposed Action consistent with the methodology presented in Section 2.4.2. Emissions of CO_2, CH_4, and N_2O were estimated from the combustion sources of the Proposed Action. Additional sources of direct and indirect GHG emissions were estimated using the CalEEMod 2022 as discussed below.

Energy Sources

The estimation of operational energy emissions was based on applicant provided data. CalEEMod default energy intensity factors (CO_2, CH_4, and N_2O mass emissions per kilowatt hour) for PG&E is based on the value for PG&E's energy mix in 2019. SB-100 calls for further development of renewable energy, with a target of 44% by 2024, 52% by 2027, and 60% by 2030. Because PG&E is striving to meet the 60% RPS by December 31, 2030, the CO_2 emissions intensity factor is anticipated to be less than assumed in CalEEMod at full buildout from implementation of the Proposed Action (2025), which would reflect the increase in percentage of renewable energy in PG&E's energy portfolio.

Refrigerants

CalEEMod was utilized to estimate fugitive GHG emissions from refrigerants used for air conditioning and refrigeration equipment. Different types of refrigeration equipment are utilized for different types of land uses and CalEEMod generates default refrigerant values based on land use subtype and industry data from the EPA. CalEEMod quantifies refrigerant emissions from leaks during regular operation and routine servicing over the equipment lifetime and then derives average annual emissions from the lifetime estimate but does not quantify emissions from the disposal of refrigeration and air conditioning equipment at the end of its lifetime.

Most of the refrigerants used today are HFCs or blends thereof, which can have high GWP values. However, California is required to reduce HFC emissions 40% below 2013 levels by 2030 under SB1383, and regulations have been adopted to place GWP limits on HFCs, such as SB 120. While CalEEMod default refrigerant values were assumed for the land use surrogate of commercial research and development land use, it is anticipated to be conservative.

Solid Waste

The Project would generate solid waste, and therefore, result in CO_2e emissions associated with landfill off-gassing. CalEEMod default values for solid waste generation were used to estimate GHG emissions associated with solid waste. Project compliance with Statewide solid waste diversion goals, including the 75% diversion rate by 2020 consistent with AB 341 (25% increase from the solid waste diversion requirements of AB 939, Integrated Waste Management Act), would reduce Project-generated GHG emissions associated with solid waste disposal. No diversion above the CalEEMod default assumptions was assumed.

Water and Wastewater

Supply, conveyance, treatment, and distribution of water for the Project require the use of electricity, which would result in associated indirect GHG emissions. Similarly, wastewater generated by the Project requires the use of electricity for conveyance and treatment, along with GHG emissions generated during wastewater treatment. Water consumption estimates for both indoor and outdoor water use was provided by the project applicant and associated electricity consumption from water use and wastewater generation were estimated using CalEEMod default values.

3.3.3 Greenhouse Gas Emissions Impact Assessment

3.3.3.1 Construction Emissions – Proposed Action

Construction of the Proposed Action would result in GHG emissions, which are primarily associated with use of off-road construction equipment, on-road haul trucks, on-road vendor trucks, and worker vehicles. The CEQ has not proposed or adopted relevant quantitative GHG thresholds for construction-generated emissions.

ACAM and spreadsheet models were used to calculate the annual GHG emissions based on the construction scenario discussed in Section 2.5.1. Table 26, Estimated Annual Construction GHG Emissions – Proposed Action, presents the estimated GHG emissions generated during construction of the Proposed Action. Details of the emission calculations are provided in Attachment A (see ACAM Detail Report-Proposed Action).

Table 26. Estimated Annual Construction GHG Emissions – Proposed Action

Year	CO_2	CH_4	N_2O	CO_2e
	Metric Tons			
2025	284	0.01	0.02	291
2026	1,080	0.03	0.09	1,118
			Total	**1,409**

Notes: CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; CO_2e = carbon dioxide equivalent.

See Attachment A for complete results.
ACAM presents GHG emissions in tons which were converted to metric tons as is the industry standard.

As shown in Table 26, the estimated total GHG emissions during construction of the Proposed Action would be approximately 1,409 MT CO_2e over the construction period.

3.3.3.2 Construction Emissions – Alternative 1

Construction of Alternative 1 would result in GHG emissions, which are primarily associated with use of off-road construction equipment, on-road haul trucks, on-road vendor trucks, and worker vehicles. Alternative 1 includes the construction of a new hangar whereas the Proposed Action would refurbish an existing hangar.

ACAM and spreadsheet models were used to calculate the annual GHG emissions based on the construction scenario discussed in Section 2.5.2. Table 27, Estimated Annual Construction GHG Emissions – Alternative 1, presents the estimated GHG emissions generated during construction of the Proposed Action. Details of the emission calculations are provided in Attachment A (see ACAM Detail Report-Alternative 1).

Table 27. Estimated Annual Construction GHG Emissions – Alternative 1

Year	CO_2	CH_4	N_2O	CO_2e
	Metric Tons			
2025	327	0.01	0.03	336
2026	1,247	0.03	0.12	1,293
			Total	**1,629**

Notes: CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; CO_2e = carbon dioxide equivalent.
See Attachment A for complete results.
ACAM presents GHG emissions in tons which were converted to metric tons as is the industry standard.

As shown in Table 27, the estimated total GHG emissions during construction of Alternative 1 would be approximately 1,629 MT CO_2e over the construction period.

3.3.3.3 Operational Emissions

Operation of the Proposed Action would generate GHG emissions through motor vehicle trips; landscape maintenance equipment operation and hearths (area sources); energy use (natural gas and electricity); solid waste disposal; and water supply, treatment, and distribution and wastewater treatment. CalEEMod was used to calculate the annual GHG emissions based on the operational assumptions described in Section 3.3.2, Methodology. The estimated operational Project-generated unmitigated GHG emissions from area sources, energy usage, motor vehicles, solid waste generation, water usage and wastewater generation, and off-road equipment are shown in Table 28, Project Operational GHG Emissions. See ACAM Detail Report-Proposed Action, Launch Emissions, SLC-4&6 – Emission Calculations – Proposed Action, SpaceX Marine Emissions Workbook SCCAB – Elizabeth C – Proposed Action, SpaceX Marine Emissions Workbook SCCAB – Kelly C – Proposed Action, SpaceX Marine Emissions Workbook SCAB – Elizabeth C – Proposed Action, SpaceX Marine Emissions Workbook SCAB – Kelly C – Proposed Action, VCAPCD Summary – Elizabeth C – Proposed Action, and VCAPCD Summary – Kelly C – Proposed Action in Attachment A for more details.

Table 28. Proposed Action Operational GHG Emissions

Emission Source	CO_2	CH_4	N_2O	CO_2e
	Metric Tons per Year			
Emergency Generators	67.81	<0.01	<0.01	78.43
Fleet Vehicle Use	79.87	0.01	<0.01	80.89
Vendor-Contractor Vehicles	107.02	0.01	<0.01	108.40
Off-Road Equipment	2,099.21	0.08	0.02	2,106.41
Roll-On-Roll-Off	11,973.77	0.21	0.50	12,126.64
Launch	16,437.35	NA	NA	16,437.35
Booster and Payload Fairing Recovery	238.98	0.00	0.01	242.25
Landings and Static Fire	6,785.88	NA	NA	6,785.88
Energy	5,173.93	0.84	0.10	5,225.09
Refrigerants	0.00	0.00	0.00	0.04
Solid Waste	106.81	10.67	0.00	373.68
Water and Wastewater	32.04	0.03	0.02	38.11
			Total	**43,603.17**

Notes: GHG = greenhouse gas; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; CO_2e = carbon dioxide equivalent.
See Attachment A for complete results.

As shown in Table 25, estimated operational GHG emissions from the Proposed Action would be approximately 43,603 MT CO_2e per year. GHG emissions of the Proposed Action and Alternative 1 would be below the DAF insignificance indicator for all years.

There is an overlap in 2026 with construction ending and operation beginning of the Proposed Action. The construction and operational GHG emissions from the Proposed Action in 2026 are shown in Table 29.

Table 29. Proposed Action Construction and Operational GHG Emissions – 2026

Emission Source	CO_2	CH_4	N_2O	CO_2e
	Metric Tons per Year			
Construction	1,080	0.03	0.09	1,118
Operation	7,185.60	1.98	0.11	7,269.04
			Total	**8,387.04**

Notes: GHG = greenhouse gas; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; CO_2e = carbon dioxide equivalent.
See Attachment A for complete results.

As shown in Table 29, estimated construction and operational GHG emissions in 2026 from the Proposed Action would be approximately 8,387 MT CO_2e. GHG emissions of the Proposed Action would be below the DAF insignificance indicator in 2026.

There is an overlap in 2026 with construction ending and operation beginning of Alternative 1. The construction and operational GHG emissions from Alternative 1 in 2026 are shown in Table 30.

Table 30. Alternative 1 Construction and Operational GHG Emissions – 2026

Emission Source	CO_2	CH_4	N_2O	CO_2e
	Metric Tons per Year			
Construction	1,247	0.03	0.12	1,293
Operation	7,185.60	1.98	0.11	7,269.04
			Total	**8,562.04**

Notes: GHG = greenhouse gas; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; CO_2e = carbon dioxide equivalent.
See Attachment A for complete results.

As shown in Table 30, estimated construction and operational GHG emissions in 2026 from Alternative 1 would be approximately 8,562 MT CO_2e. GHG emissions of Alternative 1 would be below the DAF insignificance indicator in 2026.

Table 31 presents the annual operational GHG emissions associated with 100 launches. Details of the emission calculations are provided in Attachment C.

Table 31. 100 Launch Operational GHG Emissions

Emission Source	CO_2	CH_4	N_2O	CO_2e
	Metric Tons per Year			
Emergency Generators	765.47	0.04	0.00	885.29
Worker Vehicles	1,118.16	0.06	0.05	1,132.50
Fleet Vehicle Use	159.74	0.01	0.01	161.79
Vendor-Contractor Vehicles	214.05	0.01	0.01	216.79
Off-Road Equipment	6,003.27	0.24	0.05	6,023.87
Roll-On-Roll-Off	24,213.49	0.48	1.02	24,530.38
Launch	NA	NA	NA	30,135.14
Booster and Payload Fairing Recovery	403.09	0.01	0.02	408.60
Landings and Static Fire	NA	NA	NA	10,136.36
Energy	5,173.93	0.84	0.10	5,225.09
Refrigerants	0.00	0.00	0.00	0.04
Solid Waste	106.81	10.67	0.00	373.68
Water and Wastewater	32.04	0.03	0.02	38.11
			Total	**79,267.64**

Notes: GHG = greenhouse gas; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; CO_2e = carbon dioxide equivalent.
See Appendix A for complete results.

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Attachment A

Modeling Files – Proposed Action

Table of Contents

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

1. General Information

- Action Location
Base: VANDENBERG AFB
State: California
County(s): Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Action Title: Falcon Program at Vandenberg Space Force Base Alternative 1

- Project Number/s (if applicable):

- Projected Action Start Date: 11 / 2025

- Action Purpose and Need:
Space Exploration Technologies Corporation (SpaceX) has applied to the United States Space Force (USSF) to increase Falcon flight opportunities at Vandenberg Space Force Base (VSFB) in support of manifested and anticipated vehicle operations for Falcon 9 and Falcon Heavy. SpaceX currently launches commercial and government payloads from VSFB at SLC-4 and has been allocated SLC-6 by the USSF. SpaceX supports, and is under contract for, the full spectrum of U.S. Government space mission requirements, including crew and cargo transportation for the National Aeronautics and Space Administration (NASA) and spacecraft launches for NASA and the U.S. Department of Defense (DOD).

- Action Description:
The Proposed Action is to increase the annual Falcon launch cadence at VSFB through launches at SLC-4 and SLC-6 and the modification of SLC 6 for Falcon launch vehicles to support future commercial and U.S. government launch service needs. SpaceX would launch Falcon 9 from SLC-4 and SLC-6, and Falcon Heavy from SLC-6. Falcon 9 is approximately 229 feet tall and produces approximately 1.7 million pounds of thrust at liftoff. A discussion of Falcon 9 can be found in the 2016 EA and associated supplemental environmental documents. Falcon Heavy is a heavy-lift vehicle that produces 5.12 million pounds of thrust at liftoff and has the ability to lift 141,000 pounds into low Earth orbit. Merlin engines are used on both stages of Falcon Heavy. The center core and two side boosters are essentially the same design as a Falcon 9 first stage booster, thus Falcon Heavy uses the same type of propellants as Falcon 9. Additionally, Falcon Heavy uses the same second stage as Falcon 9.

Under Alternative 1, SpaceX would implement the Proposed Action and construct an approximately 61,250 square-foot hangar north of the launch pad line to support Falcon 9 and Falcon Heavy integration and processing. Areas around the hangar would be graded to provide rear access to the hangar. As part of Alternative 1, SpaceX would demolish the Mobile Service Tower, Mobile Assembly Shelter, Fixed Umbilical Tower, and the launch crown at SLC-6. SpaceX would construct rails from the hangar to the launch pad to transport Falcon. The SLC 6 fence would be relocated and vehicular access from Luner Road to N Road would be removed.

- Point of Contact
Name: Adam Poll
Title: Civilian
Organization: Dudek
Email: apoll@dudek.com
Phone Number: 805-308-8516

Report generated with ACAM version: 5.0.23a

- Activity List:

Activity Type		Activity Title
2.	Construction / Demolition	SLC-6 Modifications

3.	Personnel	Fleet Vehicle Use
4.	Personnel	Vendor-Contractor Vehicles
5.	Construction / Demolition	Operational Equipment Use
6.	Emergency Generator	SLC 6 Emergency Generator
7.	Construction / Demolition	SLC-6 MAS Demo
8.	Construction / Demolition	SLC-6 FUT Demo
9.	Construction / Demolition	SLC-6 Crown Demo
10.	Construction / Demolition	SLC-6 MST Demo

Emission factors and air emission estimating methods come from the United States Air Force's Air Emissions Guide for Air Force Stationary Sources, Air Emissions Guide for Air Force Mobile Sources, and Air Emissions Guide for Air Force Transitory Sources.

2. Construction / Demolition

2.1 General Information & Timeline Assumptions

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: SLC-6 Modifications

- Activity Description:
SpaceX would modify SLC-6 to support Falcon 9 and Falcon Heavy launches. SpaceX would construct commodity storage tanks, a vehicle erector, a water tower, ground supporting equipment, and a rail system from the hangar to the launch pad. Where possible, existing infrastructure would be modified. This could include the liquid oxygen storage, launch pad apron and access road, and fence line. The existing flame trench would be converted to a unidirectional water-cooled diverter and a deluge/acoustic suppression system would be installed. Construction would generally occur in previously disturbed areas and on existing impervious surfaces, but some earthwork is anticipated. A new hangar or modification of an existing structure would be required for vehicle processing. A discussion of hangar alternatives is included in Section 2.2.
Approximately 143,000 square feet of commodity storage would be required. This includes storage tanks for liquid oxygen, rocket propellant-1, water, nitrogen, helium, and other launch commodities. A 200-foot water tower would be constructed on the east side of the launch complex.
Existing utilities such as power, communications, and fluids systems would be modified or reconstructed within the existing launch complex for Falcon as needed. Firebreaks would be incorporated as appropriate into the site design and final site layout is subject to SLD 30 review and approval.
Under Alternative 2, SpaceX would implement the Proposed Action and construct an approximately 61,250 square-foot hangar north of the launch pad line to support Falcon 9 and Falcon Heavy integration and processing. Areas around the hangar would be graded to provide rear access to the hangar. SpaceX would construct rails from the hangar to the launch pad to transport Falcon. The SLC 6 fence would be relocated and vehicular access from Luner Road to N Road would be removed.

- Activity Start Date
Start Month: 11
Start Month: 2025

- Activity End Date
Indefinite: False
End Month: 10
End Month: 2026

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	1.913658
SO_x	0.010946
NO_x	3.024966
CO	2.093272

Pollutant	Total Emissions (TONs)
PM 10	3.407791
PM 2.5	0.092356
Pb	0.000000
NH_3	0.132521

- Activity Emissions of GHG:

Pollutant	Total Emissions (TONs)
CH_4	0.015887
N_2O	0.132736

Pollutant	Total Emissions (TONs)
CO_2	1126.016589
CO_2e	1165.968430

- Global Scale Activity Emissions for SCGHG:

Pollutant	Total Emissions (TONs)
CH_4	0.015887
N_2O	0.132736

Pollutant	Total Emissions (TONs)
CO_2	1126.016589
CO_2e	1165.968430

2.1 Site Grading Phase

2.1.1 Site Grading Phase Timeline Assumptions

- Phase Start Date

Start Month: 11
Start Quarter: 1
Start Year: 2025

- Phase Duration

Number of Month: 1
Number of Days: 0

2.1.2 Site Grading Phase Assumptions

- General Site Grading Information

Area of Site to be Graded (ft^2): 328442
Amount of Material to be Hauled On-Site (yd^3): 0
Amount of Material to be Hauled Off-Site (yd^3): 0

- Site Grading Default Settings

Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Excavators Composite	1	8
Graders Composite	1	8
Other Construction Equipment Composite	1	8
Rubber Tired Dozers Composite	1	8
Tractors/Loaders/Backhoes Composite	3	8

- Vehicle Exhaust

Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

2.1.3 Site Grading Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Excavators Composite [HP: 36] [LF: 0.38]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.40191	0.00542	3.44643	4.21104	0.10704	0.09848
Graders Composite [HP: 148] [LF: 0.41]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.33951	0.00490	2.85858	3.41896	0.15910	0.14637
Other Construction Equipment Composite [HP: 82] [LF: 0.42]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.29762	0.00487	2.89075	3.51214	0.17229	0.15851
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.37086	0.00491	3.50629	2.90209	0.15396	0.14165
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.19600	0.00489	2.00960	3.48168	0.07738	0.07119

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Excavators Composite [HP: 36] [LF: 0.38]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02382	0.00476	587.13772	589.15263
Graders Composite [HP: 148] [LF: 0.41]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02155	0.00431	531.19419	533.01712
Other Construction Equipment Composite [HP: 82] [LF: 0.42]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02141	0.00428	527.74261	529.55369
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02159	0.00432	532.17175	533.99803
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02149	0.00430	529.86270	531.68105

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310

HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

2.1.4 Site Grading Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (20 * ACRE * WD) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
20: Conversion Factor Acre Day to pounds (20 lb / 1 Acre Day)
ACRE: Total acres (acres)
WD: Number of Total Work Days (days)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = (HA_{OnSite} + HA_{OffSite}) * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
HA_{OnSite}: Amount of Material to be Hauled On-Site (yd^3)
$HA_{OffSite}$: Amount of Material to be Hauled Off-Site (yd^3)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

2.2 Building Construction Phase

2.2.1 Building Construction Phase Timeline Assumptions

- Phase Start Date
Start Month: 11
Start Quarter: 1
Start Year: 2025

- Phase Duration
Number of Month: 11
Number of Days: 0

2.2.2 Building Construction Phase Assumptions

- General Building Construction Information
Building Category: Office or Industrial
Area of Building (ft^2): 204250
Height of Building (ft): 200
Number of Units: N/A

- Building Construction Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Cranes Composite	1	6
Forklifts Composite	2	6
Generator Sets Composite	1	8
Tractors/Loaders/Backhoes Composite	1	8
Welders Composite	3	8

- Vehicle Exhaust
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips

Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

- Vendor Trips

Average Vendor Round Trip Commute (mile): 40 (default)

- Vendor Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

2.2.3 Building Construction Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Cranes Composite [HP: 367] [LF: 0.29]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.20113	0.00487	1.94968	1.66287	0.07909	0.07277
Forklifts Composite [HP: 82] [LF: 0.2]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.26944	0.00487	2.55142	3.59881	0.13498	0.12418
Generator Sets Composite [HP: 14] [LF: 0.74]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.54223	0.00793	4.34662	2.86938	0.17681	0.16267
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.19600	0.00489	2.00960	3.48168	0.07738	0.07119
Welders Composite [HP: 46] [LF: 0.45]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.49757	0.00735	3.67618	4.52476	0.11274	0.10373

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Cranes Composite [HP: 367] [LF: 0.29]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02140	0.00428	527.58451	529.39505
Forklifts Composite [HP: 82] [LF: 0.2]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02138	0.00428	527.10822	528.91712
Generator Sets Composite [HP: 14] [LF: 0.74]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02305	0.00461	568.32220	570.27253
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02149	0.00430	529.86270	531.68105
Welders Composite [HP: 46] [LF: 0.45]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02305	0.00461	568.30078	570.25105

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

2.2.4 Building Construction Phase Formula(s)

- Construction Exhaust Emissions per Phase

CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL}* 0.002205) / 2000

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

VMT_{VE} = BA * BH * (0.42 / 1000) * HT

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.42 / 1000): Conversion Factor ft^3 to trips (0.42 trip / 1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase

$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Vender Trips Emissions per Phase
$VMT_{VT} = BA * BH * (0.38 / 1000) * HT$

VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.38 / 1000): Conversion Factor ft^3 to trips (0.38 trip / 1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

2.3 Architectural Coatings Phase

2.3.1 Architectural Coatings Phase Timeline Assumptions

- Phase Start Date
Start Month: 10
Start Quarter: 1
Start Year: 2026

- Phase Duration
Number of Month: 1
Number of Days: 0

2.3.2 Architectural Coatings Phase Assumptions

- General Architectural Coatings Information
Building Category: Non-Residential
Total Square Footage (ft^2): 143000
Number of Units: N/A

- Architectural Coatings Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

2.3.3 Architectural Coatings Phase Emission Factor(s)

- Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

2.3.4 Architectural Coatings Phase Formula(s)

- Worker Trips Emissions per Phase
$VMT_{WT} = (1 * WT * PA) / 800$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
1: Conversion Factor man days to trips (1 trip / 1 man * day)
WT: Average Worker Round Trip Commute (mile)
PA: Paint Area (ft^2)
800: Conversion Factor square feet to man days (1 ft^2 / 1 man * day)

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Off-Gassing Emissions per Phase
$VOC_{AC} = (AB * 2.0 * 0.0116) / 2000.0$

VOC_{AC}: Architectural Coating VOC Emissions (TONs)
BA: Area of Building (ft^2)
2.0: Conversion Factor total area to coated area (2.0 ft^2 coated area / total area)
0.0116: Emission Factor (lb/ft^2)
2000: Conversion Factor pounds to tons

2.4 Paving Phase

2.4.1 Paving Phase Timeline Assumptions

- Phase Start Date
Start Month: 10
Start Quarter: 1
Start Year: 2026

- Phase Duration
Number of Month: 1
Number of Days: 0

2.4.2 Paving Phase Assumptions

- General Paving Information
Paving Area (ft^2): 143000

- Paving Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Cement and Mortar Mixers Composite	4	6
Pavers Composite	1	7
Paving Equipment Composite	2	6
Rollers Composite	1	7

- Vehicle Exhaust
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

2.4.3 Paving Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

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Cement and Mortar Mixers Composite [HP: 10] [LF: 0.56]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.55280	0.00854	4.19778	3.25481	0.16332	0.15025
Pavers Composite [HP: 81] [LF: 0.42]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.23717	0.00486	2.53335	3.43109	0.12904	0.11872
Paving Equipment Composite [HP: 89] [LF: 0.36]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.18995	0.00487	2.06537	3.40278	0.08031	0.07388
Rollers Composite [HP: 36] [LF: 0.38]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.54202	0.00541	3.61396	4.09268	0.15387	0.14156

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Cement and Mortar Mixers Composite [HP: 10] [LF: 0.56]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02313	0.00463	570.16326	572.11992
Pavers Composite [HP: 81] [LF: 0.42]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02133	0.00427	525.80405	527.60847
Paving Equipment Composite [HP: 89] [LF: 0.36]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02141	0.00428	527.70636	529.51732
Rollers Composite [HP: 36] [LF: 0.38]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02381	0.00476	586.91372	588.92786

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

2.4.4 Paving Phase Formula(s)

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * EF_{POL}) / 2000$

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase
$VMT_{VE} = PA * 0.25 * (1 / 27) * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
PA: Paving Area (ft^2)
0.25: Thickness of Paving Area (ft)
(1 / 27): Conversion Factor cubic feet to cubic yards (1 yd^3 / 27 ft^3)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Off-Gassing Emissions per Phase
$VOC_P = (2.62 * PA) / 43560 / 2000$

VOC_P: Paving VOC Emissions (TONs)
2.62: Emission Factor (lb/acre)
PA: Paving Area (ft^2)

43560: Conversion Factor square feet to acre (43560 ft2 / acre)^2 / acre)
2000: Conversion Factor square pounds to TONs (2000 lb / TON)

3. Personnel

3.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Fleet Vehicle Use

- Activity Description:
Fleet Vehicle Use

- Activity Start Date
Start Month: 12
Start Year: 2026

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	0.078096
SO_x	0.000870
NO_x	0.036186
CO	0.461729

Pollutant	Emissions Per Year (TONs)
PM 10	0.004828
PM 2.5	0.001718
Pb	0.000000
NH_3	0.010317

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.005204
N_2O	0.003351

Pollutant	Emissions Per Year (TONs)
CO_2	88.040375
CO_2e	89.168978

3.2 Personnel Assumptions

- Number of Personnel
Active Duty Personnel: 0
Civilian Personnel: 0
Support Contractor Personnel: 50
Air National Guard (ANG) Personnel: 0
Reserve Personnel: 0

- Default Settings Used: Yes

- Average Personnel Round Trip Commute (mile): 20 (default)

- Personnel Work Schedule

Active Duty Personnel: 5 Days Per Week (default)
Civilian Personnel: 5 Days Per Week (default)
Support Contractor Personnel: 5 Days Per Week (default)
Air National Guard (ANG) Personnel: 4 Days Per Week (default)
Reserve Personnel: 4 Days Per Month (default)

3.3 Personnel On Road Vehicle Mixture

- On Road Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	37.55	60.32	0	0.03	0.2	0	1.9
GOVs	54.49	37.73	4.67	0	0	3.11	0

3.4 Personnel Emission Factor(s)

- On Road Vehicle Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.14234	0.00266	0.07502	1.06799	0.01592	0.00555	0.03565
LDGT	0.18838	0.00330	0.13989	1.46024	0.01732	0.00618	0.03719
HDGV	0.24098	0.00505	0.22834	1.70597	0.02754	0.00971	0.03748
LDDV	0.02105	0.00209	0.18580	0.28873	0.02760	0.01668	0.00310
LDDT	0.01458	0.00278	0.06550	0.14150	0.02318	0.01184	0.00310
HDDV	0.09991	0.01077	2.12874	0.51062	0.11544	0.05583	0.18324
MC	5.54365	0.00204	0.71045	17.29267	0.01908	0.00809	0.00866

- On Road Vehicle Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01109	0.00883	269.03971	271.94837
LDGT	0.01534	0.01225	334.10216	338.13590
HDGV	0.01993	0.01699	510.51978	516.08005
LDDV	0.00098	0.03476	220.63766	231.02106
LDDT	0.00068	0.04624	293.49614	307.29273
HDDV	0.00464	0.17922	1137.52260	1191.04533
MC	0.24921	0.04641	206.70657	226.76743

3.5 Personnel Formula(s)

- Personnel Vehicle Miles Travel for Work Days per Year

$VMT_P = NP * WD * AC$

VMT_P: Personnel Vehicle Miles Travel (miles/year)
NP: Number of Personnel
WD: Work Days per Year
AC: Average Commute (miles)

- Total Vehicle Miles Travel per Year

$VMT_{Total} = VMT_{AD} + VMT_C + VMT_{SC} + VMT_{ANG} + VMT_{AFRC}$

VMT_{Total}: Total Vehicle Miles Travel (miles)
VMT_{AD}: Active Duty Personnel Vehicle Miles Travel (miles)
VMT_C: Civilian Personnel Vehicle Miles Travel (miles)
VMT_{SC}: Support Contractor Personnel Vehicle Miles Travel (miles)
VMT_{ANG}: Air National Guard Personnel Vehicle Miles Travel (miles)
VMT_{AFRC}: Reserve Personnel Vehicle Miles Travel (miles)

- Vehicle Emissions per Year
$V_{POL} = (VMT_{Total} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{Total}: Total Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Personnel On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

4. Personnel

4.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Vendor-Contractor Vehicles

- Activity Description:
Vendor-Contractor Vehicles

- Activity Start Date
Start Month: 12
Start Year: 2026

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	0.104649
SO_x	0.001166
NO_x	0.048489
CO	0.618717

Pollutant	Emissions Per Year (TONs)
PM 10	0.006469
PM 2.5	0.002302
Pb	0.000000
NH_3	0.013825

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.006973
N_2O	0.004490

Pollutant	Emissions Per Year (TONs)
CO_2	117.974102
CO_2e	119.486431

4.2 Personnel Assumptions

- Number of Personnel
Active Duty Personnel: 0
Civilian Personnel: 0
Support Contractor Personnel: 67

Air National Guard (ANG) Personnel: 0
Reserve Personnel: 0

- Default Settings Used: Yes

- Average Personnel Round Trip Commute (mile): 20 (default)

- Personnel Work Schedule
Active Duty Personnel: 5 Days Per Week (default)
Civilian Personnel: 5 Days Per Week (default)
Support Contractor Personnel: 5 Days Per Week (default)
Air National Guard (ANG) Personnel: 4 Days Per Week (default)
Reserve Personnel: 4 Days Per Month (default)

4.3 Personnel On Road Vehicle Mixture

- On Road Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	37.55	60.32	0	0.03	0.2	0	1.9
GOVs	54.49	37.73	4.67	0	0	3.11	0

4.4 Personnel Emission Factor(s)

- On Road Vehicle Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.14234	0.00266	0.07502	1.06799	0.01592	0.00555	0.03565
LDGT	0.18838	0.00330	0.13989	1.46024	0.01732	0.00618	0.03719
HDGV	0.24098	0.00505	0.22834	1.70597	0.02754	0.00971	0.03748
LDDV	0.02105	0.00209	0.18580	0.28873	0.02760	0.01668	0.00310
LDDT	0.01458	0.00278	0.06550	0.14150	0.02318	0.01184	0.00310
HDDV	0.09991	0.01077	2.12874	0.51062	0.11544	0.05583	0.18324
MC	5.54365	0.00204	0.71045	17.29267	0.01908	0.00809	0.00866

- On Road Vehicle Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01109	0.00883	269.03971	271.94837
LDGT	0.01534	0.01225	334.10216	338.13590
HDGV	0.01993	0.01699	510.51978	516.08005
LDDV	0.00098	0.03476	220.63766	231.02106
LDDT	0.00068	0.04624	293.49614	307.29273
HDDV	0.00464	0.17922	1137.52260	1191.04533
MC	0.24921	0.04641	206.70657	226.76743

4.5 Personnel Formula(s)

- Personnel Vehicle Miles Travel for Work Days per Year
$VMT_P = NP * WD * AC$

VMT_P: Personnel Vehicle Miles Travel (miles/year)
NP: Number of Personnel
WD: Work Days per Year
AC: Average Commute (miles)

- Total Vehicle Miles Travel per Year

$VMT_{Total} = VMT_{AD} + VMT_{C} + VMT_{SC} + VMT_{ANG} + VMT_{AFRC}$

VMT_{Total}: Total Vehicle Miles Travel (miles)
VMT_{AD}: Active Duty Personnel Vehicle Miles Travel (miles)
VMT_{C}: Civilian Personnel Vehicle Miles Travel (miles)
VMT_{SC}: Support Contractor Personnel Vehicle Miles Travel (miles)
VMT_{ANG}: Air National Guard Personnel Vehicle Miles Travel (miles)
VMT_{AFRC}: Reserve Personnel Vehicle Miles Travel (miles)

- Vehicle Emissions per Year
$V_{POL} = (VMT_{Total} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{Total}: Total Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Personnel On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

5. Construction / Demolition

5.1 General Information & Timeline Assumptions

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Operational Equipment Use

- Activity Description:
Operational Equipment Use

- Activity Start Date
Start Month: 12
Start Month: 2026

- Activity End Date
Indefinite: False
End Month: 11
End Month: 2056

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.788311
SO_x	0.021383
NO_x	6.586862
CO	9.309580

Pollutant	Total Emissions (TONs)
PM 10	0.224810
PM 2.5	0.206816
Pb	0.000000
NH_3	0.000000

- Activity Emissions of GHG:

Pollutant	Total Emissions (TONs)
CH_4	0.093873
N_2O	0.018768

Pollutant	Total Emissions (TONs)
CO_2	2313.978200
CO_2e	2321.919186

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- Global Scale Activity Emissions for SCGHG:

Pollutant	Total Emissions (TONs)
CH_4	0.093873
N_2O	0.018768

Pollutant	Total Emissions (TONs)
CO_2	2313.978200
CO_2e	2321.919186

5.1 Site Grading Phase

5.1.1 Site Grading Phase Timeline Assumptions

- Phase Start Date
Start Month: 12
Start Quarter: 1
Start Year: 2026

- Phase Duration
Number of Month: 360
Number of Days: 0

5.1.2 Site Grading Phase Assumptions

- General Site Grading Information
Area of Site to be Graded (ft^2): 0
Amount of Material to be Hauled On-Site (yd^3): 0
Amount of Material to be Hauled Off-Site (yd^3): 0

- Site Grading Default Settings
Default Settings Used: No
Average Day(s) worked per week: 5

- Construction Exhaust

Equipment Name	Number Of Equipment	Hours Per Day
Aerial Lifts Composite	2	1
Forklifts Composite	7	1
Off-Highway Trucks Composite	2	1
Rough Terrain Forklifts Composite	2	1

- Vehicle Exhaust
Average Hauling Truck Capacity (yd^3): 20
Average Hauling Truck Round Trip Commute (mile): 0

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 0

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

5.1.3 Site Grading Phase Emission Factor(s)

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour)

Aerial Lifts Composite [HP: 46] [LF: 0.31]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.15248	0.00542	2.87377	3.07542	0.02070	0.01905
Forklifts Composite [HP: 82] [LF: 0.2]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.24594	0.00487	2.34179	3.57902	0.11182	0.10287
Off-Highway Trucks Composite [HP: 376] [LF: 0.38]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.17585	0.00489	1.01131	1.17821	0.03561	0.03276
Rough Terrain Forklifts Composite [HP: 96] [LF: 0.4]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.11505	0.00489	1.64283	3.22011	0.03306	0.03041

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour)

Aerial Lifts Composite [HP: 46] [LF: 0.31]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02381	0.00476	586.90035	588.91444
Forklifts Composite [HP: 82] [LF: 0.2]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02138	0.00428	527.09717	528.90603
Off-Highway Trucks Composite [HP: 376] [LF: 0.38]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02147	0.00429	529.16792	530.98389
Rough Terrain Forklifts Composite [HP: 96] [LF: 0.4]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02145	0.00429	528.88931	530.70433

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**NH_3**
LDGV	0.14234	0.00266	0.07502	1.06799	0.01592	0.00555	0.03565
LDGT	0.18838	0.00330	0.13989	1.46024	0.01732	0.00618	0.03719
HDGV	0.24098	0.00505	0.22834	1.70597	0.02754	0.00971	0.03748
LDDV	0.02105	0.00209	0.18580	0.28873	0.02760	0.01668	0.00310
LDDT	0.01458	0.00278	0.06550	0.14150	0.02318	0.01184	0.00310
HDDV	0.09991	0.01077	2.12874	0.51062	0.11544	0.05583	0.18324
MC	5.54365	0.00204	0.71045	17.29267	0.01908	0.00809	0.00866

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	**N_2O**	**CO_2**	**CO_2e**
LDGV	0.01109	0.00883	269.03971	271.94837
LDGT	0.01534	0.01225	334.10216	338.13590
HDGV	0.01993	0.01699	510.51978	516.08005
LDDV	0.00098	0.03476	220.63766	231.02106
LDDT	0.00068	0.04624	293.49614	307.29273
HDDV	0.00464	0.17922	1137.52260	1191.04533
MC	0.24921	0.04641	206.70657	226.76743

5.1.4 Site Grading Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD}$ = (20 * ACRE * WD) / 2000

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)

20: Conversion Factor Acre Day to pounds (20 lb / 1 Acre Day)
ACRE: Total acres (acres)
WD: Number of Total Work Days (days)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase
CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL}* 0.002205) / 2000

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase
VMT_{VE} = (HA_{OnSite} + $HA_{OffSite}$) * (1 / HC) * HT

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
HA_{OnSite}: Amount of Material to be Hauled On-Site (yd^3)
$HA_{OffSite}$: Amount of Material to be Hauled Off-Site (yd^3)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
VMT_{WT} = WD * WT * 1.25 * NE

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

6. Emergency Generator

6.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: SLC 6 Emergency Generator

- Activity Description:
SLC 6 Emergency Generator

- Activity Start Date
Start Month: 12
Start Year: 2026

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	0.046540
SO_x	0.000813
NO_x	1.683500
CO	0.447200

Pollutant	Emissions Per Year (TONs)
PM 10	0.052585
PM 2.5	0.052585
Pb	0.000000
NH_3	0.000000

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.003009
N_2O	0.000602

Pollutant	Emissions Per Year (TONs)
CO_2	74.750000
CO_2e	86.450000

6.2 Emergency Generator Assumptions

- Emergency Generator
Type of Fuel used in Emergency Generator: Diesel
Number of Emergency Generators: 1

- Default Settings Used: No

- Emergency Generators Consumption
Emergency Generator's Horsepower: 1300
Average Operating Hours Per Year (hours): 100

6.3 Emergency Generator Emission Factor(s)

- Emergency Generators Criteria Pollutant Emission Factor (lb/hp-hr)

VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3
0.000716	0.0000125	0.0259	0.00688	0.000809	0.000809		

- Emergency Generators Greenhouse Gasses Pollutant Emission Factor (lb/hp-hr)

CH_4	N_2O	CO_2	CO_2e
0.000046297	0.000009259	1.15	1.33

6.4 Emergency Generator Formula(s)

- Emergency Generator Emissions per Year

AE_{POL}= (NGEN * HP * OT * EF_{POL}) / 2000

AE_{POL}: Activity Emissions (TONs per Year)
NGEN: Number of Emergency Generators
HP: Emergency Generator's Horsepower (hp)
OT: Average Operating Hours Per Year (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hp-hr)

7. Construction / Demolition

7.1 General Information & Timeline Assumptions

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: SLC-6 MAS Demo

- Activity Description:
SLC-6 MAS Demo

- Activity Start Date
Start Month: 11
Start Month: 2025

- Activity End Date
Indefinite: False
End Month: 4
End Month: 2026

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.037246
SO_x	0.001060
NO_x	0.375038
CO	0.408439

Pollutant	Total Emissions (TONs)
PM 10	0.865724
PM 2.5	0.011790
Pb	0.000000
NH_3	0.007974

- Activity Emissions of GHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002653
N_2O	0.008039

Pollutant	Total Emissions (TONs)
CO_2	106.983024
CO_2e	109.444875

- Global Scale Activity Emissions for SCGHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002653

Pollutant	Total Emissions (TONs)
CO_2	106.983024

N_2O	0.008039

CO_2e	109.444875

7.1 Demolition Phase

7.1.1 Demolition Phase Timeline Assumptions

- Phase Start Date
Start Month: 11
Start Quarter: 1
Start Year: 2025

- Phase Duration
Number of Month: 6
Number of Days: 0

7.1.2 Demolition Phase Assumptions

- General Demolition Information
Area of Building to be demolished (ft^2): 15000
Height of Building to be demolished (ft): 270

- Default Settings Used: Yes

- Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Concrete/Industrial Saws Composite	1	8
Rubber Tired Dozers Composite	1	1
Tractors/Loaders/Backhoes Composite	2	6

- Vehicle Exhaust
Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

7.1.3 Demolition Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.43930	0.00743	3.63468	4.34820	0.10060	0.09255
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]						

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.37086	0.00491	3.50629	2.90209	0.15396	0.14165
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.19600	0.00489	2.00960	3.48168	0.07738	0.07119

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02333	0.00467	575.01338	576.98668
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02159	0.00432	532.17175	533.99803
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02149	0.00430	529.86270	531.68105

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

7.1.4 Demolition Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (0.00042 * BA * BH) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
0.00042: Emission Factor (lb/ft^3)
BA: Area of Building to be demolished (ft^2)
BH: Height of Building to be demolished (ft)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)

H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase
$VMT_{VE} = BA * BH * (1 / 27) * 0.25 * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building being demolish (ft^2)
BH: Height of Building being demolish (ft)
(1 / 27): Conversion Factor cubic feet to cubic yards (1 yd^3 / 27 ft^3)
0.25: Volume reduction factor (material reduced by 75% to account for air space)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

8. Construction / Demolition

8.1 General Information & Timeline Assumptions

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

- Activity Title: SLC-6 FUT Demo

- Activity Description:
SLC-6 FUT Demo

- Activity Start Date
Start Month: 11
Start Month: 2025

- Activity End Date
Indefinite: False
End Month: 4
End Month: 2026

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.033815
SO_x	0.000707
NO_x	0.302386
CO	0.391393

Pollutant	Total Emissions (TONs)
PM 10	0.188477
PM 2.5	0.009921
Pb	0.000000
NH_3	0.002066

- Activity Emissions of GHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002493
N_2O	0.002156

Pollutant	Total Emissions (TONs)
CO_2	69.645164
CO_2e	70.350016

- Global Scale Activity Emissions for SCGHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002493
N_2O	0.002156

Pollutant	Total Emissions (TONs)
CO_2	69.645164
CO_2e	70.350016

8.1 Demolition Phase

8.1.1 Demolition Phase Timeline Assumptions

- Phase Start Date
Start Month: 11
Start Quarter: 1
Start Year: 2025

- Phase Duration
Number of Month: 6
Number of Days: 0

8.1.2 Demolition Phase Assumptions

- General Demolition Information
Area of Building to be demolished (ft^2): 4216
Height of Building to be demolished (ft): 200

- Default Settings Used: Yes

- Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Concrete/Industrial Saws Composite	1	8
Rubber Tired Dozers Composite	1	1
Tractors/Loaders/Backhoes Composite	2	6

- Vehicle Exhaust

Average Hauling Truck Capacity (yd^3): 20 (default)

Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips

Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

8.1.3 Demolition Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.43930	0.00743	3.63468	4.34820	0.10060	0.09255
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.37086	0.00491	3.50629	2.90209	0.15396	0.14165
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.19600	0.00489	2.00960	3.48168	0.07738	0.07119

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02333	0.00467	575.01338	576.98668
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02159	0.00432	532.17175	533.99803
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02149	0.00430	529.86270	531.68105

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

8.1.4 Demolition Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (0.00042 * BA * BH) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
0.00042: Emission Factor (lb/ft^3)
BA: Area of Building to be demolished (ft^2)
BH: Height of Building to be demolished (ft)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = BA * BH * (1 / 27) * 0.25 * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building being demolish (ft^2)
BH: Height of Building being demolish (ft)
(1 / 27): Conversion Factor cubic feet to cubic yards (1 yd^3 / 27 ft^3)
0.25: Volume reduction factor (material reduced by 75% to account for air space)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

9. Construction / Demolition

9.1 General Information & Timeline Assumptions

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: SLC-6 Crown Demo

- Activity Description:
SLC-6 Crown Demo

- Activity Start Date
Start Month: 11
Start Month: 2025

- Activity End Date
Indefinite: False
End Month: 4
End Month: 2026

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.033393
SO_x	0.000663
NO_x	0.293450
CO	0.389296

Pollutant	Total Emissions (TONs)
PM 10	0.105184
PM 2.5	0.009692
Pb	0.000000
NH_3	0.001339

- Activity Emissions of GHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002474
N_2O	0.001433

Pollutant	Total Emissions (TONs)
CO_2	65.053031
CO_2e	65.541793

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- Global Scale Activity Emissions for SCGHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002474
N_2O	0.001433

Pollutant	Total Emissions (TONs)
CO_2	65.053031
CO_2e	65.541793

9.1 Demolition Phase

9.1.1 Demolition Phase Timeline Assumptions

- Phase Start Date
Start Month: 11
Start Quarter: 1
Start Year: 2025

- Phase Duration
Number of Month: 6
Number of Days: 0

9.1.2 Demolition Phase Assumptions

- General Demolition Information
Area of Building to be demolished (ft^2): 10200
Height of Building to be demolished (ft): 44

- Default Settings Used: Yes

- Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Concrete/Industrial Saws Composite	1	8
Rubber Tired Dozers Composite	1	1
Tractors/Loaders/Backhoes Composite	2	6

- Vehicle Exhaust
Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

9.1.3 Demolition Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.43930	0.00743	3.63468	4.34820	0.10060	0.09255
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.37086	0.00491	3.50629	2.90209	0.15396	0.14165
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.19600	0.00489	2.00960	3.48168	0.07738	0.07119

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02333	0.00467	575.01338	576.98668
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02159	0.00432	532.17175	533.99803
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02149	0.00430	529.86270	531.68105

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

9.1.4 Demolition Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (0.00042 * BA * BH) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
0.00042: Emission Factor (lb/ft^3)
BA: Area of Building to be demolished (ft^2)
BH: Height of Building to be demolished (ft)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase
$VMT_{VE} = BA * BH * (1 / 27) * 0.25 * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building being demolish (ft^2)
BH: Height of Building being demolish (ft)
(1 / 27): Conversion Factor cubic feet to cubic yards (1 yd^3 / 27 ft^3)
0.25: Volume reduction factor (material reduced by 75% to account for air space)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

10. Construction / Demolition

10.1 General Information & Timeline Assumptions

- Activity Location

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: SLC-6 MST Demo

- Activity Description:
SLC-6 MST Demo

- Activity Start Date
Start Month: 11
Start Month: 2025

- Activity End Date
Indefinite: False
End Month: 4
End Month: 2026

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.040446
SO_x	0.001390
NO_x	0.442779
CO	0.424332

Pollutant	Total Emissions (TONs)
PM 10	1.497185
PM 2.5	0.013532
Pb	0.000000
NH_3	0.013483

- Activity Emissions of GHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002801
N_2O	0.013524

Pollutant	Total Emissions (TONs)
CO_2	141.796609
CO_2e	145.896674

- Global Scale Activity Emissions for SCGHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002801
N_2O	0.013524

Pollutant	Total Emissions (TONs)
CO_2	141.796609
CO_2e	145.896674

10.1 Demolition Phase

10.1.1 Demolition Phase Timeline Assumptions

- Phase Start Date
Start Month: 11
Start Quarter: 1
Start Year: 2025

- Phase Duration
Number of Month: 6
Number of Days: 0

10.1.2 Demolition Phase Assumptions

- General Demolition Information
Area of Building to be demolished (ft^2): 25600
Height of Building to be demolished (ft): 275

- Default Settings Used: Yes

- Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Concrete/Industrial Saws Composite	1	8
Rubber Tired Dozers Composite	1	1
Tractors/Loaders/Backhoes Composite	2	6

- Vehicle Exhaust

Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips

Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

10.1.3 Demolition Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.43930	0.00743	3.63468	4.34820	0.10060	0.09255
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.37086	0.00491	3.50629	2.90209	0.15396	0.14165
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.19600	0.00489	2.00960	3.48168	0.07738	0.07119

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02333	0.00467	575.01338	576.98668
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02159	0.00432	532.17175	533.99803
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02149	0.00430	529.86270	531.68105

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
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HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
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MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

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	CH_4	N_2O	CO_2	CO_2e
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LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

10.1.4 Demolition Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (0.00042 * BA * BH) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
0.00042: Emission Factor (lb/ft^3)
BA: Area of Building to be demolished (ft^2)
BH: Height of Building to be demolished (ft)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = BA * BH * (1 / 27) * 0.25 * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building being demolish (ft^2)
BH: Height of Building being demolish (ft)
(1 / 27): Conversion Factor cubic feet to cubic yards (1 yd^3 / 27 ft^3)
0.25: Volume reduction factor (material reduced by 75% to account for air space)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds

EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

1. General Information

- Action Location
Base: VANDENBERG AFB
State: California
County(s): Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Action Title: Falcon Program at Vandenberg Space Force Base Proposed Action

- Project Number/s (if applicable):

- Projected Action Start Date: 11 / 2025

- Action Purpose and Need:
Space Exploration Technologies Corporation (SpaceX) has applied to the United States Space Force (USSF) to increase Falcon flight opportunities at Vandenberg Space Force Base (VSFB) in support of manifested and anticipated vehicle operations for Falcon 9 and Falcon Heavy. SpaceX currently launches commercial and government payloads from VSFB at SLC-4 and has been allocated SLC-6 by the USSF. SpaceX supports, and is under contract for, the full spectrum of U.S. Government space mission requirements, including crew and cargo transportation for the National Aeronautics and Space Administration (NASA) and spacecraft launches for NASA and the U.S. Department of Defense (DOD).

- Action Description:
The Proposed Action is to increase the annual Falcon launch cadence at VSFB through launches at SLC-4 and SLC-6 and the modification of SLC 6 for Falcon launch vehicles to support future commercial and U.S. government launch service needs. SpaceX would launch Falcon 9 from SLC-4 and SLC-6, and Falcon Heavy from SLC-6. Falcon 9 is approximately 229 feet tall and produces approximately 1.7 million pounds of thrust at liftoff. A discussion of Falcon 9 can be found in the 2016 EA and associated supplemental environmental documents. Falcon Heavy is a heavy-lift vehicle that produces 5.12 million pounds of thrust at liftoff and has the ability to lift 141,000 pounds into low Earth orbit. Merlin engines are used on both stages of Falcon Heavy. The center core and two side boosters are essentially the same design as a Falcon 9 first stage booster, thus Falcon Heavy uses the same type of propellants as Falcon 9. Additionally, Falcon Heavy uses the same second stage as Falcon 9.

Under the Proposed Action, SpaceX would implement the Proposed Action and would modify the horizontal integration facility (HIF) located north of SLC 6 to support Falcon 9 and Falcon Heavy operations. As part of this Proposed Action, SpaceX would demolish the Mobile Service Tower, Mobile Assembly Shelter, Fixed Umbilical Tower, and the launch crown at SLC-6. Modifications would include interior work, construction of an approximately 5,000 square foot annex on the south side of the building, and construction of an approximately 42,000 square foot paved area north of the building to provide rear access into the hangar. SpaceX would construct rails from the hangar to the launch pad to transport Falcon.

- Point of Contact
Name: Adam Poll
Title: Civilian
Organization: Dudek
Email: apoll@dudek.com
Phone Number: 805-308-8516

Report generated with ACAM version: 5.0.23a

- Activity List:

Activity Type		Activity Title
2.	Construction / Demolition	SLC-6 Modifications

3.	Personnel	Fleet Vehicle Use
4.	Personnel	Vendor-Contractor Vehicles
5.	Construction / Demolition	Operational Equipment Use
6.	Emergency Generator	SLC 6 Emergency Generator
7.	Construction / Demolition	SLC-6 MAS Demo
8.	Construction / Demolition	SLC-6 FUT Demo
9.	Construction / Demolition	SLC-6 Crown Demo
10.	Construction / Demolition	SLC-6 MST Demo

Emission factors and air emission estimating methods come from the United States Air Force's Air Emissions Guide for Air Force Stationary Sources, Air Emissions Guide for Air Force Mobile Sources, and Air Emissions Guide for Air Force Transitory Sources.

2. Construction / Demolition

2.1 General Information & Timeline Assumptions

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: SLC-6 Modifications

- Activity Description:
SpaceX would modify SLC-6 to support Falcon 9 and Falcon Heavy launches. SpaceX would construct commodity storage tanks, a vehicle erector, a water tower, ground supporting equipment, and a rail system from the hangar to the launch pad. Where possible, existing infrastructure would be modified. This could include the liquid oxygen storage, launch pad apron and access road, and fence line. The existing flame trench would be converted to a unidirectional water-cooled diverter and a deluge/acoustic suppression system would be installed. Construction would generally occur in previously disturbed areas and on existing impervious surfaces, but some earthwork is anticipated. A new hangar or modification of an existing structure would be required for vehicle processing. A discussion of hangar alternatives is included in Section 2.2.
Approximately 143,000 square feet of commodity storage would be required. This includes storage tanks for liquid oxygen, rocket propellant-1, water, nitrogen, helium, and other launch commodities. A 200-foot water tower would be constructed on the east side of the launch complex.
Existing utilities such as power, communications, and fluids systems would be modified or reconstructed within the existing launch complex for Falcon as needed. Firebreaks would be incorporated as appropriate into the site design and final site layout is subject to SLD 30 review and approval.
Under Alternative 1, SpaceX would implement the Proposed Action and would modify the horizontal integration facility (HIF) located north of SLC 6 to support Falcon 9 and Falcon Heavy operations. Modifications would include interior work, construction of an approximately 5,000 square foot annex on the south side of the building, and construction of an approximately 42,000 square foot paved area north of the building to provide rear access into the hangar. SpaceX would construct rails from the hangar to the launch pad to transport Falcon.

- Activity Start Date
Start Month: 11
Start Month: 2025

- Activity End Date
Indefinite: False
End Month: 10
End Month: 2026

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	1.891449
SO_x	0.008753
NO_x	2.561380
CO	1.951662

Pollutant	Total Emissions (TONs)
PM 10	3.223485
PM 2.5	0.080259
Pb	0.000000
NH_3	0.096741

- Activity Emissions of GHG:

Pollutant	Total Emissions (TONs)
CH_4	0.014683
N_2O	0.097093

Pollutant	Total Emissions (TONs)
CO_2	894.320351
CO_2e	923.620848

- Global Scale Activity Emissions for SCGHG:

Pollutant	Total Emissions (TONs)
CH_4	0.014683
N_2O	0.097093

Pollutant	Total Emissions (TONs)
CO_2	894.320351
CO_2e	923.620848

2.1 Site Grading Phase

2.1.1 Site Grading Phase Timeline Assumptions

- Phase Start Date
Start Month: 11
Start Quarter: 1
Start Year: 2025

- Phase Duration
Number of Month: 1
Number of Days: 0

2.1.2 Site Grading Phase Assumptions

- General Site Grading Information
Area of Site to be Graded (ft^2): 312325
Amount of Material to be Hauled On-Site (yd^3): 0
Amount of Material to be Hauled Off-Site (yd^3): 0

- Site Grading Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Graders Composite	1	8
Other Construction Equipment Composite	1	8
Rubber Tired Dozers Composite	1	8
Tractors/Loaders/Backhoes Composite	2	7

- Vehicle Exhaust
Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

2.1.3 Site Grading Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Graders Composite [HP: 148] [LF: 0.41]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.33951	0.00490	2.85858	3.41896	0.15910	0.14637
Other Construction Equipment Composite [HP: 82] [LF: 0.42]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.29762	0.00487	2.89075	3.51214	0.17229	0.15851
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.37086	0.00491	3.50629	2.90209	0.15396	0.14165
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.19600	0.00489	2.00960	3.48168	0.07738	0.07119

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Graders Composite [HP: 148] [LF: 0.41]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02155	0.00431	531.19419	533.01712
Other Construction Equipment Composite [HP: 82] [LF: 0.42]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02141	0.00428	527.74261	529.55369
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02159	0.00432	532.17175	533.99803
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02149	0.00430	529.86270	531.68105

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759

LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

2.1.4 Site Grading Phase Formula(s)

- Fugitive Dust Emissions per Phase
$PM10_{FD}$ = (20 * ACRE * WD) / 2000

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
20: Conversion Factor Acre Day to pounds (20 lb / 1 Acre Day)
ACRE: Total acres (acres)
WD: Number of Total Work Days (days)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase
CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL}* 0.002205) / 2000

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase
VMT_{VE} = (HA_{OnSite} + $HA_{OffSite}$) * (1 / HC) * HT

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
HA_{OnSite}: Amount of Material to be Hauled On-Site (yd^3)
$HA_{OffSite}$: Amount of Material to be Hauled Off-Site (yd^3)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
VMT_{WT} = WD * WT * 1.25 * NE

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)

WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

2.2 Building Construction Phase

2.2.1 Building Construction Phase Timeline Assumptions

- Phase Start Date
Start Month: 11
Start Quarter: 1
Start Year: 2025

- Phase Duration
Number of Month: 11
Number of Days: 0

2.2.2 Building Construction Phase Assumptions

- General Building Construction Information
Building Category: Office or Industrial
Area of Building (ft^2): 148000
Height of Building (ft): 200
Number of Units: N/A

- Building Construction Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Cranes Composite	1	6
Forklifts Composite	2	6
Generator Sets Composite	1	8
Tractors/Loaders/Backhoes Composite	1	8
Welders Composite	3	8

- Vehicle Exhaust
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips

Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

- Vendor Trips

Average Vendor Round Trip Commute (mile): 40 (default)

- Vendor Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

2.2.3 Building Construction Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Cranes Composite [HP: 367] [LF: 0.29]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.20113	0.00487	1.94968	1.66287	0.07909	0.07277
Forklifts Composite [HP: 82] [LF: 0.2]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.26944	0.00487	2.55142	3.59881	0.13498	0.12418
Generator Sets Composite [HP: 14] [LF: 0.74]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.54223	0.00793	4.34662	2.86938	0.17681	0.16267
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.19600	0.00489	2.00960	3.48168	0.07738	0.07119
Welders Composite [HP: 46] [LF: 0.45]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.49757	0.00735	3.67618	4.52476	0.11274	0.10373

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Cranes Composite [HP: 367] [LF: 0.29]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02140	0.00428	527.58451	529.39505
Forklifts Composite [HP: 82] [LF: 0.2]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02138	0.00428	527.10822	528.91712
Generator Sets Composite [HP: 14] [LF: 0.74]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02305	0.00461	568.32220	570.27253
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02149	0.00430	529.86270	531.68105
Welders Composite [HP: 46] [LF: 0.45]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02305	0.00461	568.30078	570.25105

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696

LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

2.2.4 Building Construction Phase Formula(s)

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = BA * BH * (0.42 / 1000) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.42 / 1000): Conversion Factor ft^3 to trips (0.42 trip / 1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase

$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works

NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Vender Trips Emissions per Phase
$VMT_{VT} = BA * BH * (0.38 / 1000) * HT$

VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.38 / 1000): Conversion Factor ft^3 to trips (0.38 trip / 1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

2.3 Architectural Coatings Phase

2.3.1 Architectural Coatings Phase Timeline Assumptions

- Phase Start Date
Start Month: 10
Start Quarter: 1
Start Year: 2026

- Phase Duration
Number of Month: 1
Number of Days: 0

2.3.2 Architectural Coatings Phase Assumptions

- General Architectural Coatings Information
Building Category: Non-Residential
Total Square Footage (ft^2): 143000
Number of Units: N/A

- Architectural Coatings Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

2.3.3 Architectural Coatings Phase Emission Factor(s)

- Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

2.3.4 Architectural Coatings Phase Formula(s)

- Worker Trips Emissions per Phase

$VMT_{WT} = (1 * WT * PA) / 800$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
1: Conversion Factor man days to trips (1 trip / 1 man * day)
WT: Average Worker Round Trip Commute (mile)
PA: Paint Area (ft^2)
800: Conversion Factor square feet to man days (1 ft^2 / 1 man * day)

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Off-Gassing Emissions per Phase

$VOC_{AC} = (AB * 2.0 * 0.0116) / 2000.0$

VOC_{AC}: Architectural Coating VOC Emissions (TONs)
BA: Area of Building (ft^2)
2.0: Conversion Factor total area to coated area (2.0 ft^2 coated area / total area)
0.0116: Emission Factor (lb/ft^2)
2000: Conversion Factor pounds to tons

2.4 Paving Phase

2.4.1 Paving Phase Timeline Assumptions

- Phase Start Date
Start Month: 10
Start Quarter: 1
Start Year: 2026

- Phase Duration
Number of Month: 1
Number of Days: 0

2.4.2 Paving Phase Assumptions

- General Paving Information
Paving Area (ft^2): 185000

- Paving Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Cement and Mortar Mixers Composite	4	6
Pavers Composite	1	7
Paving Equipment Composite	2	6
Rollers Composite	1	7

- Vehicle Exhaust
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

2.4.3 Paving Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Cement and Mortar Mixers Composite [HP: 10] [LF: 0.56]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.55280	0.00854	4.19778	3.25481	0.16332	0.15025
Pavers Composite [HP: 81] [LF: 0.42]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.23717	0.00486	2.53335	3.43109	0.12904	0.11872

Paving Equipment Composite [HP: 89] [LF: 0.36]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.18995	0.00487	2.06537	3.40278	0.08031	0.07388
Rollers Composite [HP: 36] [LF: 0.38]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.54202	0.00541	3.61396	4.09268	0.15387	0.14156

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Cement and Mortar Mixers Composite [HP: 10] [LF: 0.56]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02313	0.00463	570.16326	572.11992
Pavers Composite [HP: 81] [LF: 0.42]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02133	0.00427	525.80405	527.60847
Paving Equipment Composite [HP: 89] [LF: 0.36]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02141	0.00428	527.70636	529.51732
Rollers Composite [HP: 36] [LF: 0.38]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02381	0.00476	586.91372	588.92786

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

2.4.4 Paving Phase Formula(s)

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * EF_{POL}) / 2000$

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower

LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase
$VMT_{VE} = PA * 0.25 * (1 / 27) * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
PA: Paving Area (ft^2)
0.25: Thickness of Paving Area (ft)
(1 / 27): Conversion Factor cubic feet to cubic yards (1 yd^3 / 27 ft^3)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Off-Gassing Emissions per Phase
$VOC_P = (2.62 * PA) / 43560 / 2000$

VOC_P: Paving VOC Emissions (TONs)
2.62: Emission Factor (lb/acre)
PA: Paving Area (ft^2)
43560: Conversion Factor square feet to acre (43560 ft2 / acre)^2 / acre)
2000: Conversion Factor square pounds to TONs (2000 lb / TON)

3. Personnel

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

3.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Fleet Vehicle Use

- Activity Description:
Fleet Vehicle Use

- Activity Start Date
Start Month: 12
Start Year: 2026

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	0.078096
SO_x	0.000870
NO_x	0.036186
CO	0.461729

Pollutant	Emissions Per Year (TONs)
PM 10	0.004828
PM 2.5	0.001718
Pb	0.000000
NH_3	0.010317

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.005204
N_2O	0.003351

Pollutant	Emissions Per Year (TONs)
CO_2	88.040375
CO_2e	89.168978

3.2 Personnel Assumptions

- Number of Personnel
Active Duty Personnel: 0
Civilian Personnel: 0
Support Contractor Personnel: 50
Air National Guard (ANG) Personnel: 0
Reserve Personnel: 0

- Default Settings Used: Yes

- Average Personnel Round Trip Commute (mile): 20 (default)

- Personnel Work Schedule
Active Duty Personnel: 5 Days Per Week (default)
Civilian Personnel: 5 Days Per Week (default)
Support Contractor Personnel: 5 Days Per Week (default)
Air National Guard (ANG) Personnel: 4 Days Per Week (default)
Reserve Personnel: 4 Days Per Month (default)

3.3 Personnel On Road Vehicle Mixture

- On Road Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	37.55	60.32	0	0.03	0.2	0	1.9
GOVs	54.49	37.73	4.67	0	0	3.11	0

3.4 Personnel Emission Factor(s)

- On Road Vehicle Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.14234	0.00266	0.07502	1.06799	0.01592	0.00555	0.03565
LDGT	0.18838	0.00330	0.13989	1.46024	0.01732	0.00618	0.03719
HDGV	0.24098	0.00505	0.22834	1.70597	0.02754	0.00971	0.03748
LDDV	0.02105	0.00209	0.18580	0.28873	0.02760	0.01668	0.00310
LDDT	0.01458	0.00278	0.06550	0.14150	0.02318	0.01184	0.00310
HDDV	0.09991	0.01077	2.12874	0.51062	0.11544	0.05583	0.18324
MC	5.54365	0.00204	0.71045	17.29267	0.01908	0.00809	0.00866

- On Road Vehicle Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01109	0.00883	269.03971	271.94837
LDGT	0.01534	0.01225	334.10216	338.13590
HDGV	0.01993	0.01699	510.51978	516.08005
LDDV	0.00098	0.03476	220.63766	231.02106
LDDT	0.00068	0.04624	293.49614	307.29273
HDDV	0.00464	0.17922	1137.52260	1191.04533
MC	0.24921	0.04641	206.70657	226.76743

3.5 Personnel Formula(s)

- Personnel Vehicle Miles Travel for Work Days per Year

$VMT_P = NP * WD * AC$

VMT_P: Personnel Vehicle Miles Travel (miles/year)
NP: Number of Personnel
WD: Work Days per Year
AC: Average Commute (miles)

- Total Vehicle Miles Travel per Year

$VMT_{Total} = VMT_{AD} + VMT_C + VMT_{SC} + VMT_{ANG} + VMT_{AFRC}$

VMT_{Total}: Total Vehicle Miles Travel (miles)
VMT_{AD}: Active Duty Personnel Vehicle Miles Travel (miles)
VMT_C: Civilian Personnel Vehicle Miles Travel (miles)
VMT_{SC}: Support Contractor Personnel Vehicle Miles Travel (miles)
VMT_{ANG}: Air National Guard Personnel Vehicle Miles Travel (miles)
VMT_{AFRC}: Reserve Personnel Vehicle Miles Travel (miles)

- Vehicle Emissions per Year

$V_{POL} = (VMT_{Total} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{Total}: Total Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)

VM: Personnel On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

4. Personnel

4.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Vendor-Contractor Vehicles

- Activity Description:
Vendor-Contractor Vehicles

- Activity Start Date
Start Month: 12
Start Year: 2026

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	0.104649
SO_x	0.001166
NO_x	0.048489
CO	0.618717

Pollutant	Emissions Per Year (TONs)
PM 10	0.006469
PM 2.5	0.002302
Pb	0.000000
NH_3	0.013825

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.006973
N_2O	0.004490

Pollutant	Emissions Per Year (TONs)
CO_2	117.974102
CO_2e	119.486431

4.2 Personnel Assumptions

- Number of Personnel
Active Duty Personnel: 0
Civilian Personnel: 0
Support Contractor Personnel: 67
Air National Guard (ANG) Personnel: 0
Reserve Personnel: 0

- Default Settings Used: Yes

- Average Personnel Round Trip Commute (mile): 20 (default)

- Personnel Work Schedule

Active Duty Personnel: 5 Days Per Week (default)
Civilian Personnel: 5 Days Per Week (default)
Support Contractor Personnel: 5 Days Per Week (default)
Air National Guard (ANG) Personnel: 4 Days Per Week (default)
Reserve Personnel: 4 Days Per Month (default)

4.3 Personnel On Road Vehicle Mixture

- On Road Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	37.55	60.32	0	0.03	0.2	0	1.9
GOVs	54.49	37.73	4.67	0	0	3.11	0

4.4 Personnel Emission Factor(s)

- On Road Vehicle Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.14234	0.00266	0.07502	1.06799	0.01592	0.00555	0.03565
LDGT	0.18838	0.00330	0.13989	1.46024	0.01732	0.00618	0.03719
HDGV	0.24098	0.00505	0.22834	1.70597	0.02754	0.00971	0.03748
LDDV	0.02105	0.00209	0.18580	0.28873	0.02760	0.01668	0.00310
LDDT	0.01458	0.00278	0.06550	0.14150	0.02318	0.01184	0.00310
HDDV	0.09991	0.01077	2.12874	0.51062	0.11544	0.05583	0.18324
MC	5.54365	0.00204	0.71045	17.29267	0.01908	0.00809	0.00866

- On Road Vehicle Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01109	0.00883	269.03971	271.94837
LDGT	0.01534	0.01225	334.10216	338.13590
HDGV	0.01993	0.01699	510.51978	516.08005
LDDV	0.00098	0.03476	220.63766	231.02106
LDDT	0.00068	0.04624	293.49614	307.29273
HDDV	0.00464	0.17922	1137.52260	1191.04533
MC	0.24921	0.04641	206.70657	226.76743

4.5 Personnel Formula(s)

- Personnel Vehicle Miles Travel for Work Days per Year
$VMT_P = NP * WD * AC$

VMT_P: Personnel Vehicle Miles Travel (miles/year)
NP: Number of Personnel
WD: Work Days per Year
AC: Average Commute (miles)

- Total Vehicle Miles Travel per Year
$VMT_{Total} = VMT_{AD} + VMT_C + VMT_{SC} + VMT_{ANG} + VMT_{AFRC}$

VMT_{Total}: Total Vehicle Miles Travel (miles)
VMT_{AD}: Active Duty Personnel Vehicle Miles Travel (miles)
VMT_C: Civilian Personnel Vehicle Miles Travel (miles)
VMT_{SC}: Support Contractor Personnel Vehicle Miles Travel (miles)
VMT_{ANG}: Air National Guard Personnel Vehicle Miles Travel (miles)
VMT_{AFRC}: Reserve Personnel Vehicle Miles Travel (miles)

- Vehicle Emissions per Year
$V_{POL} = (VMT_{Total} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{Total}: Total Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Personnel On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

5. Construction / Demolition

5.1 General Information & Timeline Assumptions

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Operational Equipment Use

- Activity Description:
Operational Equipment Use

- Activity Start Date
Start Month: 12
Start Month: 2026

- Activity End Date
Indefinite: False
End Month: 11
End Month: 2056

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.788311
SO_x	0.021383
NO_x	6.586862
CO	9.309580

Pollutant	Total Emissions (TONs)
PM 10	0.224810
PM 2.5	0.206816
Pb	0.000000
NH_3	0.000000

- Activity Emissions of GHG:

Pollutant	Total Emissions (TONs)
CH_4	0.093873
N_2O	0.018768

Pollutant	Total Emissions (TONs)
CO_2	2313.978200
CO_2e	2321.919186

- Global Scale Activity Emissions for SCGHG:

Pollutant	Total Emissions (TONs)
CH_4	0.093873
N_2O	0.018768

Pollutant	Total Emissions (TONs)
CO_2	2313.978200
CO_2e	2321.919186

5.1 Site Grading Phase

5.1.1 Site Grading Phase Timeline Assumptions

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

- Phase Start Date
Start Month: 12
Start Quarter: 1
Start Year: 2026

- Phase Duration
Number of Month: 360
Number of Days: 0

5.1.2 Site Grading Phase Assumptions

- General Site Grading Information
Area of Site to be Graded (ft^2): 0
Amount of Material to be Hauled On-Site (yd^3): 0
Amount of Material to be Hauled Off-Site (yd^3): 0

- Site Grading Default Settings
Default Settings Used: No
Average Day(s) worked per week: 5

- Construction Exhaust

Equipment Name	Number Of Equipment	Hours Per Day
Aerial Lifts Composite	2	1
Forklifts Composite	7	1
Off-Highway Trucks Composite	2	1
Rough Terrain Forklifts Composite	2	1

- Vehicle Exhaust
Average Hauling Truck Capacity (yd^3): 20
Average Hauling Truck Round Trip Commute (mile): 0

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 0

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

5.1.3 Site Grading Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour)

Aerial Lifts Composite [HP: 46] [LF: 0.31]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.15248	0.00542	2.87377	3.07542	0.02070	0.01905
Forklifts Composite [HP: 82] [LF: 0.2]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.24594	0.00487	2.34179	3.57902	0.11182	0.10287
Off-Highway Trucks Composite [HP: 376] [LF: 0.38]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5

Emission Factors	0.17585	0.00489	1.01131	1.17821	0.03561	0.03276
Rough Terrain Forklifts Composite [HP: 96] [LF: 0.4]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.11505	0.00489	1.64283	3.22011	0.03306	0.03041

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour)

Aerial Lifts Composite [HP: 46] [LF: 0.31]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02381	0.00476	586.90035	588.91444
Forklifts Composite [HP: 82] [LF: 0.2]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02138	0.00428	527.09717	528.90603
Off-Highway Trucks Composite [HP: 376] [LF: 0.38]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02147	0.00429	529.16792	530.98389
Rough Terrain Forklifts Composite [HP: 96] [LF: 0.4]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02145	0.00429	528.88931	530.70433

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**NH_3**
LDGV	0.14234	0.00266	0.07502	1.06799	0.01592	0.00555	0.03565
LDGT	0.18838	0.00330	0.13989	1.46024	0.01732	0.00618	0.03719
HDGV	0.24098	0.00505	0.22834	1.70597	0.02754	0.00971	0.03748
LDDV	0.02105	0.00209	0.18580	0.28873	0.02760	0.01668	0.00310
LDDT	0.01458	0.00278	0.06550	0.14150	0.02318	0.01184	0.00310
HDDV	0.09991	0.01077	2.12874	0.51062	0.11544	0.05583	0.18324
MC	5.54365	0.00204	0.71045	17.29267	0.01908	0.00809	0.00866

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	**N_2O**	**CO_2**	**CO_2e**
LDGV	0.01109	0.00883	269.03971	271.94837
LDGT	0.01534	0.01225	334.10216	338.13590
HDGV	0.01993	0.01699	510.51978	516.08005
LDDV	0.00098	0.03476	220.63766	231.02106
LDDT	0.00068	0.04624	293.49614	307.29273
HDDV	0.00464	0.17922	1137.52260	1191.04533
MC	0.24921	0.04641	206.70657	226.76743

5.1.4 Site Grading Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (20 * ACRE * WD) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
20: Conversion Factor Acre Day to pounds (20 lb / 1 Acre Day)
ACRE: Total acres (acres)
WD: Number of Total Work Days (days)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)

NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase
$VMT_{VE} = (HA_{OnSite} + HA_{OffSite}) * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
HA_{OnSite}: Amount of Material to be Hauled On-Site (yd^3)
$HA_{OffSite}$: Amount of Material to be Hauled Off-Site (yd^3)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

6. Emergency Generator

6.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Santa Barbara

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: SLC 6 Emergency Generator

- Activity Description:
SLC 6 Emergency Generator

- Activity Start Date
Start Month: 12
Start Year: 2026

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	0.046540
SO_x	0.000813
NO_x	1.683500
CO	0.447200

Pollutant	Emissions Per Year (TONs)
PM 10	0.052585
PM 2.5	0.052585
Pb	0.000000
NH_3	0.000000

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.003009
N_2O	0.000602

Pollutant	Emissions Per Year (TONs)
CO_2	74.750000
CO_2e	86.450000

6.2 Emergency Generator Assumptions

- Emergency Generator
Type of Fuel used in Emergency Generator: Diesel
Number of Emergency Generators: 1

- Default Settings Used: No

- Emergency Generators Consumption
Emergency Generator's Horsepower: 1300
Average Operating Hours Per Year (hours): 100

6.3 Emergency Generator Emission Factor(s)

- Emergency Generators Criteria Pollutant Emission Factor (lb/hp-hr)

VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3
0.000716	0.0000125	0.0259	0.00688	0.000809	0.000809		

- Emergency Generators Greenhouse Gasses Pollutant Emission Factor (lb/hp-hr)

CH_4	N_2O	CO_2	CO_2e
0.000046297	0.000009259	1.15	1.33

6.4 Emergency Generator Formula(s)

- Emergency Generator Emissions per Year
AE_{POL}= (NGEN * HP * OT * EF_{POL}) / 2000

AE_{POL}: Activity Emissions (TONs per Year)
NGEN: Number of Emergency Generators
HP: Emergency Generator's Horsepower (hp)
OT: Average Operating Hours Per Year (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hp-hr)

7. Construction / Demolition

7.1 General Information & Timeline Assumptions

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: SLC-6 MAS Demo

- Activity Description:
SLC-6 MAS Demo

- Activity Start Date
Start Month: 11
Start Month: 2025

- Activity End Date
Indefinite: False
End Month: 4
End Month: 2026

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.037246
SO_x	0.001060
NO_x	0.375038
CO	0.408439

Pollutant	Total Emissions (TONs)
PM 10	0.865724
PM 2.5	0.011790
Pb	0.000000
NH_3	0.007974

- Activity Emissions of GHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002653
N_2O	0.008039

Pollutant	Total Emissions (TONs)
CO_2	106.983024
CO_2e	109.444875

- Global Scale Activity Emissions for SCGHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002653
N_2O	0.008039

Pollutant	Total Emissions (TONs)
CO_2	106.983024
CO_2e	109.444875

7.1 Demolition Phase

7.1.1 Demolition Phase Timeline Assumptions

- Phase Start Date
Start Month: 11
Start Quarter: 1
Start Year: 2025

- Phase Duration
Number of Month: 6
Number of Days: 0

7.1.2 Demolition Phase Assumptions

- General Demolition Information
Area of Building to be demolished (ft^2): 15000
Height of Building to be demolished (ft): 270

- Default Settings Used: Yes

- Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Concrete/Industrial Saws Composite	1	8
Rubber Tired Dozers Composite	1	1
Tractors/Loaders/Backhoes Composite	2	6

- Vehicle Exhaust
Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

7.1.3 Demolition Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.43930	0.00743	3.63468	4.34820	0.10060	0.09255
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.37086	0.00491	3.50629	2.90209	0.15396	0.14165
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.19600	0.00489	2.00960	3.48168	0.07738	0.07119

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02333	0.00467	575.01338	576.98668

Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02159	0.00432	532.17175	533.99803
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02149	0.00430	529.86270	531.68105

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

7.1.4 Demolition Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD}$ = (0.00042 * BA * BH) / 2000

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
0.00042: Emission Factor (lb/ft^3)
BA: Area of Building to be demolished (ft^2)
BH: Height of Building to be demolished (ft)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase

CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

VMT_{VE} = BA * BH * (1 / 27) * 0.25 * (1 / HC) * HT

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)

BA: Area of Building being demolish (ft^2)
BH: Height of Building being demolish (ft)
(1 / 27): Conversion Factor cubic feet to cubic yards (1 yd^3 / 27 ft^3)
0.25: Volume reduction factor (material reduced by 75% to account for air space)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

8. Construction / Demolition

8.1 General Information & Timeline Assumptions

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: SLC-6 FUT Demo

- Activity Description:
SLC-6 FUT Demo

- Activity Start Date
Start Month: 11
Start Month: 2025

- Activity End Date
Indefinite: False

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

End Month: 4
End Month: 2026

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.033815
SO_x	0.000707
NO_x	0.302386
CO	0.391393

Pollutant	Total Emissions (TONs)
PM 10	0.188477
PM 2.5	0.009921
Pb	0.000000
NH_3	0.002066

- Activity Emissions of GHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002493
N_2O	0.002156

Pollutant	Total Emissions (TONs)
CO_2	69.645164
CO_2e	70.350016

- Global Scale Activity Emissions for SCGHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002493
N_2O	0.002156

Pollutant	Total Emissions (TONs)
CO_2	69.645164
CO_2e	70.350016

8.1 Demolition Phase

8.1.1 Demolition Phase Timeline Assumptions

- Phase Start Date
Start Month: 11
Start Quarter: 1
Start Year: 2025

- Phase Duration
Number of Month: 6
Number of Days: 0

8.1.2 Demolition Phase Assumptions

- General Demolition Information
Area of Building to be demolished (ft^2): 4216
Height of Building to be demolished (ft): 200

- Default Settings Used: Yes

- Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Concrete/Industrial Saws Composite	1	8
Rubber Tired Dozers Composite	1	1
Tractors/Loaders/Backhoes Composite	2	6

- Vehicle Exhaust
Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

8.1.3 Demolition Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.43930	0.00743	3.63468	4.34820	0.10060	0.09255
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.37086	0.00491	3.50629	2.90209	0.15396	0.14165
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.19600	0.00489	2.00960	3.48168	0.07738	0.07119

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02333	0.00467	575.01338	576.98668
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02159	0.00432	532.17175	533.99803
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02149	0.00430	529.86270	531.68105

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

8.1.4 Demolition Phase Formula(s)

- Fugitive Dust Emissions per Phase
$PM10_{FD} = (0.00042 * BA * BH) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
0.00042: Emission Factor (lb/ft^3)
BA: Area of Building to be demolished (ft^2)
BH: Height of Building to be demolished (ft)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase
$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase
$VMT_{VE} = BA * BH * (1 / 27) * 0.25 * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building being demolish (ft^2)
BH: Height of Building being demolish (ft)
(1 / 27): Conversion Factor cubic feet to cubic yards ($1\ yd^3 / 27\ ft^3$)
0.25: Volume reduction factor (material reduced by 75% to account for air space)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

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$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

9. Construction / Demolition

9.1 General Information & Timeline Assumptions

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: SLC-6 Crown Demo

- Activity Description:
SLC-6 Crown Demo

- Activity Start Date
Start Month: 11
Start Month: 2025

- Activity End Date
Indefinite: False
End Month: 4
End Month: 2026

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.033393
SO_x	0.000663
NO_x	0.293450
CO	0.389296

Pollutant	Total Emissions (TONs)
PM 10	0.105184
PM 2.5	0.009692
Pb	0.000000
NH_3	0.001339

- Activity Emissions of GHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002474
N_2O	0.001433

Pollutant	Total Emissions (TONs)
CO_2	65.053031
CO_2e	65.541793

- Global Scale Activity Emissions for SCGHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002474
N_2O	0.001433

Pollutant	Total Emissions (TONs)
CO_2	65.053031
CO_2e	65.541793

9.1 Demolition Phase

9.1.1 Demolition Phase Timeline Assumptions

- Phase Start Date

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Start Month: 11
Start Quarter: 1
Start Year: 2025

- Phase Duration
Number of Month: 6
Number of Days: 0

9.1.2 Demolition Phase Assumptions

- General Demolition Information
Area of Building to be demolished (ft^2): 10200
Height of Building to be demolished (ft): 44

- Default Settings Used: Yes

- Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Concrete/Industrial Saws Composite	1	8
Rubber Tired Dozers Composite	1	1
Tractors/Loaders/Backhoes Composite	2	6

- Vehicle Exhaust
Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

9.1.3 Demolition Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.43930	0.00743	3.63468	4.34820	0.10060	0.09255
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.37086	0.00491	3.50629	2.90209	0.15396	0.14165
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.19600	0.00489	2.00960	3.48168	0.07738	0.07119

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02333	0.00467	575.01338	576.98668
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02159	0.00432	532.17175	533.99803
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02149	0.00430	529.86270	531.68105

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

9.1.4 Demolition Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (0.00042 * BA * BH) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
0.00042: Emission Factor (lb/ft^3)
BA: Area of Building to be demolished (ft^2)
BH: Height of Building to be demolished (ft)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase
VMT_{VE} = BA * BH * (1 / 27) * 0.25 * (1 / HC) * HT

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building being demolish (ft^2)
BH: Height of Building being demolish (ft)
(1 / 27): Conversion Factor cubic feet to cubic yards (1 yd^3 / 27 ft^3)
0.25: Volume reduction factor (material reduced by 75% to account for air space)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
VMT_{WT} = WD * WT * 1.25 * NE

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

10. Construction / Demolition

10.1 General Information & Timeline Assumptions

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: SLC-6 MST Demo

- Activity Description:
SLC-6 MST Demo

- Activity Start Date
Start Month: 11

Start Month: 2025

- Activity End Date
Indefinite: False
End Month: 4
End Month: 2026

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.040446
SO_x	0.001390
NO_x	0.442779
CO	0.424332

Pollutant	Total Emissions (TONs)
PM 10	1.497185
PM 2.5	0.013532
Pb	0.000000
NH_3	0.013483

- Activity Emissions of GHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002801
N_2O	0.013524

Pollutant	Total Emissions (TONs)
CO_2	141.796609
CO_2e	145.896674

- Global Scale Activity Emissions for SCGHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002801
N_2O	0.013524

Pollutant	Total Emissions (TONs)
CO_2	141.796609
CO_2e	145.896674

10.1 Demolition Phase

10.1.1 Demolition Phase Timeline Assumptions

- Phase Start Date
Start Month: 11
Start Quarter: 1
Start Year: 2025

- Phase Duration
Number of Month: 6
Number of Days: 0

10.1.2 Demolition Phase Assumptions

- General Demolition Information
Area of Building to be demolished (ft^2): 25600
Height of Building to be demolished (ft): 275

- Default Settings Used: Yes

- Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Concrete/Industrial Saws Composite	1	8
Rubber Tired Dozers Composite	1	1
Tractors/Loaders/Backhoes Composite	2	6

- Vehicle Exhaust

Average Hauling Truck Capacity (yd^3): 20 (default)

Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips

Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

10.1.3 Demolition Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.43930	0.00743	3.63468	4.34820	0.10060	0.09255
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.37086	0.00491	3.50629	2.90209	0.15396	0.14165
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.19600	0.00489	2.00960	3.48168	0.07738	0.07119

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02333	0.00467	575.01338	576.98668
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02159	0.00432	532.17175	533.99803
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02149	0.00430	529.86270	531.68105

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564

LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

10.1.4 Demolition Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (0.00042 * BA * BH) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
0.00042: Emission Factor (lb/ft^3)
BA: Area of Building to be demolished (ft^2)
BH: Height of Building to be demolished (ft)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = BA * BH * (1 / 27) * 0.25 * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building being demolish (ft^2)
BH: Height of Building being demolish (ft)
(1 / 27): Conversion Factor cubic feet to cubic yards (1 yd^3 / 27 ft^3)
0.25: Volume reduction factor (material reduced by 75% to account for air space)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase

$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)

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WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

AIR CONFORMITY APPLICABILITY MODEL REPORT
RECORD OF AIR ANALYSIS (ROAA)

1. General Information: The Air Force's Air Conformity Applicability Model (ACAM) was used to perform a net change in emissions analysis to assess the potential air quality impact/s associated with the action. The analysis was performed in accordance with the Air Force Manual 32-7002, *Environmental Compliance and Pollution Prevention*; the *Environmental Impact Analysis Process* (EIAP, 32 CFR 989); the *General Conformity Rule* (GCR, 40 CFR 93 Subpart B); and the *USAF Air Quality Environmental Impact Analysis Process (EIAP) Guide*. This report provides a summary of the ACAM analysis.

Report generated with ACAM version: 5.0.23a

a. Action Location:
Base: VANDENBERG AFB
State: California
County(s): Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

b. Action Title: Falcon Program at Vandenberg Space Force Base Alternative 1

c. Project Number/s (if applicable):

d. Projected Action Start Date: 11 / 2025

e. Action Description:

The Proposed Action is to increase the annual Falcon launch cadence at VSFB through launches at SLC-4 and SLC-6 and the modification of SLC 6 for Falcon launch vehicles to support future commercial and U.S. government launch service needs. SpaceX would launch Falcon 9 from SLC-4 and SLC-6, and Falcon Heavy from SLC-6. Falcon 9 is approximately 229 feet tall and produces approximately 1.7 million pounds of thrust at liftoff. A discussion of Falcon 9 can be found in the 2016 EA and associated supplemental environmental documents. Falcon Heavy is a heavy-lift vehicle that produces 5.12 million pounds of thrust at liftoff and has the ability to lift 141,000 pounds into low Earth orbit. Merlin engines are used on both stages of Falcon Heavy. The center core and two side boosters are essentially the same design as a Falcon 9 first stage booster, thus Falcon Heavy uses the same type of propellants as Falcon 9. Additionally, Falcon Heavy uses the same second stage as Falcon 9.

Under Alternative 1, SpaceX would implement the Proposed Action and construct an approximately 61,250 square-foot hangar north of the launch pad line to support Falcon 9 and Falcon Heavy integration and processing. Areas around the hangar would be graded to provide rear access to the hangar. As part of Alternative 1, SpaceX would demolish the Mobile Service Tower, Mobile Assembly Shelter, Fixed Umbilical Tower, and the launch crown at SLC-6. SpaceX would construct rails from the hangar to the launch pad to transport Falcon. The SLC 6 fence would be relocated and vehicular access from Luner Road to N Road would be removed.

f. Point of Contact:
Name: Adam Poll
Title: Civilian
Organization: Dudek
Email: apoll@dudek.com
Phone Number: 805-308-8516

2. Air Impact Analysis: Based on the attainment status at the action location, the requirements of the GCR are:

_____ applicable

AIR CONFORMITY APPLICABILITY MODEL REPORT
RECORD OF AIR ANALYSIS (ROAA)

__X__ not applicable

Total reasonably foreseeable net direct and indirect emissions associated with the action were estimated through ACAM on a calendar-year basis for the start of the action through achieving "steady state" (hsba.e., no net gain/loss in emission stabilized and the action is fully implemented) emissions. The ACAM analysis uses the latest and most accurate emission estimation techniques available; all algorithms, emission factors, and methodologies used are described in detail in the *USAF Air Emissions Guide for Air Force Stationary Sources*, the *USAF Air Emissions Guide for Air Force Mobile Sources*, and the *USAF Air Emissions Guide for Air Force Transitory Sources*.

"Insignificance Indicators" were used in the analysis to provide an indication of the significance of the proposed Action's potential impacts to local air quality. The insignificance indicators are trivial (de minimis) rate thresholds that have been demonstrated to have little to no impact to air quality. These insignificance indicators are the 250 ton/yr Prevention of Significant Deterioration (PSD) major source threshold and 25 ton/yr for lead for actions occurring in areas that are "Attainment" (hsba.e., not exceeding any National Ambient Air Quality Standard (NAAQS)). These indicators do not define a significant impact; however, they do provide a threshold to identify actions that are insignificant. Any action with net emissions below the insignificance indicators for all criteria pollutants is considered so insignificant that the action will not cause or contribute to an exceedance on one or more NAAQS. For further detail on insignificance indicators, refer to *Level II, Air Quality Quantitative Assessment, Insignificance Indicators*.

The action's net emissions for every year through achieving steady state were compared against the Insignificance Indicators and are summarized below.

Analysis Summary:

2025

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.110	250	No
NOx	1.171	250	No
CO	1.087	250	No
SOx	0.004	250	No
PM 10	4.185	250	No
PM 2.5	0.038	250	No
Pb	0.000	25	No
NH3	0.032	250	No

2026

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	1.970	250	No
NOx	3.433	250	No
CO	2.773	250	No
SOx	0.012	250	No
PM 10	1.885	250	No
PM 2.5	0.104	250	No
Pb	0.000	25	No
NH3	0.127	250	No

2027

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)

NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2028

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2029

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2030

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2031

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			

VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2032

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2033

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2034

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2035

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No

NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2036

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2037

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2038

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2039

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No

CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2040

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2041

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2042

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2043

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No

SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2044

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2045

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2046

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2047

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No

PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2048

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2049

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2050

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2051

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No

PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2052

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2053

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2054

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2055

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No

Pb	0.000	25	No
NH3	0.024	250	No

2056

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.253	250	No
NOx	1.969	250	No
CO	1.812	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2057 - (Steady State)

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.229	250	No
NOx	1.768	250	No
CO	1.528	250	No
SOx	0.003	250	No
PM 10	0.064	250	No
PM 2.5	0.057	250	No
Pb	0.000	25	No
NH3	0.024	250	No

None of the estimated annual net emissions associated with this action are above the insignificance indicators; therefore, the action will not cause or contribute to an exceedance of one or more NAAQSs and will have an insignificant impact on air quality. No further air assessment is needed.

Adam Poll, Civilian Feb 12 2025

Name, Title **Date**

AIR CONFORMITY APPLICABILITY MODEL REPORT
RECORD OF AIR ANALYSIS (ROAA)

1. General Information: The Air Force's Air Conformity Applicability Model (ACAM) was used to perform a net change in emissions analysis to assess the potential air quality impact/s associated with the action. The analysis was performed in accordance with the Air Force Manual 32-7002, *Environmental Compliance and Pollution Prevention*; the *Environmental Impact Analysis Process* (EIAP, 32 CFR 989); the *General Conformity Rule* (GCR, 40 CFR 93 Subpart B); and the *USAF Air Quality Environmental Impact Analysis Process (EIAP) Guide*. This report provides a summary of the ACAM analysis.

Report generated with ACAM version: 5.0.23a

a. Action Location:
Base: VANDENBERG AFB
State: California
County(s): Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

b. Action Title: Falcon Program at Vandenberg Space Force Base Proposed Action

c. Project Number/s (if applicable):

d. Projected Action Start Date: 11 / 2025

e. Action Description:

The Proposed Action is to increase the annual Falcon launch cadence at VSFB through launches at SLC-4 and SLC-6 and the modification of SLC 6 for Falcon launch vehicles to support future commercial and U.S. government launch service needs. SpaceX would launch Falcon 9 from SLC-4 and SLC-6, and Falcon Heavy from SLC-6. Falcon 9 is approximately 229 feet tall and produces approximately 1.7 million pounds of thrust at liftoff. A discussion of Falcon 9 can be found in the 2016 EA and associated supplemental environmental documents. Falcon Heavy is a heavy-lift vehicle that produces 5.12 million pounds of thrust at liftoff and has the ability to lift 141,000 pounds into low Earth orbit. Merlin engines are used on both stages of Falcon Heavy. The center core and two side boosters are essentially the same design as a Falcon 9 first stage booster, thus Falcon Heavy uses the same type of propellants as Falcon 9. Additionally, Falcon Heavy uses the same second stage as Falcon 9.

Under the Proposed Action, SpaceX would implement the Proposed Action and would modify the horizontal integration facility (HIF) located north of SLC 6 to support Falcon 9 and Falcon Heavy operations. As part of this Proposed Action, SpaceX would demolish the Mobile Service Tower, Mobile Assembly Shelter, Fixed Umbilical Tower, and the launch crown at SLC-6. Modifications would include interior work, construction of an approximately 5,000 square foot annex on the south side of the building, and construction of an approximately 42,000 square foot paved area north of the building to provide rear access into the hangar. SpaceX would construct rails from the hangar to the launch pad to transport Falcon.

f. Point of Contact:
Name: Adam Poll
Title: Civilian
Organization: Dudek
Email: apoll@dudek.com
Phone Number: 805-308-8516

2. Air Impact Analysis: Based on the attainment status at the action location, the requirements of the GCR are:

_____ applicable

AIR CONFORMITY APPLICABILITY MODEL REPORT
RECORD OF AIR ANALYSIS (ROAA)

__X__ not applicable

Total reasonably foreseeable net direct and indirect emissions associated with the action were estimated through ACAM on a calendar-year basis for the start of the action through achieving “steady state” (hsba.e., no net gain/loss in emission stabilized and the action is fully implemented) emissions. The ACAM analysis uses the latest and most accurate emission estimation techniques available; all algorithms, emission factors, and methodologies used are described in detail in the *USAF Air Emissions Guide for Air Force Stationary Sources*, the *USAF Air Emissions Guide for Air Force Mobile Sources*, and the *USAF Air Emissions Guide for Air Force Transitory Sources*.

"Insignificance Indicators" were used in the analysis to provide an indication of the significance of the proposed Action’s potential impacts to local air quality. The insignificance indicators are trivial (de minimis) rate thresholds that have been demonstrated to have little to no impact to air quality. These insignificance indicators are the 250 ton/yr Prevention of Significant Deterioration (PSD) major source threshold and 25 ton/yr for lead for actions occurring in areas that are "Attainment" (hsba.e., not exceeding any National Ambient Air Quality Standard (NAAQS)). These indicators do not define a significant impact; however, they do provide a threshold to identify actions that are insignificant. Any action with net emissions below the insignificance indicators for all criteria pollutants is considered so insignificant that the action will not cause or contribute to an exceedance on one or more NAAQS. For further detail on insignificance indicators, refer to *Level II, Air Quality Quantitative Assessment, Insignificance Indicators*.

The action’s net emissions for every year through achieving steady state were compared against the Insignificance Indicators and are summarized below.

Analysis Summary:

2025

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.104	250	No
NOx	1.067	250	No
CO	1.029	250	No
SOx	0.003	250	No
PM 10	4.020	250	No
PM 2.5	0.035	250	No
Pb	0.000	25	No
NH3	0.026	250	No

2026

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	1.954	250	No
NOx	3.074	250	No
CO	2.689	250	No
SOx	0.010	250	No
PM 10	1.866	250	No
PM 2.5	0.095	250	No
Pb	0.000	25	No
NH3	0.098	250	No

2027

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)

NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2028

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2029

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2030

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2031

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			

VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2032

Pollutant	**Action Emissions (ton/yr)**	**INSIGNIFICANCE INDICATOR**	
		Indicator (ton/yr)	**Exceedance (Yes or No)**
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2033

Pollutant	**Action Emissions (ton/yr)**	**INSIGNIFICANCE INDICATOR**	
		Indicator (ton/yr)	**Exceedance (Yes or No)**
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2034

Pollutant	**Action Emissions (ton/yr)**	**INSIGNIFICANCE INDICATOR**	
		Indicator (ton/yr)	**Exceedance (Yes or No)**
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2035

Pollutant	**Action Emissions (ton/yr)**	**INSIGNIFICANCE INDICATOR**	
		Indicator (ton/yr)	**Exceedance (Yes or No)**
NOT IN A REGULATORY AREA			
VOC	0.256	250	No

NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2036

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2037

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2038

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2039

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No

CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2040

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2041

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2042

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2043

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No

SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2044

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2045

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2046

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2047

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No

PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2048

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2049

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2050

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2051

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No

PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2052

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2053

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2054

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2055

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.256	250	No
NOx	1.988	250	No
CO	1.838	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No

Pb	0.000	25	No
NH3	0.024	250	No

2056

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.253	250	No
NOx	1.969	250	No
CO	1.812	250	No
SOx	0.004	250	No
PM 10	0.071	250	No
PM 2.5	0.063	250	No
Pb	0.000	25	No
NH3	0.024	250	No

2057 - (Steady State)

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.229	250	No
NOx	1.768	250	No
CO	1.528	250	No
SOx	0.003	250	No
PM 10	0.064	250	No
PM 2.5	0.057	250	No
Pb	0.000	25	No
NH3	0.024	250	No

None of the estimated annual net emissions associated with this action are above the insignificance indicators; therefore, the action will not cause or contribute to an exceedance of one or more NAAQSs and will have an insignificant impact on air quality. No further air assessment is needed.

Adam Poll, Civilian Feb 12 2025

Name, Title **Date**

AIR CONFORMITY APPLICABILITY MODEL REPORT
GREENHOUSE GAS (GHG) EMISSIONS

1. General Information: The Air Force's Air Conformity Applicability Model (ACAM) was used to perform an analysis to estimate GHG emissions and assess the theoretical Social Cost of Greenhouse Gases (SC GHG) associated with the action. The analysis was performed in accordance with the Air Force Manual 32-7002, Environmental Compliance and Pollution Prevention; the Environmental Impact Analysis Process (EIAP, 32 CFR 989); and the USAF Air Quality Environmental Impact Analysis Process (EIAP) Guide. This report provides a summary of GHG emissions and SC GHG analysis.

Report generated with ACAM version: 5.0.23a

a. Action Location:
Base: VANDENBERG AFB
State: California
County(s): Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

b. Action Title: Falcon Program at Vandenberg Space Force Base Alternative 1

c. Project Number/s (if applicable):

d. Projected Action Start Date: 11 / 2025

e. Action Description:

The Proposed Action is to increase the annual Falcon launch cadence at VSFB through launches at SLC-4 and SLC-6 and the modification of SLC 6 for Falcon launch vehicles to support future commercial and U.S. government launch service needs. SpaceX would launch Falcon 9 from SLC-4 and SLC-6, and Falcon Heavy from SLC-6. Falcon 9 is approximately 229 feet tall and produces approximately 1.7 million pounds of thrust at liftoff. A discussion of Falcon 9 can be found in the 2016 EA and associated supplemental environmental documents. Falcon Heavy is a heavy-lift vehicle that produces 5.12 million pounds of thrust at liftoff and has the ability to lift 141,000 pounds into low Earth orbit. Merlin engines are used on both stages of Falcon Heavy. The center core and two side boosters are essentially the same design as a Falcon 9 first stage booster, thus Falcon Heavy uses the same type of propellants as Falcon 9. Additionally, Falcon Heavy uses the same second stage as Falcon 9.

Under Alternative 1, SpaceX would implement the Proposed Action and construct an approximately 61,250 square-foot hangar north of the launch pad line to support Falcon 9 and Falcon Heavy integration and processing. Areas around the hangar would be graded to provide rear access to the hangar. As part of Alternative 1, SpaceX would demolish the Mobile Service Tower, Mobile Assembly Shelter, Fixed Umbilical Tower, and the launch crown at SLC-6. SpaceX would construct rails from the hangar to the launch pad to transport Falcon. The SLC 6 fence would be relocated and vehicular access from Luner Road to N Road would be removed.

f. Point of Contact:
Name: Adam Poll
Title: Civilian
Organization: Dudek
Email: apoll@dudek.com
Phone Number: 805-308-8516

2. Analysis: Total combined direct and indirect GHG emissions associated with the action were estimated through ACAM on a calendar-year basis from the action start through the expected life cycle of the action. The life cycle for Air Force actions with "steady state" emissions (SS, net gain/loss in emission stabilized and the action is

fully implemented) is assumed to be 10 years beyond the SS emissions year or 20 years beyond SS emissions year for aircraft operations related actions.

GHG Emissions Analysis Summary:

GHGs produced by fossil-fuel combustion are primarily carbon dioxide (CO2), methane (CH4), and nitrous oxide (NO2). These three GHGs represent more than 97 percent of all U.S. GHG emissions. Emissions of GHGs are typically quantified and regulated in units of CO2 equivalents (CO2e). The CO2e takes into account the global warming potential (GWP) of each GHG. The GWP is the measure of a particular GHG's ability to absorb solar radiation as well as its residence time within the atmosphere. All GHG emissions estimates were derived from various emission sources using the methods, algorithms, emission factors, and GWPs from the most current Air Emissions Guide for Air Force Stationary Sources, Air Emissions Guide for Air Force Mobile Sources, and/or Air Emissions Guide for Air Force Transitory Sources.

The Air Force has adopted the Prevention of Significant Deterioration (PSD) threshold for GHG of 75,000 ton per year (ton/yr) of CO2e (or 68,039 metric ton per year, mton/yr) as an indicator or "threshold of insignificance" for NEPA air quality impacts in all areas. This indicator does not define a significant impact; however, it provides a threshold to identify actions that are insignificant (de minimis, too trivial or minor to merit consideration). Actions with a net change in GHG (CO2e) emissions below the insignificance indicator (threshold) are considered too insignificant on a global scale to warrant any further analysis. Note that actions with a net change in GHG (CO2e) emissions above the insignificance indicator (threshold) are only considered potentially significant and require further assessment to determine if the action poses a significant impact. For further detail on insignificance indicators see Level II, Air Quality Quantitative Assessment, Insignificance Indicators (April 2023).

The following table summarizes the action-related GHG emissions on a calendar-year basis through the projected life cycle of the action.

Action-Related Annual GHG Emissions (mton/yr)						
YEAR	**CO2**	**CH4**	**N2O**	**CO2e**	**Threshold**	**Exceedance**
2025	327	0.00680087	0.02968214	336	68,039	No
2026	1,070	0.01845029	0.1142369	1,105	68,039	No
2027	325	0.01661548	0.00822667	338	68,039	No
2028	325	0.01661548	0.00822667	338	68,039	No
2029	325	0.01661548	0.00822667	338	68,039	No
2030	325	0.01661548	0.00822667	338	68,039	No
2031	325	0.01661548	0.00822667	338	68,039	No
2032	325	0.01661548	0.00822667	338	68,039	No
2033	325	0.01661548	0.00822667	338	68,039	No
2034	325	0.01661548	0.00822667	338	68,039	No
2035	325	0.01661548	0.00822667	338	68,039	No
2036	325	0.01661548	0.00822667	338	68,039	No
2037	325	0.01661548	0.00822667	338	68,039	No
2038	325	0.01661548	0.00822667	338	68,039	No
2039	325	0.01661548	0.00822667	338	68,039	No
2040	325	0.01661548	0.00822667	338	68,039	No
2041	325	0.01661548	0.00822667	338	68,039	No
2042	325	0.01661548	0.00822667	338	68,039	No
2043	325	0.01661548	0.00822667	338	68,039	No
2044	325	0.01661548	0.00822667	338	68,039	No
2045	325	0.01661548	0.00822667	338	68,039	No
2046	325	0.01661548	0.00822667	338	68,039	No
2047	325	0.01661548	0.00822667	338	68,039	No

AIR CONFORMITY APPLICABILITY MODEL REPORT
GREENHOUSE GAS (GHG) EMISSIONS

2048	325	0.01661548	0.00822667	338	68,039	No
2049	325	0.01661548	0.00822667	338	68,039	No
2050	325	0.01661548	0.00822667	338	68,039	No
2051	325	0.01661548	0.00822667	338	68,039	No
2052	325	0.01661548	0.00822667	338	68,039	No
2053	325	0.01661548	0.00822667	338	68,039	No
2054	325	0.01661548	0.00822667	338	68,039	No
2055	325	0.01661548	0.00822667	338	68,039	No
2056	319	0.01637892	0.00817937	332	68,039	No
2057 [SS Year]	255	0.0137768	0.00765913	268	68,039	No
2058	255	0.0137768	0.00765913	268	68,039	No
2059	255	0.0137768	0.00765913	268	68,039	No
2060	255	0.0137768	0.00765913	268	68,039	No
2061	255	0.0137768	0.00765913	268	68,039	No
2062	255	0.0137768	0.00765913	268	68,039	No
2063	255	0.0137768	0.00765913	268	68,039	No
2064	255	0.0137768	0.00765913	268	68,039	No
2065	255	0.0137768	0.00765913	268	68,039	No
2066	255	0.0137768	0.00765913	268	68,039	No
2067	255	0.0137768	0.00765913	268	68,039	No

The following U.S. and State's GHG emissions estimates (next two tables) are based on a five-year average (2016 through 2020) of individual state-reported GHG emissions (Reference: State Climate Summaries 2022, NOAA National Centers for Environmental Information, National Oceanic and Atmospheric Administration. https://statesummaries.ncics.org/downloads/).

YEAR	CO2	CH4	N2O	CO2e
2025	336,950,322	1,567,526	55,459	338,573,307
2026	336,950,322	1,567,526	55,459	338,573,307
2027	336,950,322	1,567,526	55,459	338,573,307
2028	336,950,322	1,567,526	55,459	338,573,307
2029	336,950,322	1,567,526	55,459	338,573,307
2030	336,950,322	1,567,526	55,459	338,573,307
2031	336,950,322	1,567,526	55,459	338,573,307
2032	336,950,322	1,567,526	55,459	338,573,307
2033	336,950,322	1,567,526	55,459	338,573,307
2034	336,950,322	1,567,526	55,459	338,573,307
2035	336,950,322	1,567,526	55,459	338,573,307
2036	336,950,322	1,567,526	55,459	338,573,307
2037	336,950,322	1,567,526	55,459	338,573,307
2038	336,950,322	1,567,526	55,459	338,573,307
2039	336,950,322	1,567,526	55,459	338,573,307
2040	336,950,322	1,567,526	55,459	338,573,307
2041	336,950,322	1,567,526	55,459	338,573,307
2042	336,950,322	1,567,526	55,459	338,573,307
2043	336,950,322	1,567,526	55,459	338,573,307
2044	336,950,322	1,567,526	55,459	338,573,307
2045	336,950,322	1,567,526	55,459	338,573,307
2046	336,950,322	1,567,526	55,459	338,573,307
2047	336,950,322	1,567,526	55,459	338,573,307
2048	336,950,322	1,567,526	55,459	338,573,307
2049	336,950,322	1,567,526	55,459	338,573,307
2050	336,950,322	1,567,526	55,459	338,573,307

2051	336,950,322	1,567,526	55,459	338,573,307
2052	336,950,322	1,567,526	55,459	338,573,307
2053	336,950,322	1,567,526	55,459	338,573,307
2054	336,950,322	1,567,526	55,459	338,573,307
2055	336,950,322	1,567,526	55,459	338,573,307
2056	336,950,322	1,567,526	55,459	338,573,307
2057 [SS Year]	336,950,322	1,567,526	55,459	338,573,307
2058	336,950,322	1,567,526	55,459	338,573,307
2059	336,950,322	1,567,526	55,459	338,573,307
2060	336,950,322	1,567,526	55,459	338,573,307
2061	336,950,322	1,567,526	55,459	338,573,307
2062	336,950,322	1,567,526	55,459	338,573,307
2063	336,950,322	1,567,526	55,459	338,573,307
2064	336,950,322	1,567,526	55,459	338,573,307
2065	336,950,322	1,567,526	55,459	338,573,307
2066	336,950,322	1,567,526	55,459	338,573,307
2067	336,950,322	1,567,526	55,459	338,573,307

U.S. Annual GHG Emissions (mton/yr)				
YEAR	**CO2**	**CH4**	**N2O**	**CO2e**
2025	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2026	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2027	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2028	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2029	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2030	5,136,454,179	25,626,912	1,500,708	5,163,581,798
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2063	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2064	5,136,454,179	25,626,912	1,500,708	5,163,581,798
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GHG Relative Significance Assessment:

A Relative Significance Assessment uses the rule of reason and the concept of proportionality along with the consideration of the affected area (yGba.e., global, national, and regional) and the degree (intensity) of the proposed action's effects. The Relative Significance Assessment provides real-world context and allows for a reasoned choice against alternatives through a relative comparison analysis. The analysis weighs each alternative's annual net change in GHG emissions proportionally against (or relative to) global, national, and regional emissions.

The action's surroundings, circumstances, environment, and background (context associated with an action) provide the setting for evaluating the GHG intensity (impact significance). From an air quality perspective, context of an action is the local area's ambient air quality relative to meeting the NAAQSs, expressed as attainment, nonattainment, or maintenance areas (this designation is considered the attainment status). GHGs are non-hazardous to health at normal ambient concentrations and, at a cumulative global scale, action-related GHG emissions can only potentially cause warming of the climatic system. Therefore, the action-related GHGs generally have an insignificant impact to local air quality.

However, the affected area (context) of GHG is global. Therefore, the intensity or degree of the proposed action's GHG effects are gauged through the quantity of GHG associated with the action as compared to a baseline of the state, U.S., and global GHG inventories. Each action (or alternative) has significance, based on their annual net change in GHG emissions, in relation to or proportionally to the global, national, and regional annual GHG emissions.

To provide real-world context to the GHG effects on a global scale, an action's net change in GHG emissions is compared relative to the state (where action will occur) and U.S. annual emissions. The following table provides a relative comparison of an action's net change in GHG emissions vs. state and U.S. projected GHG emissions for the same time period.

Total GHG Relative Significance (mton)					
		CO2	**CH4**	**N2O**	**CO2e**
2025-2067	State Total	14,488,863,826	67,403,622	2,384,752	14,558,652,199
2025-2067	U.S. Total	220,867,529,697	1,101,957,202	64,530,428	222,034,017,328
2025-2067	Action	13,933	0.675024	0.474922	14,518
Percent of State Totals		0.00009616%	0.00000100%	0.00001991%	0.00009972%
Percent of U.S. Totals		0.00000631%	0.00000006%	0.00000074%	0.00000654%

From a global context, the action's total GHG percentage of total global GHG for the same time period is: 0.00000088%.*

* Global value based on the U.S. emits 13.4% of all global GHG annual emissions (2018 Emissions Data, Center for Climate and Energy Solutions, accessed 7-6-2023, https://www.c2es.org/content/international-emissions).

AIR CONFORMITY APPLICABILITY MODEL REPORT
GREENHOUSE GAS (GHG) EMISSIONS

1. General Information: The Air Force's Air Conformity Applicability Model (ACAM) was used to perform an analysis to estimate GHG emissions and assess the theoretical Social Cost of Greenhouse Gases (SC GHG) associated with the action. The analysis was performed in accordance with the Air Force Manual 32-7002, Environmental Compliance and Pollution Prevention; the Environmental Impact Analysis Process (EIAP, 32 CFR 989); and the USAF Air Quality Environmental Impact Analysis Process (EIAP) Guide. This report provides a summary of GHG emissions and SC GHG analysis.

Report generated with ACAM version: 5.0.23a

a. Action Location:
Base: VANDENBERG AFB
State: California
County(s): Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

b. Action Title: Falcon Program at Vandenberg Space Force Base Proposed Action

c. Project Number/s (if applicable):

d. Projected Action Start Date: 11 / 2025

e. Action Description:

The Proposed Action is to increase the annual Falcon launch cadence at VSFB through launches at SLC-4 and SLC-6 and the modification of SLC 6 for Falcon launch vehicles to support future commercial and U.S. government launch service needs. SpaceX would launch Falcon 9 from SLC-4 and SLC-6, and Falcon Heavy from SLC-6. Falcon 9 is approximately 229 feet tall and produces approximately 1.7 million pounds of thrust at liftoff. A discussion of Falcon 9 can be found in the 2016 EA and associated supplemental environmental documents. Falcon Heavy is a heavy-lift vehicle that produces 5.12 million pounds of thrust at liftoff and has the ability to lift 141,000 pounds into low Earth orbit. Merlin engines are used on both stages of Falcon Heavy. The center core and two side boosters are essentially the same design as a Falcon 9 first stage booster, thus Falcon Heavy uses the same type of propellants as Falcon 9. Additionally, Falcon Heavy uses the same second stage as Falcon 9.

Under the Proposed Action, SpaceX would implement the Proposed Action and would modify the horizontal integration facility (HIF) located north of SLC 6 to support Falcon 9 and Falcon Heavy operations. As part of this Proposed Action, SpaceX would demolish the Mobile Service Tower, Mobile Assembly Shelter, Fixed Umbilical Tower, and the launch crown at SLC-6. Modifications would include interior work, construction of an approximately 5,000 square foot annex on the south side of the building, and construction of an approximately 42,000 square foot paved area north of the building to provide rear access into the hangar. SpaceX would construct rails from the hangar to the launch pad to transport Falcon.

f. Point of Contact:

Name: Adam Poll
Title: Civilian
Organization: Dudek
Email: apoll@dudek.com
Phone Number: 805-308-8516

2. Analysis: Total combined direct and indirect GHG emissions associated with the action were estimated through ACAM on a calendar-year basis from the action start through the expected life cycle of the action. The life cycle for Air Force actions with "steady state" emissions (SS, net gain/loss in emission stabilized and the action is

fully implemented) is assumed to be 10 years beyond the SS emissions year or 20 years beyond SS emissions year for aircraft operations related actions.

GHG Emissions Analysis Summary:

GHGs produced by fossil-fuel combustion are primarily carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (NO_2). These three GHGs represent more than 97 percent of all U.S. GHG emissions. Emissions of GHGs are typically quantified and regulated in units of CO_2 equivalents (CO_2e). The CO_2e takes into account the global warming potential (GWP) of each GHG. The GWP is the measure of a particular GHG's ability to absorb solar radiation as well as its residence time within the atmosphere. All GHG emissions estimates were derived from various emission sources using the methods, algorithms, emission factors, and GWPs from the most current Air Emissions Guide for Air Force Stationary Sources, Air Emissions Guide for Air Force Mobile Sources, and/or Air Emissions Guide for Air Force Transitory Sources.

The Air Force has adopted the Prevention of Significant Deterioration (PSD) threshold for GHG of 75,000 ton per year (ton/yr) of CO_2e (or 68,039 metric ton per year, mton/yr) as an indicator or "threshold of insignificance" for NEPA air quality impacts in all areas. This indicator does not define a significant impact; however, it provides a threshold to identify actions that are insignificant (de minimis, too trivial or minor to merit consideration). Actions with a net change in GHG (CO_2e) emissions below the insignificance indicator (threshold) are considered too insignificant on a global scale to warrant any further analysis. Note that actions with a net change in GHG (CO_2e) emissions above the insignificance indicator (threshold) are only considered potentially significant and require further assessment to determine if the action poses a significant impact. For further detail on insignificance indicators see Level II, Air Quality Quantitative Assessment, Insignificance Indicators (April 2023).

The following table summarizes the action-related GHG emissions on a calendar-year basis through the projected life cycle of the action.

Action-Related Annual GHG Emissions (mton/yr)						
YEAR	**CO2**	**CH4**	**N2O**	**CO2e**	**Threshold**	**Exceedance**
2025	284	0.00642481	0.02374771	291	68,039	No
2026	902	0.01773475	0.08783716	930	68,039	No
2027	325	0.01661548	0.00822667	338	68,039	No
2028	325	0.01661548	0.00822667	338	68,039	No
2029	325	0.01661548	0.00822667	338	68,039	No
2030	325	0.01661548	0.00822667	338	68,039	No
2031	325	0.01661548	0.00822667	338	68,039	No
2032	325	0.01661548	0.00822667	338	68,039	No
2033	325	0.01661548	0.00822667	338	68,039	No
2034	325	0.01661548	0.00822667	338	68,039	No
2035	325	0.01661548	0.00822667	338	68,039	No
2036	325	0.01661548	0.00822667	338	68,039	No
2037	325	0.01661548	0.00822667	338	68,039	No
2038	325	0.01661548	0.00822667	338	68,039	No
2039	325	0.01661548	0.00822667	338	68,039	No
2040	325	0.01661548	0.00822667	338	68,039	No
2041	325	0.01661548	0.00822667	338	68,039	No
2042	325	0.01661548	0.00822667	338	68,039	No
2043	325	0.01661548	0.00822667	338	68,039	No
2044	325	0.01661548	0.00822667	338	68,039	No
2045	325	0.01661548	0.00822667	338	68,039	No
2046	325	0.01661548	0.00822667	338	68,039	No
2047	325	0.01661548	0.00822667	338	68,039	No

2048	325	0.01661548	0.00822667	338	68,039	No
2049	325	0.01661548	0.00822667	338	68,039	No
2050	325	0.01661548	0.00822667	338	68,039	No
2051	325	0.01661548	0.00822667	338	68,039	No
2052	325	0.01661548	0.00822667	338	68,039	No
2053	325	0.01661548	0.00822667	338	68,039	No
2054	325	0.01661548	0.00822667	338	68,039	No
2055	325	0.01661548	0.00822667	338	68,039	No
2056	319	0.01637892	0.00817937	332	68,039	No
2057 [SS Year]	255	0.0137768	0.00765913	268	68,039	No
2058	255	0.0137768	0.00765913	268	68,039	No
2059	255	0.0137768	0.00765913	268	68,039	No
2060	255	0.0137768	0.00765913	268	68,039	No
2061	255	0.0137768	0.00765913	268	68,039	No
2062	255	0.0137768	0.00765913	268	68,039	No
2063	255	0.0137768	0.00765913	268	68,039	No
2064	255	0.0137768	0.00765913	268	68,039	No
2065	255	0.0137768	0.00765913	268	68,039	No
2066	255	0.0137768	0.00765913	268	68,039	No
2067	255	0.0137768	0.00765913	268	68,039	No

The following U.S. and State's GHG emissions estimates (next two tables) are based on a five-year average (2016 through 2020) of individual state-reported GHG emissions (Reference: State Climate Summaries 2022, NOAA National Centers for Environmental Information, National Oceanic and Atmospheric Administration. https://statesummaries.ncics.org/downloads/).

YEAR	CO2	CH4	N2O	CO2e
2025	336,950,322	1,567,526	55,459	338,573,307
2026	336,950,322	1,567,526	55,459	338,573,307
2027	336,950,322	1,567,526	55,459	338,573,307
2028	336,950,322	1,567,526	55,459	338,573,307
2029	336,950,322	1,567,526	55,459	338,573,307
2030	336,950,322	1,567,526	55,459	338,573,307
2031	336,950,322	1,567,526	55,459	338,573,307
2032	336,950,322	1,567,526	55,459	338,573,307
2033	336,950,322	1,567,526	55,459	338,573,307
2034	336,950,322	1,567,526	55,459	338,573,307
2035	336,950,322	1,567,526	55,459	338,573,307
2036	336,950,322	1,567,526	55,459	338,573,307
2037	336,950,322	1,567,526	55,459	338,573,307
2038	336,950,322	1,567,526	55,459	338,573,307
2039	336,950,322	1,567,526	55,459	338,573,307
2040	336,950,322	1,567,526	55,459	338,573,307
2041	336,950,322	1,567,526	55,459	338,573,307
2042	336,950,322	1,567,526	55,459	338,573,307
2043	336,950,322	1,567,526	55,459	338,573,307
2044	336,950,322	1,567,526	55,459	338,573,307
2045	336,950,322	1,567,526	55,459	338,573,307
2046	336,950,322	1,567,526	55,459	338,573,307
2047	336,950,322	1,567,526	55,459	338,573,307
2048	336,950,322	1,567,526	55,459	338,573,307
2049	336,950,322	1,567,526	55,459	338,573,307
2050	336,950,322	1,567,526	55,459	338,573,307

AIR CONFORMITY APPLICABILITY MODEL REPORT
GREENHOUSE GAS (GHG) EMISSIONS

2051	336,950,322	1,567,526	55,459	338,573,307
2052	336,950,322	1,567,526	55,459	338,573,307
2053	336,950,322	1,567,526	55,459	338,573,307
2054	336,950,322	1,567,526	55,459	338,573,307
2055	336,950,322	1,567,526	55,459	338,573,307
2056	336,950,322	1,567,526	55,459	338,573,307
2057 [SS Year]	336,950,322	1,567,526	55,459	338,573,307
2058	336,950,322	1,567,526	55,459	338,573,307
2059	336,950,322	1,567,526	55,459	338,573,307
2060	336,950,322	1,567,526	55,459	338,573,307
2061	336,950,322	1,567,526	55,459	338,573,307
2062	336,950,322	1,567,526	55,459	338,573,307
2063	336,950,322	1,567,526	55,459	338,573,307
2064	336,950,322	1,567,526	55,459	338,573,307
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2067	336,950,322	1,567,526	55,459	338,573,307

U.S. Annual GHG Emissions (mton/yr)				
YEAR	**CO2**	**CH4**	**N2O**	**CO2e**
2025	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2026	5,136,454,179	25,626,912	1,500,708	5,163,581,798
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GHG Relative Significance Assessment:

A Relative Significance Assessment uses the rule of reason and the concept of proportionality along with the consideration of the affected area (yGba.e., global, national, and regional) and the degree (intensity) of the proposed action's effects. The Relative Significance Assessment provides real-world context and allows for a reasoned choice against alternatives through a relative comparison analysis. The analysis weighs each alternative's annual net change in GHG emissions proportionally against (or relative to) global, national, and regional emissions.

The action's surroundings, circumstances, environment, and background (context associated with an action) provide the setting for evaluating the GHG intensity (impact significance). From an air quality perspective, context of an action is the local area's ambient air quality relative to meeting the NAAQSs, expressed as attainment, nonattainment, or maintenance areas (this designation is considered the attainment status). GHGs are non-hazardous to health at normal ambient concentrations and, at a cumulative global scale, action-related GHG emissions can only potentially cause warming of the climatic system. Therefore, the action-related GHGs generally have an insignificant impact to local air quality.

However, the affected area (context) of GHG is global. Therefore, the intensity or degree of the proposed action's GHG effects are gauged through the quantity of GHG associated with the action as compared to a baseline of the state, U.S., and global GHG inventories. Each action (or alternative) has significance, based on their annual net change in GHG emissions, in relation to or proportionally to the global, national, and regional annual GHG emissions.

To provide real-world context to the GHG effects on a global scale, an action's net change in GHG emissions is compared relative to the state (where action will occur) and U.S. annual emissions. The following table provides a relative comparison of an action's net change in GHG emissions vs. state and U.S. projected GHG emissions for the same time period.

Total GHG Relative Significance (mton)					
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2025-2067	U.S. Total	220,867,529,697	1,101,957,202	64,530,428	222,034,017,328
2025-2067	Action	13,723	0.673932	0.442588	14,298
Percent of State Totals		0.00009471%	0.00000100%	0.00001856%	0.00009821%
Percent of U.S. Totals		0.00000621%	0.00000006%	0.00000069%	0.00000644%

From a global context, the action's total GHG percentage of total global GHG for the same time period is: 0.00000086%.*

* Global value based on the U.S. emits 13.4% of all global GHG annual emissions (2018 Emissions Data, Center for Climate and Energy Solutions, accessed 7-6-2023, https://www.c2es.org/content/international-emissions).

Launch, Landing, and Static Fire

						Emission Factors						Emissions							Emissions						
			<3,000ft			Pounds per burn second						Tons emitted per launch						Metric tons per Activity	Tons per year						Metric tons per year
Type	Stage	Fuel	Burn time (seconds)	Number of Engines	Annual Activities	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5	CO2e	VOC	NOx	CO	SOx	PM10	PM2.5	CO2e
Launch Falcon 9	1	RP1/LOX	23	9	45	0.00	9.42	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	273.96	0.00	4.88	0.00	0.00	0.00	0.00	12,328.01
Launch Falcon Heavy	1	RP1/LOX	21	27	5	0.00	28.27	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.00	821.87	0.00	1.48	0.00	0.00	0.00	0.00	4,109.34
Landing (Offshore) Falcon 9	1	RP1/LOX	18	3	62	0.00	3.14	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	90.41	0.00	1.75	0.00	0.00	0.00	0.00	5,605.14
Landing (VSFB) Falcon 9	1	RP1/LOX	18	3	2	0.00	3.14	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	90.41	0.00	0.06	0.00	0.00	0.00	0.00	180.81
Landing (VSFB) Falcon Heavy	1	RP1/LOX	18	6	5	0.00	6.28	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	90.41	0.00	0.28	0.00	0.00	0.00	0.00	452.03
Static Fire Falcon 9	1	RP1/LOX	7	9	15	0.00	9.42	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	18.26	0.00	0.49	0.00	0.00	0.00	0.00	273.96
Static Fire Falcon Heavy	1	RP1/LOX	7	27	5	0.00	28.27	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	54.79	0.00	0.49	0.00	0.00	0.00	0.00	273.96
																		Total	0.00	9.44	0.00	0.00	0.00	0.00	23,223.23

Emission Factors Per Engine

	Emission Factors (pounds per second per engine)						
Propellant	VOC	NOx	CO	SOx	PM10	PM2.5	CO2
RP-1/LOX	0.00	1.05	0.00	0.00	0.00	0.00	639.12

Source: Exhaust Plume Calculations for SpaceX Merlin5 Booster Engine, Sierra Engineering & Software, Inc. (June 14, 2019)

Notes:

Launch emissions include fuel spent up to 3,000 ft AGL.

Landing emissions include all intermittent burns below 3,000 ft AGL.

Static fire assumes all 9 engines with a 7 second burn time.

Landing emissions assumed to be 33% of nominal power (only 3 engines used).

Launch GHG emissions include fuel spent up to 100,000ft MSL (approximately 105 seconds).

Landing GHG emissions include all intermittent burns below 100,000 ft MSL.

Booster Recovery Operations

																Emissions (<3 nm)											Emissions (3-12 nm)										
Vessel	Operations Per Year	Total Ship time on Range	Engines and Generators		Horsepower	Emission Factors (g/kWh)										Tons							Metric Tons				Tons							Metric Tons			
		Hours	No.	Load		VOCs	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O	VOCs	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O	CO2e	VOCs	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O	CO2e
Tugboat	62	68	2	0.5	850	0.53	2.60	1.10	0.41	0.19	0.19	0.00	656.12	0.01	0.03	0.01	0.05	0.02	0.01	0.00	0.00	0.00	12.20	0.00	0.00	12.37	0.03	0.16	0.07	0.03	0.01	0.01	0.00	36.61	0.00	0.00	37.11
	62	68	2	0.31	133	0.53	2.60	1.10	0.41	0.19	0.19	0.00	656.12	0.01	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00	1.18	0.00	0.00	1.20	0.00	0.02	0.01	0.00	0.00	0.00	0.00	3.55	0.00	0.00	3.60
Support Boat	62	68	1	0.5	3,900	0.53	2.60	1.10	0.41	0.19	0.19	0.00	656.12	0.01	0.03	0.02	0.12	0.05	0.02	0.01	0.01	0.00	28.00	0.00	0.00	28.38	0.07	0.37	0.16	0.06	0.03	0.03	0.00	83.99	0.00	0.00	85.13
	62	68	2	0.31	114	0.53	2.60	1.10	0.41	0.19	0.19	0.00	656.12	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.01	0.00	0.00	1.03	0.00	0.01	0.01	0.00	0.00	0.00	0.00	3.04	0.00	0.00	3.09
Barge	62	12	1	0.6	2,600	0.53	2.60	1.10	0.41	0.19	0.19	0.00	656.12	0.01	0.03	0.00	0.02	0.01	0.00	0.00	0.00	0.00	3.95	0.00	0.00	4.01	0.01	0.05	0.02	0.01	0.00	0.00	0.00	11.86	0.00	0.00	12.02
	62	68	1	0.6	268	0.18	2.50	0.90	0.16	0.22	0.22	0.00	568.30	0.03	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00	2.00	0.00	0.00	2.03	0.00	0.03	0.01	0.00	0.00	0.00	0.00	6.00	0.00	0.00	6.10
															Total	**0.04**	**0.21**	**0.09**	**0.03**	**0.02**	**0.02**	**0.00**	**48.35**	**0.00**	**0.00**	**49.01**	**0.13**	**0.64**	**0.27**	**0.10**	**0.05**	**0.05**	**0.00**	**145.05**	**0.00**	**0.01**	**147.04**

Notes:

Total ship time, engine specifics, and emission factors consistent with the 2023 SEA.

Fairing Recovery Operations

Vessel	Operations Per Year	Total Ship time on Range	Engines and Generators		Horsepower	Emission Factors (g/kWh)									
		Hours	No.	Load		VOCs	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
Support Boat	50	68	2	0.6	820	0.53	2.60	1.10	0.41	0.19	0.19	0.00	656.12	0.01	0.03

Vessel	Emissions (<3 nm)										
	Tons							Metric Tons			
	VOCs	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O	CO2e
Support Boat	0.01	0.05	0.02	0.01	0.00	0.00	0.00	11.39	0.00	0.00	11.55

Vessel	Emissions (3-12 nm)										
	Tons							Metric Tons			
	VOCs	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O	CO2e
Support Boat	0.03	0.15	0.06	0.02	0.01	0.01	0.00	34.18	0.00	0.00	34.64

Notes:

Total ship time, engine specifics, and emission factors consistent with the 2023 SEA.

RP-1, RSV Loading, Payload Fueling, and Solvent Emissions

Equipment	NO_x	ROC	CO	SO_x	PM	PM_{10}	$PM_{2.5}$
Falcon 9 RP-1							
lb/day		0.68					
TPY		0.01					
Falcon Heavy RP-1							
lb/day		11.61					
TPY		0.03					
RSV Loading							
lb/day		14.47					
TPY		0.06					
Payload Fueling							
lb/day	14.84	0.15					
TPY	0.11	0.00					
Solvent Use							
lb/day							
TPY							
Total Emissions							
lb/day	**14.84**	**26.92**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
TPY	**0.11**	**0.09**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Falcon 9 Potential to Emit Calculations

Attachment: A-1
Permit Number: PTO 15069
Facility: SpaceX

RP-1 and System Input Data

Information	*Value*	*Units*	*Reference*
Specific Gravity at System Temp................	0.840	--	Material Specifications
Vapor Pressure @ 20 °F.............................	0.00088	psi	Material Specifications
Vapor Molecular Weight............................	148.00	lb/lb-mol	Material Specifications
Gas Constant..	10.73	scf-psi/°R-lb-mol	Ideal Gas Laws
System and RP-1 Temperature.................	474.67	°R	Permit Application
RP-1 Emission Factor..........................	0.00003	lb/ft^3	Calculated Value

Maximum Process Event Summary

Event Name	*Value*	*Units*	*Reference*
Events...	45	events/year	Permit Application
Static Launch and Abort Events.....................	15	events/year	Permit Application
Events per day	2	events/day	Permit Application
Event Vehicle RP-1 Throughput Volume..........	48,500	gals/event	Permit Application
Event Fill Line Throughput Volume................	1,543	gals/event	Permit Application
Daily Launch Volume.................................	50,043	gals/day	Calculated Value
Daily Static Launch and Abort Volume..........	50,043	gals/day	Calculated Value
Daily Launch Volume.................................	6,690	ft^3/day	Calculated Value
Daily Static Launch and Abort Volume..........	13,380	ft^3/day	Calculated Value
Annual Launch Volume...............................	2,251,935	gals/year	Calculated Value
Annual Static Launch and Abort Volume..........	750,645	gals/year	Calculated Value
Annual Launch Volume...............................	301,041	ft^3/yr	Calculated Value
Annual Static Launch and Abort Volume.........	100,347	ft^3/yr	Calculated Value

ROC Potential to Emit

Process	**lb/day**	**TPY**
Launches	0.34	0.00
Static Launches/Abort	0.68	0.00
Total PTE	**0.68**	**0.01**

Notes:
1. One Falcon 9 launch or static launch/abort permitted per day. PTE reflects the worst case scenario.

Processed By: KMB Date: 2/11/2020

Falcon Heavy Potential to Emit Calculations

Attachment:	A-2
Permit Number:	PTO 15069
Facility:	SpaceX

RP-1 and System Input Data

Information	*Value*	*Units*	*Reference*
Specific Gravity at System Temp...............	0.809	--	Material Specifications
Vapor Pressure @ 70 °F............................	0.01100	psi	Material Specifications
Vapor Molecular Weight............................	148.00	lb/lb-mol	Material Specifications
Gas Constant..	10.73	scf-psi/°R-lb-mol	Ideal Gas Laws
System and RP-1 Temperature.................	529.67	°R	Permit Application
RP-1 Emission Factor..........................	0.00029	lb/ft^3	Calculated Value

Maximum Process Event Summary

Event Name	*Value*	*Units*	*Reference*
Launches..	5	events/year	Permit Application
Static Launch and Abort Events....................	5	events/year	Permit Application
Event Vehicle RP-1 Throughput Volume..........	150,000	gals/event	Permit Application
Event Fill Line Throughput Volume...............	1,543	gals/event	Permit Application
Daily Launch Volume.................................	151,543	gals/day	Calculated Value
Daily Static Launch and Abort Volume..........	151,543	gals/day	Calculated Value
Daily Launch Volume.................................	20,258	ft^3/day	Calculated Value
Daily Static Launch and Abort Volume..........	40,517	ft^3/day	Calculated Value
Annual Launch Volume...............................	757,715	gals/year	Calculated Value
Annual Static Launch and Abort Volume..........	757,715	gals/year	Calculated Value
Annual Launch Volume...............................	101,292	ft^3/yr	Calculated Value
Annual Static Launch and Abort Volume.........	101,292	ft^3/yr	Calculated Value

ROC Potential to Emit

Process	lb/day	TPY
Launches	5.80	0.01
Static Launches/Abort	11.61	0.01
Total PTE	**11.61**	**0.03**

Notes:

1. One Falcon Heavy launch or static launch/abort permitted per day. PTE reflects the worst case scenario.

Processed By: KMB

Date: 2/11/2020

RSV Loading Potential to Emit Calculations

Attachment: A-3
Permit Number: PTO 15069
Facility: SpaceX

RP-1 and System Input Data

Information	*Value*	*Units*	*Reference*
Specific Gravity at System Temp................	0.809	--	Material Specifications
Vapor Pressure @ 70 °F..............................	0.011	psi	Material Specifications
Vapor Molecular Weight............................	148.00	lb/lb-mol	Material Specifications
Gas Constant..	10.73	scf-psi/°R-lb-mol	Ideal Gas Laws
System and RP-1 Temperature................	529.67	°R	Permit Application
RP-1 Emission Factor..........................	0.00029	lb/ft^3	Calculated Value

RP-1 Fuel Consumption

Consumption Operations	*Value*	*Units*	*Reference*
Worst Case Daily RP-1 Consumption............	378,000	gals/day	Equal to Total RP-1 Tank Calcs
Worst Case Annual RP-1 Consumption.......	3,009,650	gals	Combined Falcon 9 / Heavy Annual Launch Volume
Falcon Heavy RP-1 Consumption................	50,531	ft^3	Calculated Values
Falcon 9 RP-1 Consumption........................	402,333	ft^3	Calculated Values

ROC Potential to Emit

lb/day	TPY
14.47	0.06

Processed By: KMB

Date: 2/11/2020

Payload Fueling Potential to Emit Calculations

Attachment: A-4
Permit Number: PTO 15069
Facility: SpaceX

Payload/Unloading Input Data

Information	*Value*	*Units*	*Reference*
Flow Rate (loading/unloading).............	5.00	scf/min	Permit Application
MMH Molecular Weight......................	60.10	lb/lb-mol	Permit Application
N_2O_4 Molecular Weight...................	92.01	lb/lb-mol	Permit Application
Molar Denisty...........................	0.00264	lb-mole/scf	Permit Application
Processing Time.........................	4	hours	Permit Application
Loading Annual Operations.................	10	events/year	Permit Application
Unloading Annual Operations.............	5	events/year	Permit Application
Loading Control Efficiency...........	99.95	%	Permit Application
Unloading Control Efficiency..........	95.70	%	Permit Application
NO_x Fugitives Per Event..................	2.31	lb/event	Permit Application
ROC Fugitives Per Event..................	0.058	lb/event	Permit Application

Payload Loading Controlled Potential to Emit

Propellant	Pollutant	lb/day	TPY
N_2O_4	NO_x	12.53	0.06
MMH	ROC	0.10	0.00
N_2O_4	NO_x (Fugitives)	2.31	0.01
MMH	ROC (Fugitives)	0.06	0.00

Payload Unloading Controlled Potential to Emit

Propellant	Pollutant	lb/day	TPY
N_2O_4	NO_x	12.53	0.03
MMH	ROC	0.10	0.00
N_2O_4	NO_x (Fugitives)	2.31	0.01
MMH	ROC (Fugitives)	0.06	0.00

Total Potential to Emit

Propellant	Pollutant	lb/day	TPY
N_2O_4	NO_x	14.84	0.11
MMH	ROC	0.15	0.00

Notes:

1. One payload loading or unloading event permitted per day.
   PTE reflects the worst case scenario.

Processed By: KMB

Date: 2/11/2020

Roll-On Roll-Off Emissions - Los Angeles County Elizabeth C

Source Category	VOC	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$	Pb	CO2	CH4	N2O	CO2e
	ton/yr							MT/yr			
Marine Vessel	0.70	7.87	14.11	0.19	0.17	0.17	0.00	1828.85	0.03	0.07	1851.51
Off-Road	0.02	0.33	0.44	0.00	0.01	0.01	0.00	74.30	0.02	0.01	77.75
Total	**0.72**	**8.20**	**14.54**	**0.19**	**0.18**	**0.18**	**0.00**	**1,903.16**	**0.05**	**0.08**	**1,929.27**

SpaceX Marine Emissions - Los Angeles County

Marine Emission Estimates - Elizabeth C

Boat Classification	Phase	Engine	Engine Tier	Fuel	# Engines	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)
Tugboat	Transit	Propulsion	4	0.1%S	2	1,300	969	1.00	10.70	931
Tugboat	Transit	Auxiliary	3	0.1%S	1	99	74	0.31	10.70	931
Generator-Barge	Transit	Generator Sets	4	0.1%S	1	49	37	0.74	10.70	931
Emission Subtotals										

Boat Classification	Emission Factors VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
	(g/kW-hr)									
Tugboat	0.19	1.80	5.00	0.07	0.04	0.04	0.00	715.76	0.01	0.03
Tugboat	0.38	5.02	5.00	0.07	0.12	0.12	0.00	656.00	0.01	0.03
	(g/hp-hr)									
Generator-Barge	0.12	2.75	4.10	0.01	0.01	0.01	-	568.30	0.02	0.01
Emission Subtotals										

Boat Classification	Maximum Daily Emissions VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
	(lb/day)									
Tugboat	8.69	82.32	228.68	3.11	1.83	1.83	0.03	32,735.78	1.33	0.46
Tugboat	0.20	2.72	2.71	0.04	0.06	0.06	0.00	354.98	0.02	0.01
Generator-Barge	0.10	2.35	3.51	0.00	0.01	0.01	-	486.09	0.01	0.02
Emission Subtotals	**9.00**	**87.39**	**234.89**	**3.15**	**1.90**	**1.90**	**0.03**	**33,576.85**	**1.35**	**0.48**

Boat Classification	Annual Emissions VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20	CO2E
	(ton/yr)							(MT/yr)			
Tugboat	0.38	3.58	9.95	0.14	0.08	0.08	0.00	1,291.84	0.02	0.05	1,307.89
Tugboat	0.01	0.12	0.12	0.00	0.00	0.00	0.00	14.01	0.00	0.00	14.20
Generator-Barge	0.00	0.06	0.10	0.00	0.00	0.00	-	12.14	0.00	0.00	12.20
Emission Subtotals	**0.39**	**3.76**	**10.16**	**0.14**	**0.08**	**0.08**	**0.00**	**1,317.98**	**0.02**	**0.05**	**1,334.28**

Note:

Marine Emission Estimates - Bernardine C

Boat Classification	Phase	Engine	Engine Tier	Fuel	# Engines	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)
Tugboat	Transit	Propulsion	3	0.1%S	2	500	373	1.00	10.70	931
Tugboat	Transit	Auxiliary	3	0.1%S	1	99	74	0.31	10.70	931
Emission Subtotals										

Boat Classification	Emission Factors VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
	(g/kW-hr)									
Tugboat	0.39	5.21	5.00	0.07	0.11	0.11	0.00	715.76	0.01	0.03
Tugboat	0.38	5.02	5.00	0.07	0.12	0.12	0.00	656.00	0.01	0.03
Emission Subtotals										

Boat Classification	Maximum Daily Emissions VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
	(lb/day)									
Tugboat	6.90	91.61	87.95	1.20	1.93	1.93	0.01	12,590.69	0.51	0.18
Tugboat	0.20	2.72	2.71	0.04	0.06	0.06	0.00	354.98	0.02	0.01
Emission Subtotals	**7.10**	**94.33**	**90.66**	**1.23**	**2.00**	**2.00**	**0.01**	**12,945.67**	**0.53**	**0.18**

Boat Classification	Annual Emissions VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20	CO2E
	(ton/yr)							(MT/yr)			
Tugboat	0.30	3.99	3.83	0.05	0.08	0.08	0.00	496.86	0.01	0.02	503.03
Tugboat	0.01	0.12	0.12	0.00	0.00	0.00	0.00	14.01	0.00	0.00	14.20
Emission Subtotals	**0.31**	**4.10**	**3.94**	**0.05**	**0.09**	**0.09**	**0.00**	**510.87**	**0.01**	**0.02**	**517.23**

Note:

Emission Factors

Marine Propulsion

Engine Type	Engine Family	Model	Tier	Fuel	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
					(g/kW-hr)									
Slow Speed Diesel		<=1999	Tier 0	0.1%S	0.600	17.01	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		<=1999	Tier 0	0.1%S	0.500	13.16	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2000-2010	Tier 1	0.1%S	0.600	15.98	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2000-2010	Tier 1	0.1%S	0.500	12.22	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2011-2015	Tier 2	0.1%S	0.600	14.38	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2011-2015	Tier 2	0.1%S	0.500	10.53	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2016+	Tier 3	0.1%S	0.600	3.38	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2016+	Tier 3	0.1%S	0.500	2.63	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
EPA Certification	HCEXN19.0AAA		Tier 3	0.1%S	0.392	5.21	5.0	0.07	0.11	0.11	0.0006067	716		
EPA Certification	D233051MX03		Tier 4	0.1%S	0.190	1.80	5.0	0.07	0.04	0.04	0.0006067	716		

Notes:
Emission factors from Table 2.3 and 2.4 of the 2019 Port of Los Angeles Emission Inventory Methodology Report
EPA certification based on Tier 3 rating for the engine family from Table 1 to CFR §1042.101.
Emission factor for Pb from the Santa Barbara Air Pollution Control District Approved TAC Emission Factors, December 2023.

Marine Auxiliary

Engine Type	Model	Tier	Fuel	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
				(g/kW-hr)									
Aux High Speed Diesel	<=1999	Tier 0	0.1%S	0.600	10.9	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	<=1999	Tier 0	0.1%S	0.600	13.82	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel	2000-2010	Tier 1	0.1%S	0.600	9.78	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	2000-2010	Tier 1	0.1%S	0.600	12.22	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel	2011-2015	Tier 2	0.1%S	0.600	7.71	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	2011-2015	Tier 2	0.1%S	0.600	10.53	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel	2011-2015	Tier 3	0.1%S	0.600	1.97	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	2011-2015	Tier 3	0.1%S	0.600	2.63	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux Med Speed Diesel Tier 3 Standard	2011-2015	Tier 3	0.1%S	0.378	5.022	5	0.068	0.12	0.12	0.0006067			
				(g/hp-hr)									
Generator Sets		Tier 4 Final	0.1%S	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	-	568.2990	0.0180	0.0081

Notes:
Emission factors from Table 2.9 and 2.10 of the 2019 Port of Los Angeles Emission Inventory Methodology Report
Load factors for auxiliary engines based on Table 3.1 of the of the 2019 Port of Los Angeles Emission Inventory Methodology Report
EPA certification based on Tier 3 rating for the engine family from Table 5 to CFR §1042.101.
Emission factor for Pb from the Santa Barbara Air Pollution Control District Approved TAC Emission Factors, December 2023.

Marine exhaust emissions were calculated using the following equation:

$$Emissions_{diesel} = \Sigma\, EF_i \times Eng_i \times AvgHP \times Load_i \times Activity_i$$

Where:

EF	=	*Emission factor in grams per horse-power hour*
Eng	=	*Number of engines*
AvgHP	=	*Maximum rated average horsepower*
Load	=	*Load factor*
Activity	=	*Hours of operation*
i	=	*Equipment type*

SpaceX Offroad Emissions - Los Angeles County

Off-Road Emission Estimates

Construction Equipment	OFFROAD Model Category	Engine Tier	Quantity	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (day/yr)	Emission Factors (g/BHP-hr) VOC	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N2O
Crane-LR 1300	Crane	3	1	603	450	0.29	16	38	0.12	2.32	2.6	0.005	0.088	0.088	510.334	0.152	0.068138
Crane-Tadano ATF 220G	Crane	4	1	197	147	0.29	8	38	0.0600	0.2600	3.7000	0.0050	0.0080	0.0080	514.2600	0.1540	0.0690
KMAG	NA	3	1	453	338	0.3	4.0	38	0.1200	2.3200	2.6000	0.0050	0.0088	0.0088	528.8080	0.1540	0.0690
Generator-Barge	Generator Sets	4	1	49	37	0.74	1.5	38	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	568.2990	0.0180	0.0081
Emission Subtotals																	

Construction Equipment	Daily Emissions (lb/day) VOC	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N20
Crane-LR 1300	0.74	14.31	16.04	0.03	0.54	0.54	3,147.87	0.94	0.42
Crane-Tadano ATF 220G	0.06	0.26	3.73	0.01	0.01	0.01	518.16	0.16	0.07
KMAG	0.14	2.78	3.12	0.01	0.01	0.01	634	0.18	0.08
Generator-Barge	0.01	0.33	0.49	0.00	0.00	0.00	68	0.00	0.00
Emission Subtotals	**0.96**	**17.68**	**23.37**	**0.04**	**0.56**	**0.56**	**4,368.26**	**1.28**	**0.57**

Construction Equipment	Annual Emissions (MT/yr) CO2	CH4	N2O	CO2E
Crane-LR 1300	53.54	0.02	0.01	56.07
Crane-Tadano ATF 220G	8.81	0.00	0.00	9.23
KMAG	10.79	0.00	0.00	11.28
Generator-Barge	1.16	0.00	0.00	1.16
Emission Subtotals	**74.30**	**0.02**	**0.01**	**77.75**

Notes:

Emission factors are default emission factors from CalEEMod 2016.3.2, which relies on OFFROAD 2011.

Load factor for generator and cranes are defaults from CalEEMod 2016.3.2.

Load factor for KMAG based on average speed over route compared to rated maximum travel speed.

Emission Factors

Equipment Type	Year	Low HP	High HP	VOC (g/BHP-hr)	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N2O
KMAG	Tier 3	300	599	0.1200	2.3200	2.6000	0.0050	0.0088	0.0088	528.8080	0.1540	0.0690
Generator Sets	Tier 4 Final	25	49	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	568.2990	0.0180	0.0081
Crane-LR 1300	Tier 3	600	750	0.1200	2.3200	2.6000	0.0050	0.0880	0.0880	510.3340	0.1520	0.0681
Crane-Tadano ATF 220G	Tier 4 Final	120	174	0.0600	0.2600	3.7000	0.0050	0.0080	0.0080	514.2600	0.1540	0.0690

Off-road mobile equipment exhaust emissions were calculated using the following equation:

$$Emissions_{diesel} = \Sigma\, EF_i \times Pop_i \times AvgHP \times Load_i \times Activity_i$$

Where:

EF	=	*Emission factor in grams per horse-power hour*
Pop	=	*Population, or the number of pieces of equipment*
AvgHP	=	*Maximum rated average horsepower*
Load	=	*Load factor*
Activity	=	*Hours of operation*
i	=	*Equipment type*

Roll-On Roll-Off Emissions Kelly C - Los Angeles County

Source Category	**VOC**	**NO_x**	**CO**	**SO_x**	**PM_{10}**	**$PM_{2.5}$**	**Pb**	**CO2**	**CH4**	**N2O**	**CO2e**
	ton/yr							**MT/yr**			
Marine Vessel	0.35	4.65	4.49	0.06	0.10	0.10	0.00	582.08	0.01	0.02	589.28
Off-Road	0.01	0.11	0.15	0.00	0.00	0.00	0.00	24.77	0.01	0.00	25.92
Total	**0.36**	**4.76**	**4.63**	**0.06**	**0.10**	**0.10**	**0.00**	**606.84**	**0.02**	**0.03**	**615.19**

SpaceX Marine Roll-On Roll-Off Emissions

Marine Emission Estimates - Kelly C

Boat Classification	Phase	Engine	Engine Tier	Fuel	# Engines	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)	Emission Factors VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
											(g/kW-hr)									
Tugboat	Transit	Propulsion	3	0.1%S	2	1,000	746	1.00	10.70	353	0.39	5.21	5.00	0.07	0.11	0.11	0.00	715.76	0.01	0.03
Tugboat	Transit	Auxiliary	3	0.1%S	1	99	74	0.31	10.70	353	0.38	5.02	5.00	0.07	0.12	0.12	0.00	656.00	0.01	0.03
											(g/hp-hr)									
Generator-Barge	Transit	Generator Sets	4	0.1%S	1	49	37	0.74	10.70	353	0.12	2.75	4.10	0.01	0.01	0.01	-	568.30	0.02	0.01

Boat Classification	Engine	Maximum Daily Emissions VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
		(lb/day)									
Tugboat	Propulsion	13.79	183.22	175.91	2.39	3.87	3.87	0.02	25,181.37	1.02	0.35
Tugboat	Auxiliary	0.20	2.72	2.71	0.04	0.06	0.06	0.00	354.98	0.02	0.01
Generator-Barge	Generator Sets	0.10	2.35	3.51	0.00	0.01	0.01	-	486.09	0.01	0.02
Emission Subtotals		**14.10**	**188.29**	**182.12**	**2.43**	**3.94**	**3.94**	**0.02**	**26,022.44**	**1.04**	**0.37**

Boat Classification	Engine	Annual Emissions VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20	CO2E
		(ton/yr)							(MT/yr)			
Tugboat	Propulsion	0.23	3.02	2.90	0.04	0.06	0.06	0.00	376.93	0.01	0.02	381.61
Tugboat	Auxiliary	0.00	0.04	0.04	0.00	0.00	0.00	0.00	5.31	0.00	0.00	5.39
Generator-Barge	Generator Sets	0.00	0.03	0.04	0.00	0.00	0.00	-	6.06	0.00	0.00	6.09
Emission Subtotals		**0.23**	**3.10**	**2.99**	**0.04**	**0.07**	**0.07**	**0.00**	**388.30**	**0.01**	**0.02**	**393.08**

Note:

Marine Emission Estimates - Bernardine C

Boat Classification	Phase	Engine	Engine Tier	Fuel	# Engines	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)	Emission Factors VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
											(g/kW-hr)									
Tugboat	Transit	Propulsion	3	0.1%S	2	500	373	1.00	10.70	353	0.39	5.21	5.00	0.07	0.11	0.11	0.00	715.76	0.01	0.03
Tugboat	Transit	Auxiliary	3	0.1%S	1	99	74	0.31	10.70	353	0.38	5.02	5.00	0.07	0.12	0.12	0.00	656.00	0.01	0.03

Boat Classification	Engine	Maximum Daily Emissions VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
		(lb/day)									
Tugboat	Propulsion	6.90	91.61	87.95	1.20	1.93	1.93	0.01	12,590.69	0.51	0.18
Tugboat	Auxiliary	0.20	2.72	2.71	0.04	0.06	0.06	0.00	354.98	0.02	0.01
Emission Subtotals		**7.10**	**94.33**	**90.66**	**1.23**	**2.00**	**2.00**	**0.01**	**12,945.67**	**0.53**	**0.18**

Boat Classification	Engine	Annual Emissions VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20	CO2E
		(ton/yr)							(MT/yr)			
Tugboat	Propulsion	0.11	1.51	1.45	0.02	0.03	0.03	0.00	188.46	0.00	0.01	190.81
Tugboat	Auxiliary	0.00	0.04	0.04	0.00	0.00	0.00	0.00	5.31	0.00	0.00	5.39
Emission Subtotals		**0.12**	**1.56**	**1.50**	**0.02**	**0.03**	**0.03**	**0.00**	**193.78**	**0.00**	**0.01**	**196.19**

Note:

Emission Factors

Marine Propulsion

Engine Type	Engine Family	Model	Tier	Fuel	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
					(g/kW-hr)									
Slow Speed Diesel		<=1999	Tier 0	0.1%S	0.600	17.01	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		<=1999	Tier 0	0.1%S	0.500	13.16	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2000-2010	Tier 1	0.1%S	0.600	15.98	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2000-2010	Tier 1	0.1%S	0.500	12.22	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2011-2015	Tier 2	0.1%S	0.600	14.38	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2011-2015	Tier 2	0.1%S	0.500	10.53	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2016+	Tier 3	0.1%S	0.600	3.38	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2016+	Tier 3	0.1%S	0.500	2.63	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
EPA Certification	HCEXN19.0AAA		Tier 3	0.1%S	0.392	5.21	5.0	0.07	0.11	0.11	0.0006067	716		
EPA Certification	D233051MX03		Tier 4	0.1%S	0.190	1.80	5.0	0.07	0.04	0.04	0.0006067	716		

Notes:
Emission factors from Table 2.3 and 2.4 of the 2019 Port of Los Angeles Emission Inventory Methodology Report
EPA certification based on Tier 3 rating for the engine family from Table 1 to CFR §1042.101.
Emission factor for Pb from the Santa Barbara Air Pollution Control District Approved TAC Emission Factors, December 2023.

Marine Auxiliary

Engine Type	Model	Tier	Fuel	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
				(g/kW-hr)									
Aux High Speed Diesel	<=1999	Tier 0	0.1%S	0.600	10.9	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	<=1999	Tier 0	0.1%S	0.600	13.82	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel	2000-2010	Tier 1	0.1%S	0.600	9.78	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	2000-2010	Tier 1	0.1%S	0.600	12.22	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel	2011-2015	Tier 2	0.1%S	0.600	7.71	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	2011-2015	Tier 2	0.1%S	0.600	10.53	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel	2011-2015	Tier 3	0.1%S	0.600	1.97	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	2011-2015	Tier 3	0.1%S	0.600	2.63	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux Med Speed Diesel Tier 3 Standard	2011-2015	Tier 3	0.1%S	0.378	5.022	5	0.068	0.12	0.12	0.0006067			
				(g/hp-hr)									
Generator Sets		Tier 4 Final	0.1%S	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	-	568.2990	0.0180	0.0081

Notes:
Emission factors from Table 2.9 and 2.10 of the 2019 Port of Los Angeles Emission Inventory Methodology Report
Load factors for auxiliary engines based on Table 3.1 of the of the 2019 Port of Los Angeles Emission Inventory Methodology Report
EPA certification based on Tier 3 rating for the engine family from Table 5 to CFR §1042.101.
Emission factor for Pb from the Santa Barbara Air Pollution Control District Approved TAC Emission Factors, December 2023.

Marine exhaust emissions were calculated using the following equation:

$$Emissions_{diesel} = \Sigma\, EF_i \times Eng_i \times AvgHP \times Load_i \times Activity_i$$

Where:

EF	=	*Emission factor in grams per horse-power hour*
Eng	=	*Number of engines*
AvgHP	=	*Maximum rated average horsepower*
Load	=	*Load factor*
Activity	=	*Hours of operation*
i	=	*Equipment type*

SpaceX Offroad Roll-On Roll-Off Emissions

Off-Road Emission Estimates

Construction Equipment	OFFROAD Model Category	Engine Tier	Quantity	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (day/yr)
Crane-LR 1300	Crane	3	1	603	450	0.29	16	13
Crane-Tadano ATF 220G	Crane	4	1	197	147	0.29	8	13
KMAG	NA	3	1	453	338	0.3	4.0	13
Generator-Barge	Generator Sets	4	1	49	37	0.74	1.5	13
Emission Subtotals								

Construction Equipment	Emission Factors (g/BHP-hr) VOC	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N2O
Crane-LR 1300	0.12	2.32	2.6	0.005	0.088	0.088	510.334	0.152	0.068138
Crane-Tadano ATF 220G	0.0600	0.2600	3.7000	0.0050	0.0080	0.0080	514.2600	0.1540	0.0690
KMAG	0.1200	2.3200	2.6000	0.0050	0.0088	0.0088	528.8080	0.1540	0.0690
Generator-Barge	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	568.2990	0.0180	0.0081
Emission Subtotals									

Construction Equipment	Daily Emissions (lb/day) VOC	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N20
Crane-LR 1300	0.74	14.31	16.04	0.03	0.54	0.54	3,147.87	0.94	0.42
Crane-Tadano ATF 220G	0.06	0.26	3.73	0.01	0.01	0.01	518.16	0.16	0.07
KMAG	0.14	2.78	3.12	0.01	0.01	0.01	634	0.18	0.08
Generator-Barge	0.01	0.33	0.49	0.00	0.00	0.00	68	0.00	0.00
Emission Subtotals	**0.96**	**17.68**	**23.37**	**0.04**	**0.56**	**0.56**	**4,368.26**	**1.28**	**0.57**

Construction Equipment	Annual Emissions (MT/yr) CO2	CH4	N2O	CO2E
Crane-LR 1300	17.85	0.01	0.00	18.69
Crane-Tadano ATF 220G	2.94	0.00	0.00	3.08
KMAG	3.60	0.00	0.00	3.76
Generator-Barge	0.39	0.00	0.00	0.39
Emission Subtotals	**24.77**	**0.01**	**0.00**	**25.92**

Notes:

Emission factors are default emission factors from CalEEMod 2016.3.2, which relies on OFFROAD 2011.
Load factor for generator and cranes are defaults from CalEEMod 2016.3.2.
Load factor for KMAG based on average speed over route compared to rated maximum travel speed.

Emission Factors

Equipment Type	Year	Low HP	High HP	VOC	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N2O
				(g/BHP-hr)								
KMAG	Tier 3	300	599	0.1200	2.3200	2.6000	0.0050	0.0088	0.0088	528.8080	0.1540	0.0690
Generator Sets	Tier 4 Final	25	49	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	568.2990	0.0180	0.0081
Crane-LR 1300	Tier 3	600	750	0.1200	2.3200	2.6000	0.0050	0.0880	0.0880	510.3340	0.1520	0.0681
Crane-Tadano ATF 220G	Tier 4 Final	120	174	0.0600	0.2600	3.7000	0.0050	0.0080	0.0080	514.2600	0.1540	0.0690

Off-road mobile equipment exhaust emissions were calculated using the following equation:

$$Emissions_{diesel} = \Sigma\, EF_i \times Pop_i \times AvgHP \times Load_i \times Activity_i$$

Where:

EF	=	*Emission factor in grams per horse-power hour*
Pop	=	*Population, or the number of pieces of equipment*
AvgHP	=	*Maximum rated average horsepower*
Load	=	*Load factor*
Activity	=	*Hours of operation*
i	=	*Equipment type*

Roll-On Roll-Off Emissions Elizabeth C - Santa Barbara County

Source Category	VOC	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$	Pb	CO2	CH4	N20	CO2e
	ton/yr							MT/yr			
Marine Vessel	1.56	17.50	31.42	0.43	0.38	0.38	0.00	4,074.88	0.06	0.17	4125.57
Off-Road	0.01	0.20	0.28	0.00	0.00	0.00	0.00	42.38	0.01	0.00	43.59
Total	**1.57**	**17.70**	**31.70**	**0.43**	**0.38**	**0.38**	**0.00**	**4,117.25**	**0.06**	**0.17**	**4,169.16**

SpaceX Marine Roll-On Roll-Off Emissions

Marine Emission Estimates - Elizabeth C

Boat Classification	Phase	Engine	Engine Tier	Fuel	# Engines	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)
Tugboat	Transit	Propulsion	4	0.1%S	2	1,300	969	1.00	24.00	2088
Tugboat	Transit	Auxiliary	3	0.1%S	1	99	74	0.31	24.00	2088
Emission Subtotals										

Boat Classification	Engine	Emission Factors (g/kW-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
Tugboat	Propulsion	0.19	1.80	5.00	0.07	0.04	0.04	0.00	715.76	0.01	0.03
Tugboat	Auxiliary	0.38	5.02	5.00	0.07	0.12	0.12	0.00	656.00	0.01	0.03
Emission Subtotals											

Boat Classification	Engine	Maximum Daily Emissions (lb/day) VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
Tugboat	Propulsion	19.49	184.65	512.92	6.98	4.10	4.10	0.06	73,426.05	2.97	1.03
Tugboat	Auxiliary	0.46	6.10	6.07	0.08	0.15	0.15	0.00	796.22	0.04	0.01
Emission Subtotals		**19.95**	**190.75**	**518.99**	**7.06**	**4.25**	**4.25**	**0.06**	**74,222.28**	**3.01**	**1.04**

Boat Classification	Engine	Annual Emissions (ton/year) VOC	NOx	CO	SOx	PM10	PM2.5	Pb	(MT/yr) CO2	CH4	N20	CO2E
Tugboat	Propulsion	0.85	8.03	22.31	0.30	0.18	0.18	0.00	2,897.58	0.04	0.12	2,933.58
Tugboat	Auxiliary	0.02	0.27	0.26	0.00	0.01	0.01	0.00	31.42	0.00	0.00	31.85
Emission Subtotals		**0.87**	**8.30**	**22.58**	**0.31**	**0.18**	**0.18**	**0.00**	**2,929.00**	**0.04**	**0.12**	**2,965.43**

Note:

Marine Emission Estimates - Bernardine C

Boat Classification	Phase	Engine	Engine Tier	Fuel	# Engines	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)
Tugboat	Transit	Propulsion	3	0.1%S	2	500	373	1.00	24.00	2088
Tugboat	Transit	Auxiliary	3	0.1%S	1	99	74	0.31	24.00	2088
Emission Subtotals										

Boat Classification	Engine	Emission Factors (g/kW-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
Tugboat	Propulsion	0.39	5.21	5.00	0.07	0.11	0.11	0.00	715.76	0.01	0.03
Tugboat	Auxiliary	0.38	5.02	5.00	0.07	0.12	0.12	0.00	656.00	0.01	0.03
Emission Subtotals											

Boat Classification	Engine	Maximum Daily Emissions (lb/day) VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
Tugboat	Propulsion	15.47	205.49	197.28	2.68	4.34	4.34	0.02	28,240.79	1.14	0.39
Tugboat	Auxiliary	0.46	6.10	6.07	0.08	0.15	0.15	0.00	796.22	0.04	0.01
Emission Subtotals		**15.93**	**211.58**	**203.35**	**2.77**	**4.49**	**4.49**	**0.02**	**29,037.01**	**1.18**	**0.41**

Boat Classification	Engine	Annual Emissions (ton/yr) VOC	NOx	CO	SOx	PM10	PM2.5	Pb	(MT/yr) CO2	CH4	N20	CO2E
Tugboat	Propulsion	0.67	8.94	8.58	0.12	0.19	0.19	0.00	1,114.45	0.02	0.05	1,128.30
Tugboat	Auxiliary	0.02	0.27	0.26	0.00	0.01	0.01	0.00	31.42	0.00	0.00	31.85
Emission Subtotals		**0.69**	**9.20**	**8.85**	**0.12**	**0.20**	**0.20**	**0.00**	**1,145.88**	**0.02**	**0.05**	**1,160.15**

Note:

Marine Propulsion

Engine Type	Engine Family	Model	Tier	Fuel	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
					(g/kW-hr)									
Slow Speed Diesel		<=1999	Tier 0	0.1%S	0.600	17.01	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		<=1999	Tier 0	0.1%S	0.500	13.16	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2000-2010	Tier 1	0.1%S	0.600	15.98	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2000-2010	Tier 1	0.1%S	0.500	12.22	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2011-2015	Tier 2	0.1%S	0.600	14.38	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2011-2015	Tier 2	0.1%S	0.500	10.53	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2016+	Tier 3	0.1%S	0.600	3.38	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2016+	Tier 3	0.1%S	0.500	2.63	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
EPA Certification	HCEXN19.0AAA		Tier 3	0.1%S	0.392	5.21	5.0	0.07	0.11	0.11	0.0006067	716		
EPA Certification	D233051MX03		Tier 4	0.1%S	0.190	1.80	5.0	0.07	0.04	0.04	0.0006067	716		

Notes:
Emission factors from Table 2.3 and 2.4 of the 2019 Port of Los Angeles Emission Inventory Methodology Report
EPA certification based on Tier 3 rating for the engine family from Table 1 to CFR §1042.101.
Emission factor for Pb from the Santa Barbara Air Pollution Control District Approved TAC Emission Factors, December 2023.

Marine Auxiliary

Engine Type	Model	Tier	Fuel	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
				(g/kW-hr)									
Aux High Speed Diesel	<=1999	Tier 0	0.1%S	0.600	10.9	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	<=1999	Tier 0	0.1%S	0.600	13.82	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel	2000-2010	Tier 1	0.1%S	0.600	9.78	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	2000-2010	Tier 1	0.1%S	0.600	12.22	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel	2011-2015	Tier 2	0.1%S	0.600	7.71	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	2011-2015	Tier 2	0.1%S	0.600	10.53	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel	2011-2015	Tier 3	0.1%S	0.600	1.97	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	2011-2015	Tier 3	0.1%S	0.600	2.63	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux Med Speed Diesel Tier 3 Standard	2011-2015	Tier 3	0.1%S	0.378	5.022	5	0.068	0.12	0.12	0.0006067			
				(g/hp-hr)									
Generator Sets		Tier 4 Final	0.1%S	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	-	568.2990	0.0180	0.0081

Notes:
Emission factors from Table 2.9 and 2.10 of the 2019 Port of Los Angeles Emission Inventory Methodology Report
Load factors for auxiliary engines based on Table 3.1 of the of the 2019 Port of Los Angeles Emission Inventory Methodology Report
EPA certification based on Tier 3 rating for the engine family from Table 5 to CFR §1042.101.
Emission factor for Pb from the Santa Barbara Air Pollution Control District Approved TAC Emission Factors, December 2023.

Marine exhaust emissions were calculated using the following equation:

$$Emissions_{diesel} = \Sigma\, EF_i \times Eng_i \times AvgHP \times Load_i \times Activity_i$$

Where:

EF	=	*Emission factor in grams per horse-power hour*
Eng	=	*Number of engines*
AvgHP	=	*Maximum rated average horsepower*
Load	=	*Load factor*
Activity	=	*Hours of operation*
i	=	*Equipment type*

SpaceX Offroad Roll-On Roll-Off Emissions

Off-Road Emission Estimates

Construction Equipment	OFFROAD Model Category	Engine Tier	Quantity	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)
Crane-HTC-3140LB J8	Crane-transport	4	1	550	410	0.29	0.5	19
Crane-HTC-3140LB J8	Crane-lift	4	1	215	160	0.29	2	75
KMAG	NA	3	1	453	338	0.30	8	281
Generator-Barge	Generator Sets	4	1	49	37	0.74	24.0	900
Emission Subtotals								

Construction Equipment	Emission Factors (g/BHP-hr) VOC	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N2O
Crane-HTC-3140LB J8	0.0600	0.2600	2.2000	0.0050	0.0080	0.0080	470.5495	0.1522	0.0682
Crane-HTC-3140LB J8	0.0600	0.2600	2.2000	0.0050	0.0080	0.0080	472.9057	0.1529	0.0690
KMAG	0.1200	2.3200	2.6000	0.0050	0.0088	0.0088	528.8080	0.1540	0.0690
Generator-Barge	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	568.2990	0.0180	0.0081
Emission Subtotals									

Construction Equipment	Daily Emissions (lb/day) VOC	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N20
Crane-HTC-3140LB J8	0.01	0.05	0.39	0.00	0.00	0.00	82.73	0.03	0.01
Crane-HTC-3140LB J8	0.02	0.07	0.60	0.00	0.00	0.00	130.01	0.04	0.02
KMAG	0.27	5.21	5.84	0.01	0.02	0.02	1,188.24	0.35	0.16
Generator-Barge	0.23	5.28	7.87	0.01	0.02	0.02	1,090	0.03	0.02
Emission Subtotals	**0.53**	**10.61**	**14.70**	**0.02**	**0.04**	**0.04**	**2,491.27**	**0.45**	**0.20**

Construction Equipment	Annual Emissions (ton/year) VOC	NOx	CO	SOx	PM10	PM2.5	(MT/yr) CO2	CH4	N2O	CO2E
Crane-HTC-3140LB J8	0.00	0.00	0.01	0.00	0.00	0.00	1.41	0.00	0.00	1.48
Crane-HTC-3140LB J8	0.00	0.00	0.01	0.00	0.00	0.00	2.21	0.00	0.00	2.33
KMAG	0.01	0.10	0.11	0.00	0.00	0.00	20.21	0.01	0.00	21.15
Generator-Barge	0.00	0.10	0.15	0.00	0.00	0.00	18.55	0.00	0.00	18.64
Emission Subtotals	**0.01**	**0.20**	**0.28**	**0.00**	**0.00**	**0.00**	**42.38**	**0.01**	**0.00**	**43.59**

Notes:

Emission factors are default emission factors from CalEEMod 2016.3.2, which relies on OFFROAD 2011.

Load factor for generator are defaults from CalEEMod 2016.3.2.

Load factor for KMAG based on average speed over route compared to rated maximum travel speed.

Fugitive dust emissions from paved roads assumes the KMAG is loaded.

Emission Factors

Equipment Type	Year	Low HP	High HP	VOC	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N2O
				(g/BHP-hr)								
KMAG	Tier 3	300	599	0.1200	2.3200	2.6000	0.0050	0.0088	0.0088	528.8080	0.1540	0.0690
Crane-HTC-3140LB J8	Tier 4 Final	175	299	0.0600	0.2600	2.2000	0.0050	0.0080	0.0080	472.9057	0.1529	0.0690
Crane-HTC-3140LB J8	Tier 4 Final	300	599	0.0600	0.2600	2.2000	0.0050	0.0080	0.0080	470.5495	0.1522	0.0682
Generator Sets	Tier 4 Final	25	49	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	568.2990	0.0180	0.0081

Off-road mobile equipment exhaust emissions were calculated using the following equation:

$$Emissions_{diesel} = \Sigma\, EF_i \times Pop_i \times AvgHP \times Load_i \times Activity_i$$

Where:

EF = *Emission factor in grams per horse-power hour*

Pop = *Population, or the number of pieces of equipment*

AvgHP = *Maximum rated average horsepower*

Load = *Load factor*

Activity = *Hours of operation*

i = *Equipment type*

Roll-On Roll-Off Emissions Kelly C - Santa Barbara County

Source Category	VOC	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$	Pb	CO2	CH4	N20	CO2e
	ton/yr							MT/yr			
Marine Vessel	0.78	10.37	9.97	0.14	0.22	0.22	0.00	1,292.01	0.02	0.05	1308.09
Off-Road	0.00	0.07	0.09	0.00	0.00	0.00	0.00	14.13	0.00	0.00	14.53
Total	**0.78**	**10.44**	**10.06**	**0.14**	**0.22**	**0.22**	**0.00**	**1,306.13**	**0.02**	**0.05**	**1,322.62**

SpaceX Marine Roll-On Roll-Off Emissions

Marine Emission Estimates - Kelly C

Boat Classification	Phase	Engine	Engine Tier	Fuel	# Engines	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)	Emission Factors VOC (g/kW-hr)	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
Tugboat	Transit	Propulsion	3	0.1%S	2	1,000	746	1.00	24.00	792	0.39	5.21	5.00	0.07	0.11	0.11	0.00	715.76	0.01	0.03
Tugboat	Transit	Auxiliary	3	0.1%S	1	99	74	0.31	24.00	792	0.38	5.02	5.00	0.07	0.12	0.12	0.00	656.00	0.01	0.03
Emission Subtotals																				

Boat Classification	Maximum Daily Emissions VOC (lb/day)	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
Tugboat (Propulsion)	30.93	410.97	394.56	5.37	8.68	8.68	0.05	56,481.58	2.29	0.79
Tugboat (Auxiliary)	0.46	6.10	6.07	0.08	0.15	0.15	0.00	796.22	0.04	0.01
Emission Subtotals	**31.39**	**417.07**	**400.63**	**5.45**	**8.83**	**8.83**	**0.05**	**57,277.80**	**2.32**	**0.80**

Boat Classification	Annual Emissions VOC (ton/year)	NOx	CO	SOx	PM10	PM2.5	Pb	CO2 (MT/yr)	CH4	N20	CO2E
Tugboat (Propulsion)	0.51	6.78	6.51	0.09	0.14	0.14	0.00	845.45	0.01	0.03	855.95
Tugboat (Auxiliary)	0.01	0.10	0.10	0.00	0.00	0.00	0.00	11.92	0.00	0.00	12.08
Emission Subtotals	**0.52**	**6.88**	**6.61**	**0.09**	**0.15**	**0.15**	**0.00**	**857.37**	**0.01**	**0.03**	**868.03**

Note:

Marine Emission Estimates - Bernardine C

Boat Classification	Phase	Engine	Engine Tier	Fuel	# Engines	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)	Emission Factors VOC (g/kW-hr)	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
Tugboat	Transit	Propulsion	3	0.1%S	2	500	373	1.00	24.00	792	0.39	5.21	5.00	0.07	0.11	0.11	0.00	715.76	0.01	0.03
Tugboat	Transit	Auxiliary	3	0.1%S	1	99	74	0.31	24.00	792	0.38	5.02	5.00	0.07	0.12	0.12	0.00	656.00	0.01	0.03
Emission Subtotals																				

Boat Classification	Maximum Daily Emissions VOC (lb/day)	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
Tugboat (Propulsion)	15.47	205.49	197.28	2.68	4.34	4.34	0.02	28,240.79	1.14	0.39
Tugboat (Auxiliary)	0.46	6.10	6.07	0.08	0.15	0.15	0.00	796.22	0.04	0.01
Emission Subtotals	**15.93**	**211.58**	**203.35**	**2.77**	**4.49**	**4.49**	**0.02**	**29,037.01**	**1.18**	**0.41**

Boat Classification	Annual Emissions VOC (ton/yr)	NOx	CO	SOx	PM10	PM2.5	Pb	CO2 (MT/yr)	CH4	N20	CO2E
Tugboat (Propulsion)	0.26	3.39	3.26	0.04	0.07	0.07	0.00	422.72	0.01	0.02	427.98
Tugboat (Auxiliary)	0.01	0.10	0.10	0.00	0.00	0.00	0.00	11.92	0.00	0.00	12.08
Emission Subtotals	**0.26**	**3.49**	**3.36**	**0.05**	**0.07**	**0.07**	**0.00**	**434.64**	**0.01**	**0.02**	**440.06**

Note:

Marine Propulsion

Engine Type	Engine Family	Model	Tier	Fuel	VOC (g/kW-hr)	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
Slow Speed Diesel		<=1999	Tier 0	0.1%S	0.600	17.01	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		<=1999	Tier 0	0.1%S	0.500	13.16	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2000-2010	Tier 1	0.1%S	0.600	15.98	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2000-2010	Tier 1	0.1%S	0.500	12.22	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2011-2015	Tier 2	0.1%S	0.600	14.38	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2011-2015	Tier 2	0.1%S	0.500	10.53	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2016+	Tier 3	0.1%S	0.600	3.38	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2016+	Tier 3	0.1%S	0.500	2.63	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
EPA Certification	HCEXN19.0AAA		Tier 3	0.1%S	0.392	5.21	5.0	0.07	0.11	0.11	0.0006067	716		
EPA Certification	D233051MX03		Tier 4	0.1%S	0.190	1.80	5.0	0.07	0.04	0.04	0.0006067	716		

Notes:
Emission factors from Table 2.3 and 2.4 of the 2019 Port of Los Angeles Emission Inventory Methodology Report
EPA certification based on Tier 3 rating for the engine family from Table 1 to CFR §1042.101.
Emission factor for Pb from the Santa Barbara Air Pollution Control District Approved TAC Emission Factors, December 2023.

Marine Auxiliary

Engine Type	Model	Tier	Fuel	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
				(g/kW-hr)									
Aux High Speed Diesel	<=1999	Tier 0	0.1%S	0.600	10.9	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	<=1999	Tier 0	0.1%S	0.600	13.82	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel	2000-2010	Tier 1	0.1%S	0.600	9.78	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	2000-2010	Tier 1	0.1%S	0.600	12.22	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel	2011-2015	Tier 2	0.1%S	0.600	7.71	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	2011-2015	Tier 2	0.1%S	0.600	10.53	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel	2011-2015	Tier 3	0.1%S	0.600	1.97	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	2011-2015	Tier 3	0.1%S	0.600	2.63	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux Med Speed Diesel Tier 3 Standard	2011-2015	Tier 3	0.1%S	0.378	5.022	5	0.068	0.12	0.12	0.0006067			
				(g/hp-hr)									
Generator Sets		Tier 4 Final	0.1%S	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	-	568.2990	0.0180	0.0081

Notes:
Emission factors from Table 2.9 and 2.10 of the 2019 Port of Los Angeles Emission Inventory Methodology Report
Load factors for auxiliary engines based on Table 3.1 of the of the 2019 Port of Los Angeles Emission Inventory Methodology Report
EPA certification based on Tier 3 rating for the engine family from Table 5 to CFR §1042.101.
Emission factor for Pb from the Santa Barbara Air Pollution Control District Approved TAC Emission Factors, December 2023.

Marine exhaust emissions were calculated using the following equation:

$$Emissions_{diesel} = \Sigma\, EF_i \times Eng_i \times AvgHP \times Load_i \times Activity_i$$

Where:

EF	=	*Emission factor in grams per horse-power hour*
Eng	=	*Number of engines*
AvgHP	=	*Maximum rated average horsepower*
Load	=	*Load factor*
Activity	=	*Hours of operation*
i	=	*Equipment type*

SpaceX Offroad Roll-On Roll-Off Emissions

Off-Road Emission Estimates

Construction Equipment	OFFROAD Model Category	Engine Tier	Quantity	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)	Emission Factors VOC (g/BHP-hr)	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N2O
Crane-HTC-3140LB J8	Crane-transport	4	1	550	410	0.29	0.5	6	0.0600	0.2600	2.2000	0.0050	0.0080	0.0080	470.5495	0.1522	0.0682
Crane-HTC-3140LB J8	Crane-lift	4	1	215	160	0.29	2	25	0.0600	0.2600	2.2000	0.0050	0.0080	0.0080	472.9057	0.1529	0.0690
KMAG	NA	3	1	453	338	0.30	8	94	0.1200	2.3200	2.6000	0.0050	0.0088	0.0088	528.8080	0.1540	0.0690
Generator-Barge	Generator Sets	4	1	49	37	0.74	24.0	300	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	568.2990	0.0180	0.0081
Emission Subtotals																	

Construction Equipment	Daily Emissions VOC (lb/day)	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N20
Crane-HTC-3140LB J8	0.01	0.05	0.39	0.00	0.00	0.00	82.73	0.03	0.01
Crane-HTC-3140LB J8	0.02	0.07	0.60	0.00	0.00	0.00	130.01	0.04	0.02
KMAG	0.27	5.21	5.84	0.01	0.02	0.02	1,188.24	0.35	0.16
Generator-Barge	0.23	5.28	7.87	0.01	0.02	0.02	1,090	0.03	0.02
Emission Subtotals	**0.53**	**10.61**	**14.70**	**0.02**	**0.04**	**0.04**	**2,491.27**	**0.45**	**0.20**

Construction Equipment	Annual Emissions VOC (ton/year)	NOx (ton/year)	CO (ton/year)	SOx (ton/year)	PM10 (ton/year)	PM2.5 (ton/year)	CO2 (MT/yr)	CH4 (MT/yr)	N2O (MT/yr)	CO2E (MT/yr)
Crane-HTC-3140LB J8	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.00	0.00	0.49
Crane-HTC-3140LB J8	0.00	0.00	0.00	0.00	0.00	0.00	0.74	0.00	0.00	0.78
KMAG	0.00	0.03	0.04	0.00	0.00	0.00	6.74	0.00	0.00	7.05
Generator-Barge	0.00	0.03	0.05	0.00	0.00	0.00	6.18	0.00	0.00	6.21
Emission Subtotals	**0.00**	**0.07**	**0.09**	**0.00**	**0.00**	**0.00**	**14.13**	**0.00**	**0.00**	**14.53**

Notes:

Emission factors are default emission factors from CalEEMod 2016.3.2, which relies on OFFROAD 2011.

Load factor for generator are defaults from CalEEMod 2016.3.2.

Load factor for KMAG based on average speed over route compared to rated maximum travel speed.

Fugitive dust emissions from paved roads assumes the KMAG is loaded.

Emission Factors

Equipment Type	Year	Low HP	High HP	VOC (g/BHP-hr)	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N2O
KMAG	Tier 3	300	599	0.1200	2.3200	2.6000	0.0050	0.0088	0.0088	528.8080	0.1540	0.0690
Crane-HTC-3140LB J8	Tier 4 Final	175	299	0.0600	0.2600	2.2000	0.0050	0.0080	0.0080	472.9057	0.1529	0.0690
Crane-HTC-3140LB J8	Tier 4 Final	300	599	0.0600	0.2600	2.2000	0.0050	0.0080	0.0080	470.5495	0.1522	0.0682
Generator Sets	Tier 4 Final	25	49	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	568.2990	0.0180	0.0081

Off-road mobile equipment exhaust emissions were calculated using the following equation:

$$Emissions_{diesel} = \Sigma\, EF_i \times Pop_i \times AvgHP \times Load_i \times Activity_i$$

Where:

EF	=	*Emission factor in grams per horse-power hour*
Pop	=	*Population, or the number of pieces of equipment*
AvgHP	=	*Maximum rated average horsepower*
Load	=	*Load factor*
Activity	=	*Hours of operation*
i	=	*Equipment type*

SpaceX Roll-On Roll-Off Ventura County

Marine Emission Estimates - Elizabeth C

Boat Classification	Phase	Engine	Engine Tier	Fuel	# Engines	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)
Tugboat	Transit	Propulsion	4	0.1%S	2	1,300	969	1.00	20.00	1560
Tugboat	Transit	Auxiliary	3	0.1%S	1	99	74	0.31	20.00	1560
Generator-Barge	Transit	Generator Sets	4	0.1%S	1	49	37	0.74	20.00	1560
Emission Subtotals										

Boat Classification	Engine	Emission Factors VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
		(g/kW-hr)									
Tugboat	Propulsion	0.19	1.80	5.00	0.07	0.04	0.04	0.00	715.76	0.01	0.03
Tugboat	Auxiliary	0.38	5.02	5.00	0.07	0.12	0.12	0.00	656.00	0.01	0.03
		(g/hp-hr)									
Generator-Barge	Generator Sets	0.12	2.75	4.10	0.01	0.01	0.01	-	568.30	0.02	0.01

Boat Classification	Engine	Maximum Daily Emissions VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
		(lb/day)									
Tugboat	Propulsion	16.24	153.88	427.44	5.81	3.42	3.42	0.05	61,188.38	2.48	0.85
Tugboat	Auxiliary	0.38	5.08	5.06	0.07	0.12	0.12	0.00	663.52	0.03	0.01
Generator-Barge	Generator Sets	0.19	4.40	6.55	0.01	0.01	0.01	-	908.58	0.01	0.03
Emission Subtotals		**16.82**	**163.35**	**439.05**	**5.89**	**3.55**	**3.55**	**0.05**	**62,760.48**	**2.52**	**0.89**

Boat Classification	Engine	Annual Emissions VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20	CO2E
		(ton/yr)							(MT/yr)			
Tugboat	Propulsion	0.63	6.00	16.67	0.23	0.13	0.13	0.00	2,164.86	0.03	0.09	2,191.75
Tugboat	Auxiliary	0.01	0.20	0.20	0.00	0.00	0.00	0.00	23.48	0.00	0.00	23.79
Generator-Barge	Generator Sets	0.01	0.13	0.19	0.00	0.00	0.00	-	24.27	0.00	0.00	24.40
Emission Subtotals		**0.65**	**6.33**	**17.06**	**0.23**	**0.14**	**0.14**	**0.00**	**2,212.61**	**0.03**	**0.09**	**2,239.94**

Note:

Marine Emission Estimates - Bernardine C

Boat Classification	Phase	Engine	Engine Tier	Fuel	# Engines	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)
Tugboat	Transit	Propulsion	3	0.1%S	2	500	373	1.00	20.00	1560
Tugboat	Transit	Auxiliary	3	0.1%S	1	99	74	0.31	20.00	1560
Emission Subtotals										

Boat Classification	Engine	Emission Factors VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
		(g/kW-hr)									
Tugboat	Propulsion	0.39	5.21	5.00	0.07	0.11	0.11	0.00	715.76	0.01	0.03
Tugboat	Auxiliary	0.38	5.02	5.00	0.07	0.12	0.12	0.00	656.00	0.01	0.03

Boat Classification	Engine	Maximum Daily Emissions VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
		(lb/day)									
Tugboat	Propulsion	12.89	171.24	164.40	2.24	3.62	3.62	0.02	23,533.99	0.95	0.33
Tugboat	Auxiliary	0.38	5.08	5.06	0.07	0.12	0.12	0.00	663.52	0.03	0.01
Emission Subtotals		**13.27**	**176.32**	**169.46**	**2.30**	**3.74**	**3.74**	**0.02**	**24,197.51**	**0.98**	**0.34**

Boat Classification	Engine	Annual Emissions VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20	CO2E
		(ton/yr)							(MT/yr)			
Tugboat	Propulsion	0.50	6.68	6.41	0.09	0.14	0.14	0.00	832.64	0.01	0.03	842.98
Tugboat	Auxiliary	0.01	0.20	0.20	0.00	0.00	0.00	0.00	23.48	0.00	0.00	23.79
Emission Subtotals		**0.52**	**6.88**	**6.61**	**0.09**	**0.15**	**0.15**	**0.00**	**856.11**	**0.01**	**0.03**	**866.78**

Note:

Emission Factors

Marine Propulsion

Engine Type	Engine Family	Model	Tier	Fuel	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
					(g/kW-hr)									
Slow Speed Diesel		<=1999	Tier 0	0.1%S	0.600	17.01	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		<=1999	Tier 0	0.1%S	0.500	13.16	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2000-2010	Tier 1	0.1%S	0.600	15.98	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2000-2010	Tier 1	0.1%S	0.500	12.22	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2011-2015	Tier 2	0.1%S	0.600	14.38	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2011-2015	Tier 2	0.1%S	0.500	10.53	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2016+	Tier 3	0.1%S	0.600	3.38	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2016+	Tier 3	0.1%S	0.500	2.63	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
EPA Certification	HCEXN19.0AAA		Tier 3	0.1%S	0.392	5.21	5.0	0.07	0.11	0.11	0.0006067	716		
EPA Certification	D233051MX03		Tier 4	0.1%S	0.190	1.80	5.0	0.07	0.04	0.04	0.0006067	716		

Notes:
Emission factors from Table 2.3 and 2.4 of the 2019 Port of Los Angeles Emission Inventory Methodology Report
EPA certification based on Tier 3 rating for the engine family from Table 1 to CFR §1042.101.
Emission factor for Pb from the Santa Barbara Air Pollution Control District Approved TAC Emission Factors, December 2023.

Marine Auxiliary

Engine Type	Model	Tier	Fuel	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
				(g/kW-hr)									
Aux High Speed Diesel	<=1999	Tier 0	0.1%S	0.600	10.9	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	<=1999	Tier 0	0.1%S	0.600	13.82	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel	2000-2010	Tier 1	0.1%S	0.600	9.78	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	2000-2010	Tier 1	0.1%S	0.600	12.22	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel	2011-2015	Tier 2	0.1%S	0.600	7.71	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	2011-2015	Tier 2	0.1%S	0.600	10.53	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel	2011-2015	Tier 3	0.1%S	0.600	1.97	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	2011-2015	Tier 3	0.1%S	0.600	2.63	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux Med Speed Diesel Tier 3 Standard	2011-2015	Tier 3	0.1%S	0.378	5.022	5	0.068	0.12	0.12	0.0006067			
				(g/hp-hr)									
Generator Sets		Tier 4 Final	0.1%S	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	-	568.2990	0.0180	0.0081

Notes:
Emission factors from Table 2.9 and 2.10 of the 2019 Port of Los Angeles Emission Inventory Methodology Report
Load factors for auxiliary engines based on Table 3.1 of the of the 2019 Port of Los Angeles Emission Inventory Methodology Report
EPA certification based on Tier 3 rating for the engine family from Table 5 to CFR §1042.101.
Emission factor for Pb from the Santa Barbara Air Pollution Control District Approved TAC Emission Factors, December 2023.

Marine exhaust emissions were calculated using the following equation:

$$Emissions_{diesel} = \Sigma\ EF_i \times Eng_i \times AvgHP \times Load_i \times Activity_i$$

Where:

EF	=	*Emission factor in grams per horse-power hour*
Eng	=	*Number of engines*
AvgHP	=	*Maximum rated average horsepower*
Load	=	*Load factor*
Activity	=	*Hours of operation*
i	=	*Equipment type*

SpaceX Roll-On Roll-Off Emissions Ventura County

Marine Emission Estimates - Kelly C

											Emission Factors										Maximum Daily Emissions										Annual Emissions										
Boat Classification	Phase	Engine	Engine Tier	Fuel	# Engines	Engine Rating	Engine Rating	Load Factor	Operation	Operation	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20	CO2E
						(hp)	(kW)		(hr/day)	(hours/yr)	(g/kW-hr)										(lb/day)										(ton/yr)							(MT/yr)			
Tugboat	Transit	Propulsion	3	0.1%S	2	1,000	746	1.00	20.00	590	0.39	5.21	5.00	0.07	0.11	0.11	0.00	715.76	0.01	0.03	25.78	342.48	328.80	4.47	7.23	7.23	0.04	47,067.98	1.91	0.66	0.38	5.05	4.85	0.07	0.11	0.11	0.00	629.82	0.01	0.03	637.64
Tugboat	Transit	Auxiliary	3	0.1%S	1	99	74	0.31	20.00	590	0.38	5.02	5.00	0.07	0.12	0.12	0.00	656.00	0.01	0.03	0.38	5.08	5.06	0.07	0.12	0.12	0.00	663.52	0.03	0.01	0.01	0.07	0.07	0.00	0.00	0.00	0.00	8.88	0.00	0.00	9.00
											(g/hp-hr)																														
Generator-Barge	Transit	Generator Sets	4	0.1%S	1	49	37	0.74	20.00	590	0.12	2.75	4.10	0.01	0.01	0.01	-	568.30	0.02	0.01	0.19	4.40	6.55	0.01	0.01	0.01	0	908.58	0.01	0.03	0.00	0.05	0.07	0.00	0.00	0.00	-	9.18	0.00	0.00	9.23
Emission Subtotals																					**26.35**	**351.95**	**340.41**	**4.55**	**7.37**	**7.37**	**0.04**	**48,640.08**	**1.95**	**0.70**	**0.39**	**5.18**	**5.00**	**0.07**	**0.11**	**0.11**	**0.00**	**647.88**	**0.01**	**0.03**	**655.87**

Note:

Marine Emission Estimates - Bernardine C

											Emission Factors										Maximum Daily Emissions										Annual Emissions										
Boat Classification	Phase	Engine	Engine Tier	Fuel	# Engines	Engine Rating	Engine Rating	Load Factor	Operation	Operation	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20	CO2E
						(hp)	(kW)		(hr/day)	(hours/yr)	(g/kW-hr)										(lb/day)										(ton/yr)							(MT/yr)			
Tugboat	Transit	Propulsion	3	0.1%S	2	500	373	1.00	20.00	590	0.39	5.21	5.00	0.07	0.11	0.11	0.00	715.76	0.01	0.03	12.89	171.24	164.40	2.24	3.62	3.62	0.02	23,533.99	0.95	0.33	0.19	2.53	2.42	0.03	0.05	0.05	0.00	314.91	0.00	0.01	318.82
Tugboat	Transit	Auxiliary	3	0.1%S	1	99	74	0.31	20.00	590	0.38	5.02	5.00	0.07	0.12	0.12	0.00	656.00	0.01	0.03	0.38	5.08	5.06	0.07	0.12	0.12	0.00	663.52	0.03	0.01	0.01	0.07	0.07	0.00	0.00	0.00	0.00	8.88	0.00	0.00	9.00
Emission Subtotals																					**13.27**	**176.32**	**169.46**	**2.30**	**3.74**	**3.74**	**0.02**	**24,197.51**	**0.98**	**0.34**	**0.20**	**2.60**	**2.50**	**0.03**	**0.06**	**0.06**	**0.00**	**323.79**	**0.00**	**0.01**	**327.82**

Note:

Emission Factors

Marine Propulsion

Engine Type	Engine Family	Model	Tier	Fuel	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
					(g/kW-hr)									
Slow Speed Diesel		<=1999	Tier 0	0.1%S	0.600	17.01	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		<=1999	Tier 0	0.1%S	0.500	13.16	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2000-2010	Tier 1	0.1%S	0.600	15.98	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2000-2010	Tier 1	0.1%S	0.500	12.22	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2011-2015	Tier 2	0.1%S	0.600	14.38	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2011-2015	Tier 2	0.1%S	0.500	10.53	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2016+	Tier 3	0.1%S	0.600	3.38	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2016+	Tier 3	0.1%S	0.500	2.63	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
EPA Certification	HCEXN19.0AAA		Tier 3	0.1%S	0.392	5.21	5.0	0.07	0.11	0.11	0.0006067	716		
EPA Certification	D233051MX03		Tier 4	0.1%S	0.190	1.80	5.0	0.07	0.04	0.04	0.0006067	716		

Notes:
Emission factors from Table 2.3 and 2.4 of the 2019 Port of Los Angeles Emission Inventory Methodology Report
EPA certification based on Tier 3 rating for the engine family from Table 1 to CFR §1042.101.
Emission factor for Pb from the Santa Barbara Air Pollution Control District Approved TAC Emission Factors, December 2023.

Marine Auxiliary

Engine Type		Model	Tier	Fuel	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
					(g/kW-hr)									
Aux High Speed Diesel		<=1999	Tier 0	0.1%S	0.600	10.9	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel		<=1999	Tier 0	0.1%S	0.600	13.82	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel		2000-2010	Tier 1	0.1%S	0.600	9.78	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel		2000-2010	Tier 1	0.1%S	0.600	12.22	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel		2011-2015	Tier 2	0.1%S	0.600	7.71	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel		2011-2015	Tier 2	0.1%S	0.600	10.53	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel		2011-2015	Tier 3	0.1%S	0.600	1.97	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel		2011-2015	Tier 3	0.1%S	0.600	2.63	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux Med Speed Diesel	Tier 3 Standard	2011-2015	Tier 3	0.1%S	0.378	5.022	5	0.068	0.12	0.12	0.0006067			
					(g/hp-hr)									
Generator Sets			Tier 4 Final	0.1%S	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	-	568.2990	0.0180	0.0081

Notes:
Emission factors from Table 2.9 and 2.10 of the 2019 Port of Los Angeles Emission Inventory Methodology Report
Load factors for auxiliary engines based on Table 3.1 of the of the 2019 Port of Los Angeles Emission Inventory Methodology Report
EPA certification based on Tier 3 rating for the engine family from Table 5 to CFR §1042.101.
Emission factor for Pb from the Santa Barbara Air Pollution Control District Approved TAC Emission Factors, December 2023.

Marine exhaust emissions were calculated using the following equation:

$$Emissions_{diesel} = \Sigma\, EF_i \times Eng_i \times AvgHP \times Load_i \times Activity_i$$

Where:

EF	=	*Emission factor in grams per horse-power hour*
Eng	=	*Number of engines*
AvgHP	=	*Maximum rated average horsepower*
Load	=	*Load factor*
Activity	=	*Hours of operation*
i	=	*Equipment type*

SpaceX SLC-4 and SLC-6 Operations Detailed Report

Table of Contents

1. Basic Project Information

1.1. Basic Project Information

Data Field	Value
Project Name	SpaceX SLC-4 and SLC-6 Operations
Construction Start Date	1/1/2024
Operational Year	2025
Lead Agency	—
Land Use Scale	Project/site
Analysis Level for Defaults	County
Windspeed (m/s)	3.10
Precipitation (days)	27.8
Location	34.58233161250706, -120.6276097945451
County	Santa Barbara
City	Unincorporated
Air District	Santa Barbara County APCD
Air Basin	South Central Coast
TAZ	3342
EDFZ	6
Electric Utility	Pacific Gas & Electric Company
Gas Utility	Southern California Gas
App Version	2022.1.1.20

1.2. Land Use Types

Land Use Subtype	Size	Unit	Lot Acreage	Building Area (sq ft)	Landscape Area (sq ft)	Special Landscape Area (sq ft)	Population	Description

General Heavy Industry	1.00	1000sqft	0.02	1,000	0.00	—	—	—

1.3. User-Selected Emission Reduction Measures by Emissions Sector

No measures selected

2. Emissions Summary

2.1. Construction Emissions Compared Against Thresholds

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Un/Mit.	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	6.50	5.78	17.7	71.8	0.05	0.19	8.91	9.09	0.18	2.14	2.32	—	14,748	14,748	0.78	1.05	49.4	15,128
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	6.58	5.81	18.5	72.4	0.05	0.19	8.91	9.09	0.18	2.14	2.32	—	14,586	14,586	0.83	1.05	1.28	14,920
Average Daily (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	6.38	5.70	16.3	70.4	0.04	0.17	8.44	8.61	0.16	2.01	2.17	—	13,252	13,252	0.75	0.85	19.9	13,544
Annual (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	1.16	1.04	2.97	12.9	0.01	0.03	1.54	1.57	0.03	0.37	0.40	—	2,194	2,194	0.12	0.14	3.29	2,242

2.2. Construction Emissions by Year, Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e

Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2024	6.50	5.78	17.7	71.8	0.05	0.19	8.91	9.09	0.18	2.14	2.32	—	14,748	14,748	0.78	1.05	49.4	15,128
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2024	6.58	5.81	18.5	72.4	0.05	0.19	8.91	9.09	0.18	2.14	2.32	—	14,586	14,586	0.83	1.05	1.28	14,920
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2024	6.38	5.70	16.3	70.4	0.04	0.17	8.44	8.61	0.16	2.01	2.17	—	13,252	13,252	0.75	0.85	19.9	13,544
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2024	1.16	1.04	2.97	12.9	0.01	0.03	1.54	1.57	0.03	0.37	0.40	—	2,194	2,194	0.12	0.14	3.29	2,242

2.4. Operations Emissions Compared Against Thresholds

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Un/Mit.	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	33.6	30.6	103	77.9	0.15	4.49	0.00	4.49	4.49	0.00	4.49	693	47,019	47,712	70.3	0.84	0.26	49,721
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	33.6	30.6	103	77.9	0.15	4.49	0.00	4.49	4.49	0.00	4.49	693	47,019	47,711	70.3	0.84	0.26	49,721
Average Daily (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	1.74	1.61	5.02	4.05	0.01	0.23	0.00	0.23	0.23	0.00	0.23	693	32,205	32,898	69.8	0.73	0.26	34,858
Annual (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	0.32	0.29	0.92	0.74	< 0.005	0.04	0.00	0.04	0.04	0.00	0.04	115	5,332	5,447	11.5	0.12	0.04	5,771

2.5. Operations Emissions by Sector, Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Sector	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mobile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Area	0.01	0.03	< 0.005	0.04	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	0.18	0.18	< 0.005	< 0.005	—	0.18
Energy	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	31,251	31,251	5.06	0.61	—	31,560
Water	—	—	—	—	—	—	—	—	—	—	—	47.7	146	194	0.19	0.11	—	230
Waste	—	—	—	—	—	—	—	—	—	—	—	645	0.00	645	64.5	0.00	—	2,257
Refrig.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.26	0.26
Stationary	33.6	30.5	103	77.9	0.15	4.49	0.00	4.49	4.49	0.00	4.49	0.00	15,622	15,622	0.63	0.12	0.00	15,674
Total	33.6	30.6	103	77.9	0.15	4.49	0.00	4.49	4.49	0.00	4.49	693	47,019	47,712	70.3	0.84	0.26	49,721
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mobile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Area	—	0.03	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Energy	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	31,251	31,251	5.06	0.61	—	31,560
Water	—	—	—	—	—	—	—	—	—	—	—	47.7	146	194	0.19	0.11	—	230
Waste	—	—	—	—	—	—	—	—	—	—	—	645	0.00	645	64.5	0.00	—	2,257
Refrig.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.26	0.26
Stationary	33.6	30.5	103	77.9	0.15	4.49	0.00	4.49	4.49	0.00	4.49	0.00	15,622	15,622	0.63	0.12	0.00	15,674
Total	33.6	30.6	103	77.9	0.15	4.49	0.00	4.49	4.49	0.00	4.49	693	47,019	47,711	70.3	0.84	0.26	49,721
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Mobile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Area	< 0.005	0.03	< 0.005	0.02	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	0.09	0.09	< 0.005	< 0.005	—	0.09
Energy	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	31,251	31,251	5.06	0.61	—	31,560
Water	—	—	—	—	—	—	—	—	—	—	—	47.7	146	194	0.19	0.11	—	230
Waste	—	—	—	—	—	—	—	—	—	—	—	645	0.00	645	64.5	0.00	—	2,257
Refrig.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.26	0.26
Stationary	1.74	1.58	5.02	4.03	0.01	0.23	0.00	0.23	0.23	0.00	0.23	0.00	808	808	0.03	0.01	0.00	811
Total	1.74	1.61	5.02	4.05	0.01	0.23	0.00	0.23	0.23	0.00	0.23	693	32,205	32,898	69.8	0.73	0.26	34,858
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mobile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Area	< 0.005	0.01	< 0.005	< 0.005	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	0.01	0.01	< 0.005	< 0.005	—	0.01
Energy	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	5,174	5,174	0.84	0.10	—	5,225
Water	—	—	—	—	—	—	—	—	—	—	—	7.90	24.1	32.0	0.03	0.02	—	38.1
Waste	—	—	—	—	—	—	—	—	—	—	—	107	0.00	107	10.7	0.00	—	374
Refrig.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.04	0.04
Stationary	0.32	0.29	0.92	0.74	< 0.005	0.04	0.00	0.04	0.04	0.00	0.04	0.00	134	134	0.01	< 0.005	0.00	134
Total	0.32	0.29	0.92	0.74	< 0.005	0.04	0.00	0.04	0.04	0.00	0.04	115	5,332	5,447	11.5	0.12	0.04	5,771

3. Construction Emissions Details

3.1. Fleet Vehicle Use (2024) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	1.00	0.94	0.68	8.01	0.00	0.00	1.24	1.24	0.00	0.29	0.29	—	1,283	1,283	0.09	0.06	5.99	1,308

Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	1.02	0.95	0.78	8.21	0.00	0.00	1.24	1.24	0.00	0.29	0.29	—	1,256	1,256	0.10	0.06	0.16	1,276
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	1.00	0.94	0.78	8.02	0.00	0.00	1.22	1.22	0.00	0.29	0.29	—	1,261	1,261	0.09	0.06	2.60	1,283
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.18	0.17	0.14	1.46	0.00	0.00	0.22	0.22	0.00	0.05	0.05	—	209	209	0.02	0.01	0.43	212
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.3. Vendor-Contractor Vehicles (2024) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—

Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.49	0.24	7.84	3.83	0.03	0.06	1.19	1.25	0.06	0.33	0.39	—	4,842	4,842	0.22	0.70	12.2	5,068
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.48	0.23	8.06	3.91	0.03	0.06	1.19	1.25	0.06	0.33	0.39	—	4,845	4,845	0.22	0.70	0.32	5,059
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.35	0.17	5.79	2.78	0.02	0.04	0.84	0.89	0.04	0.23	0.28	—	3,477	3,477	0.15	0.50	3.76	3,634
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.06	0.03	1.06	0.51	< 0.005	0.01	0.15	0.16	0.01	0.04	0.05	—	576	576	0.03	0.08	0.62	602
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.5. Equipment (2024) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.62	0.49	5.82	20.3	0.02	0.13	—	0.13	0.12	—	0.12	—	1,985	1,985	0.07	0.01	—	1,991
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.62	0.49	5.82	20.3	0.02	0.13	—	0.13	0.12	—	0.12	—	1,985	1,985	0.07	0.01	—	1,991
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.62	0.49	5.83	20.4	0.02	0.13	—	0.13	0.12	—	0.12	—	1,990	1,990	0.07	0.01	—	1,996
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.11	0.09	1.06	3.72	< 0.005	0.02	—	0.02	0.02	—	0.02	—	329	329	0.01	< 0.005	—	330
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.7. Worker Vehicles (2024) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—

Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	4.40	4.10	3.37	39.6	0.00	0.00	6.47	6.47	0.00	1.52	1.52	—	6,638	6,638	0.41	0.28	31.2	6,762
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	4.47	4.14	3.89	40.0	0.00	0.00	6.47	6.47	0.00	1.52	1.52	—	6,500	6,500	0.44	0.28	0.81	6,595
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	4.41	4.09	3.86	39.2	0.00	0.00	6.37	6.37	0.00	1.49	1.49	—	6,524	6,524	0.43	0.28	13.5	6,631
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.80	0.75	0.70	7.16	0.00	0.00	1.16	1.16	0.00	0.27	0.27	—	1,080	1,080	0.07	0.05	2.24	1,098
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

4. Operations Emissions Details

4.1. Mobile Emissions by Land Use

4.1.1. Unmitigated

Mobile source emissions results are presented in Sections 2.6. No further detailed breakdown of emissions is available.

4.2. Energy

4.2.1. Electricity Emissions By Land Use - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e

Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	—	—	—	—	—	—	—	—	—	—	—	—	31,251	31,251	5.06	0.61	—	31,560
Total	—	—	—	—	—	—	—	—	—	—	—	—	31,251	31,251	5.06	0.61	—	31,560
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	—	—	—	—	—	—	—	—	—	—	—	—	31,251	31,251	5.06	0.61	—	31,560
Total	—	—	—	—	—	—	—	—	—	—	—	—	31,251	31,251	5.06	0.61	—	31,560
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	—	—	—	—	—	—	—	—	—	—	—	—	5,174	5,174	0.84	0.10	—	5,225
Total	—	—	—	—	—	—	—	—	—	—	—	—	5,174	5,174	0.84	0.10	—	5,225

4.2.3. Natural Gas Emissions By Land Use - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00
Total	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

General Heavy Industry	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00
Total	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00
Total	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00

4.3. Area Emissions by Source

4.3.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Source	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Consumer Products	—	0.02	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Architectural Coatings	—	0.01	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Landscape Equipment	0.01	0.01	< 0.005	0.04	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	0.18	0.18	< 0.005	< 0.005	—	0.18
Total	0.01	0.03	< 0.005	0.04	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	0.18	0.18	< 0.005	< 0.005	—	0.18
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Consumer	—	0.02	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Architectural Coatings	—	0.01	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	0.03	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Consumer Products	—	< 0.005	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Architectural Coatings	—	< 0.005	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Landscape Equipment	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	0.01	0.01	< 0.005	< 0.005	—	0.01
Total	< 0.005	0.01	< 0.005	< 0.005	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	0.01	0.01	< 0.005	< 0.005	—	0.01

4.4. Water Emissions by Land Use

4.4.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	—	—	—	—	—	—	—	—	—	—	—	47.7	146	194	0.19	0.11	—	230
Total	—	—	—	—	—	—	—	—	—	—	—	47.7	146	194	0.19	0.11	—	230

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	—	—	—	—	—	—	—	—	—	—	—	47.7	146	194	0.19	0.11	—	230
Total	—	—	—	—	—	—	—	—	—	—	—	47.7	146	194	0.19	0.11	—	230
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	—	—	—	—	—	—	—	—	—	—	—	7.90	24.1	32.0	0.03	0.02	—	38.1
Total	—	—	—	—	—	—	—	—	—	—	—	7.90	24.1	32.0	0.03	0.02	—	38.1

4.5. Waste Emissions by Land Use

4.5.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	—	—	—	—	—	—	—	—	—	—	—	645	0.00	645	64.5	0.00	—	2,257
Total	—	—	—	—	—	—	—	—	—	—	—	645	0.00	645	64.5	0.00	—	2,257
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	—	—	—	—	—	—	—	—	—	—	—	645	0.00	645	64.5	0.00	—	2,257
Total	—	—	—	—	—	—	—	—	—	—	—	645	0.00	645	64.5	0.00	—	2,257

Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	—	—	—	—	—	—	—	—	—	—	—	107	0.00	107	10.7	0.00	—	374
Total	—	—	—	—	—	—	—	—	—	—	—	107	0.00	107	10.7	0.00	—	374

4.6. Refrigerant Emissions by Land Use

4.6.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.26	0.26
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.26	0.26
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.26	0.26
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.26	0.26
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.04	0.04
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.04	0.04

4.7. Offroad Emissions By Equipment Type

4.7.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Equipment Type	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.8. Stationary Emissions By Equipment Type

4.8.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Equipment Type	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Emergency Generator	33.6	30.5	103	77.9	0.15	4.49	0.00	4.49	4.49	0.00	4.49	0.00	15,622	15,622	0.63	0.12	0.00	15,674

Total	33.6	30.5	103	77.9	0.15	4.49	0.00	4.49	4.49	0.00	4.49	0.00	15,622	15,622	0.63	0.12	0.00	15,674
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Emergency Generator	33.6	30.5	103	77.9	0.15	4.49	0.00	4.49	4.49	0.00	4.49	0.00	15,622	15,622	0.63	0.12	0.00	15,674
Total	33.6	30.5	103	77.9	0.15	4.49	0.00	4.49	4.49	0.00	4.49	0.00	15,622	15,622	0.63	0.12	0.00	15,674
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Emergency Generator	0.32	0.29	0.92	0.74	< 0.005	0.04	0.00	0.04	0.04	0.00	0.04	0.00	134	134	0.01	< 0.005	0.00	134
Total	0.32	0.29	0.92	0.74	< 0.005	0.04	0.00	0.04	0.04	0.00	0.04	0.00	134	134	0.01	< 0.005	0.00	134

4.9. User Defined Emissions By Equipment Type

4.9.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Equipment Type	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10. Soil Carbon Accumulation By Vegetation Type

4.10.1. Soil Carbon Accumulation By Vegetation Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Vegetation	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.2. Above and Belowground Carbon Accumulation by Land Use Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.3. Avoided and Sequestered Emissions by Species - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Species	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Sequest	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

5. Activity Data

5.1. Construction Schedule

Phase Name	Phase Type	Start Date	End Date	Days Per Week	Work Days per Phase	Phase Description
Fleet Vehicle Use	Site Preparation	1/1/2024	12/31/2024	7.00	366	—
Vendor-Contractor Vehicles	Site Preparation	1/1/2024	12/31/2024	5.00	262	—
Equipment	Grading	1/1/2024	12/31/2024	7.00	366	—
Worker Vehicles	Grading	1/1/2024	12/31/2024	7.00	366	—

5.2. Off-Road Equipment

5.2.1. Unmitigated

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Equipment	Aerial Lifts	Diesel	Average	8.00	1.00	84.0	0.37
Equipment	Forklifts	CNG	Average	10.0	1.00	70.0	0.30
Equipment	Off-Highway Trucks	Diesel	Average	6.00	1.00	367	0.40
Equipment	Rough Terrain Forklifts	Diesel	Average	8.00	1.00	96.0	0.40

5.3. Construction Vehicles

5.3.1. Unmitigated

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Fleet Vehicle Use	—	—	—	—
Fleet Vehicle Use	Worker	200	8.80	LDA,LDT1,LDT2
Fleet Vehicle Use	Vendor	—	5.30	HHDT,MHDT
Fleet Vehicle Use	Hauling	0.00	20.0	HHDT
Fleet Vehicle Use	Onsite truck	—	—	HHDT
Vendor-Contractor Vehicles	—	—	—	—
Vendor-Contractor Vehicles	Worker	0.00	8.80	LDA,LDT1,LDT2
Vendor-Contractor Vehicles	Vendor	268	5.30	HHDT,MHDT
Vendor-Contractor Vehicles	Hauling	0.00	20.0	HHDT
Vendor-Contractor Vehicles	Onsite truck	—	—	HHDT
Equipment	—	—	—	—
Equipment	Worker	0.00	8.80	LDA,LDT1,LDT2
Equipment	Vendor	—	5.30	HHDT,MHDT
Equipment	Hauling	0.00	20.0	HHDT
Equipment	Onsite truck	—	—	HHDT
Worker Vehicles	—	—	—	—
Worker Vehicles	Worker	848	10.8	LDA,LDT1,LDT2
Worker Vehicles	Vendor	—	5.30	HHDT,MHDT
Worker Vehicles	Hauling	0.00	20.0	HHDT
Worker Vehicles	Onsite truck	—	—	HHDT

5.4. Vehicles

5.4.1. Construction Vehicle Control Strategies

Non-applicable. No control strategies activated by user.

5.5. Architectural Coatings

Phase Name	Residential Interior Area Coated (sq ft)	Residential Exterior Area Coated (sq ft)	Non-Residential Interior Area Coated (sq ft)	Non-Residential Exterior Area Coated (sq ft)	Parking Area Coated (sq ft)

5.6. Dust Mitigation

5.6.1. Construction Earthmoving Activities

Phase Name	Material Imported (cy)	Material Exported (cy)	Acres Graded (acres)	Material Demolished (sq. ft.)	Acres Paved (acres)
Fleet Vehicle Use	—	—	0.00	0.00	—
Vendor-Contractor Vehicles	—	—	0.00	0.00	—
Equipment	—	—	0.00	0.00	—
Worker Vehicles	—	—	0.00	0.00	—

5.6.2. Construction Earthmoving Control Strategies

Non-applicable. No control strategies activated by user.

5.7. Construction Paving

Land Use	Area Paved (acres)	% Asphalt
General Heavy Industry	0.00	0%

5.8. Construction Electricity Consumption and Emissions Factors

kWh per Year and Emission Factor (lb/MWh)

Year	kWh per Year	CO2	CH4	N2O
2024	0.00	204	0.03	< 0.005

5.9. Operational Mobile Sources

5.9.1. Unmitigated

Land Use Type	Trips/Weekday	Trips/Saturday	Trips/Sunday	Trips/Year	VMT/Weekday	VMT/Saturday	VMT/Sunday	VMT/Year
Total all Land Uses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

5.10. Operational Area Sources

5.10.1. Hearths

5.10.1.1. Unmitigated

5.10.2. Architectural Coatings

Residential Interior Area Coated (sq ft)	Residential Exterior Area Coated (sq ft)	Non-Residential Interior Area Coated (sq ft)	Non-Residential Exterior Area Coated (sq ft)	Parking Area Coated (sq ft)
0	0.00	1,500	500	—

5.10.3. Landscape Equipment

Season	Unit	Value
Snow Days	day/yr	0.00
Summer Days	day/yr	180

5.11. Operational Energy Consumption

5.11.1. Unmitigated

Electricity (kWh/yr) and CO2 and CH4 and N2O and Natural Gas (kBTU/yr)

Land Use	Electricity (kWh/yr)	CO2	CH4	N2O	Natural Gas (kBTU/yr)
General Heavy Industry	55,919,136	204	0.0330	0.0040	0.00

5.12. Operational Water and Wastewater Consumption

5.12.1. Unmitigated

Land Use	Indoor Water (gal/year)	Outdoor Water (gal/year)
General Heavy Industry	22,330,980	36,220,000

5.13. Operational Waste Generation

5.13.1. Unmitigated

Land Use	Waste (ton/year)	Cogeneration (kWh/year)
General Heavy Industry	1,197	—

5.14. Operational Refrigeration and Air Conditioning Equipment

5.14.1. Unmitigated

Land Use Type	Equipment Type	Refrigerant	GWP	Quantity (kg)	Operations Leak Rate	Service Leak Rate	Times Serviced
General Heavy Industry	Other commercial A/C and heat pumps	R-410A	2,088	0.30	4.00	4.00	18.0

5.15. Operational Off-Road Equipment

5.15.1. Unmitigated

Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor

5.16. Stationary Sources

5.16.1. Emergency Generators and Fire Pumps

Equipment Type	Fuel Type	Number per Day	Hours per Day	Hours per Year	Horsepower	Load Factor
Emergency Generator	Diesel	3.00	2.00	25.0	779	1.00
Emergency Generator	Diesel	1.00	2.00	25.0	367	1.00
Emergency Generator	Diesel	1.00	2.00	25.0	320	1.00
Emergency Generator	Diesel	1.00	24.0	576	314	1.00

5.16.2. Process Boilers

Equipment Type	Fuel Type	Number	Boiler Rating (MMBtu/hr)	Daily Heat Input (MMBtu/day)	Annual Heat Input (MMBtu/yr)

5.17. User Defined

Equipment Type	Fuel Type

5.18. Vegetation

5.18.1. Land Use Change

5.18.1.1. Unmitigated

Vegetation Land Use Type	Vegetation Soil Type	Initial Acres	Final Acres

5.18.1. Biomass Cover Type

5.18.1.1. Unmitigated

Biomass Cover Type	Initial Acres	Final Acres

5.18.2. Sequestration

5.18.2.1. Unmitigated

Tree Type	Number	Electricity Saved (kWh/year)	Natural Gas Saved (btu/year)

6. Climate Risk Detailed Report

6.1. Climate Risk Summary

Cal-Adapt midcentury 2040–2059 average projections for four hazards are reported below for your project location. These are under Representation Concentration Pathway (RCP) 8.5 which assumes GHG emissions will continue to rise strongly through 2050 and then plateau around 2100.

Climate Hazard	Result for Project Location	Unit
Temperature and Extreme Heat	6.60	annual days of extreme heat
Extreme Precipitation	4.10	annual days with precipitation above 20 mm
Sea Level Rise	0.00	meters of inundation depth
Wildfire	9.82	annual hectares burned

Temperature and Extreme Heat data are for grid cell in which your project are located. The projection is based on the 98th historical percentile of daily maximum/minimum temperatures from observed historical data (32 climate model ensemble from Cal-Adapt, 2040–2059 average under RCP 8.5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Extreme Precipitation data are for the grid cell in which your project are located. The threshold of 20 mm is equivalent to about ¾ an inch of rain, which would be light to moderate rainfall if received over a full day or heavy rain if received over a period of 2 to 4 hours. Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Sea Level Rise data are for the grid cell in which your project are located. The projections are from Radke et al. (2017), as reported in Cal-Adapt (Radke et al., 2017, CEC-500-2017-008), and consider inundation location and depth for the San Francisco Bay, the Sacramento-San Joaquin River Delta and California coast resulting different increments of sea level rise coupled with extreme storm events. Users may select from four scenarios to view the range in potential inundation depth for the grid cell. The four scenarios are: No rise, 0.5 meter, 1.0 meter, 1.41 meters
Wildfire data are for the grid cell in which your project are located. The projections are from UC Davis, as reported in Cal-Adapt (2040–2059 average under RCP 8.5), and consider historical data of climate, vegetation, population density, and large (> 400 ha) fire history. Users may select from four model simulations to view the range in potential wildfire probabilities for the grid cell. The four simulations make different assumptions about expected rainfall and temperature are: Warmer/drier (HadGEM2-ES), Cooler/wetter (CNRM-CM5), Average conditions (CanESM2), Range of different rainfall and temperature possibilities (MIROC5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.

6.2. Initial Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	N/A	N/A	N/A	N/A
Wildfire	N/A	N/A	N/A	N/A
Flooding	N/A	N/A	N/A	N/A

Drought	N/A	N/A	N/A	N/A
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.
The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.
The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores do not include implementation of climate risk reduction measures.

6.3. Adjusted Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	N/A	N/A	N/A	N/A
Wildfire	N/A	N/A	N/A	N/A
Flooding	N/A	N/A	N/A	N/A
Drought	N/A	N/A	N/A	N/A
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.
The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.
The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores include implementation of climate risk reduction measures.

6.4. Climate Risk Reduction Measures

7. Health and Equity Details

7.1. CalEnviroScreen 4.0 Scores

The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Exposure Indicators	—
AQ-Ozone	6.40
AQ-PM	8.33
AQ-DPM	1.94
Drinking Water	69.5
Lead Risk Housing	39.5
Pesticides	69.9
Toxic Releases	4.78
Traffic	30.0
Effect Indicators	—
CleanUp Sites	87.5
Groundwater	99.1
Haz Waste Facilities/Generators	99.3
Impaired Water Bodies	51.2
Solid Waste	83.3
Sensitive Population	—
Asthma	22.0
Cardio-vascular	38.5
Low Birth Weights	7.06
Socioeconomic Factor Indicators	—
Education	7.40
Housing	81.9
Linguistic	0.00
Poverty	44.9
Unemployment	67.5

7.2. Healthy Places Index Scores

The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Economic	—
Above Poverty	51.63608366
Employed	0.230976517
Median HI	47.9019633
Education	—
Bachelor's or higher	52.66264596
High school enrollment	100
Preschool enrollment	20.94187091
Transportation	—
Auto Access	92.6344155
Active commuting	57.93660978
Social	—
2-parent households	92.39060695
Voting	25.18927242
Neighborhood	—
Alcohol availability	97.0101373
Park access	4.722186578
Retail density	7.404080585
Supermarket access	2.399589375
Tree canopy	53.80469652
Housing	—
Homeownership	0.436288977
Housing habitability	62.00436289
Low-inc homeowner severe housing cost burden	99.12742205

Low-inc renter severe housing cost burden	76.40189914
Uncrowded housing	77.4541255
Health Outcomes	—
Insured adults	99.2429103
Arthritis	0.0
Asthma ER Admissions	72.7
High Blood Pressure	0.0
Cancer (excluding skin)	0.0
Asthma	0.0
Coronary Heart Disease	0.0
Chronic Obstructive Pulmonary Disease	0.0
Diagnosed Diabetes	0.0
Life Expectancy at Birth	78.6
Cognitively Disabled	87.2
Physically Disabled	99.2
Heart Attack ER Admissions	56.4
Mental Health Not Good	0.0
Chronic Kidney Disease	0.0
Obesity	0.0
Pedestrian Injuries	19.6
Physical Health Not Good	0.0
Stroke	0.0
Health Risk Behaviors	—
Binge Drinking	0.0
Current Smoker	0.0
No Leisure Time for Physical Activity	0.0
Environmental Exposures	—

Wildfire Risk	0.0
SLR Inundation Area	0.0
Children	0.1
Elderly	99.5
English Speaking	94.4
Foreign-born	2.8
Outdoor Workers	87.6
Adaptive Capacity	—
Impervious Surface Cover	90.1
Traffic Density	15.0
Traffic Access	0.0
Other Indices	—
Hardship	41.2
Other Decision Support	—
2016 Voting	26.1

7.3. Overall Health & Equity Scores

Metric	Result for Project Census Tract
CalEnviroScreen 4.0 Score for Project Location (a)	35.0
Healthy Places Index Score for Project Location (b)	28.0
Project Located in a Designated Disadvantaged Community (Senate Bill 535)	No
Project Located in a Low-Income Community (Assembly Bill 1550)	Yes
Project Located in a Community Air Protection Program Community (Assembly Bill 617)	No

a: The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.
b: The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

7.4. Health & Equity Measures

No Health & Equity Measures selected.

7.5. Evaluation Scorecard

Health & Equity Evaluation Scorecard not completed.

7.6. Health & Equity Custom Measures

No Health & Equity Custom Measures created.

8. User Changes to Default Data

Screen	Justification
Construction: Construction Phases	Operational vehicle and equipment use modeled here.
Construction: Off-Road Equipment	Based on applicant provided information.
Construction: Trips and VMT	Based on applicant provided information.
Operations: Energy Use	Based on applicant provided information. All electric.
Operations: Water and Waste Water	Based on applicant provided information. Outdoor water use for launch support.
Operations: Solid Waste	Based on applicant provided information.
Operations: Refrigerants	etwer
Operations: Emergency Generators and Fire Pumps	Existing permitted generators for GHG emissions.

Attachment B

Exhaust Plume Calculations for SpaceX Merlin5 Booster Engine

Sierra Engineering & Software, Inc.

ANALYSIS REPORT

NUMBER: 2019-002

DATE: 14 June 2019

SUBJECT: Exhaust Plume Calculations for SpaceX Merlin5 Booster Engine

NO. OF APPEN. 0

PREPARED FOR: Matthew Thompson, SpaceX

(W.O. 6012)

DISTRIBUTION: Katy Smith, SpaceX

1.0 SUMMARY

Calculations were performed to estimate the far-field exhaust constituents of the SpaceX Merlin 5 LOX-kerosene booster rocket engine firing under sea-level conditions. Although the exit-plane exhaust is fuel-rich and contains high concentrations of carbon monoxide (CO), subsequent entrainment of ambient air results in complete conversion of the CO into carbon dioxide (CO_2) and oxidation of the soot from the gas generator exhaust. A small amount of thermal nitrous oxides (NOx) is formed, all as NO. The NO emission is predicted to be 1.047 lb_m/s under nominal power (100%) operation.

2.0 ENGINE DESCRIPTION

The subject engine is the baseline booster engine for the SpaceX Falcon 9 launch vehicle family. This analysis address the latest version of the engine, the Merlin 5. The propellants are liquid oxygen (LOX) and the RP-1 grade of kerosene. The subject engine consists of a 16.27:1 regeneratively-cooled thrust chamber nozzle exhaust plus a fuel-rich gas exhaust from the turbopump drive system. As a simplification needed to address the problem with the existing axisymmetric analysis tools, the computational nozzle exit plane includes an outer annulus of low mixture ratio turbine exhaust gas generator surrounding the physical thrust chamber exhaust plume. Characteristic dimensions of the thrust chamber nozzle are included in Table 1.

The nominal operating condition for the Merlin 5 engine is an injector face stagnation pressure (Pc) of 1859 psia and an engine O/F mixture ratio (MR) of 2.356. The associated thrust chamber MR is 2.576 and the gas generator (GG) MR is 0.423. The GG mass fraction is about 4.28% of the total engine flow. The current analysis was performed for the 100% nominal engine operating pressure (Pc=1859 psia) and an engine MR of 2.58.

Table 1: Merlin 5 Nozzle Characteristics

Throat Radius (in)	4.429
Downstream radius of curvature (in)	1.250
Tangency angle (deg)	35.33
Nozzle lip exit angle (deg)	8.973
Nozzle exit diameter (in) [excluding GG exhaust duct]	35.733
Nozzle throat to exit length (in)	39.617

3.0 ANALYSIS APPROACH

A series of simulations were required to estimate the emissions from the Merlin 5 engine. The PERCORP analysis model[1] was used to estimate the O/F mixture ratio variations that exist within the Merlin 5 thrust chamber. The fuel-rich combustion model in PERCORP was also used to estimate the gas generate exhaust constituents. The VIPER parabolized Navier-Stokes model[2] was used to kinetically expand the thrust chamber exhaust to the nozzle exit plane. The VIPER results were used to assess the validity of the PERCORP solution, correlating engine thrust, mass flow rate and specific impulse (ISP) to test results. PERCORP input parameters were adjusted until there was good agreement between the VIPER performance predictions and the test results. The SPF code[3] was used to predict the flow structure of the free exhaust plume and the entrainment of ambient air. VIPER solution was used as the starting condition for the SPF. Though the SPF code can handle detailed chemical kinetics within the plume evolving flow field, the strong barrel shock downstream of the nozzle exit produces numerical convergence problems with the version of SPF used. The present SPF simulations were performed without chemical kinetics. The results were air entrainment and gas temperature profiles. The SPF and VIPER results were used as inputs for one-dimensional kinetic modelling of the plume flow field. The kinetic model in the TDK code[4] was used to model chemical reactions within the evolving plume flow field.

TDK modelling of the plume flow field included chemical mechanism that address a) the oxidation of CO to CO_2, b) the complex oxidation of hydrocarbons to H_2O and CO_2, c) the oxidation of soot to CO_2, and d) the thermal generation of NOx in a mixture of air and combustion products. Table 2 includes the chemical reactions and rates used in the TDK simulation.

Table 2: Kinetic Reactions Included in One Dimensional Chemistry Simulations*

	A	N	B
H + H + m = H2 + m†	6.4E17	1.0	0.0
H + OH + m = H2O + m	8.4E21	2.0	0.0
O + O + m = O2 + m	1.9E13	0.0	-1.79
CO + O + m = CO2 + m	1.0E14	0.0	0.0
O + H + m = OH + m	3.62E18	1.0	0.0
CH4 + m = CH3 + H + m	1.259E17	0	88.4
HCO + m = CO + H + m	5.012E14	0	19.0
C2H3 + m = C2H2 + H + m	7.943E14	0	31.5
N+NO = N2+O	2.700E13	0	0.355
N+O2 = NO+O	9.000E9	-1.0	6.5
N+OH = NO+H	3.360E13	0	0.385
HO2+NO = NO2+OH	2.110E12	0	-0.480
NO2+O = NO+O2	3.900E12	0	-0.240
NO2+H = NO+OH	1.320E14	0	0.360
O2 + H = O + OH	2.2E14	0.0	16.8
H2 + O = H + OH	1.8E10	-1.	8.9
H2 + OH = H2O + H	2.2E13	0.0	5.15
OH + OH = H2O + O	6.3E12	0.0	1.09
CO + OH = CO2 + H	1.5E7	-1.3	-.765
CO + O = CO2	2.5E6	0.0	3.18
CO2 + O = CO + O2	1.7E13	0.0	52.7
CH4+ OH = CH3 + H2O	3.162E13	0	6.0
H + CH4 = CH3 + H2	6.310E14	0	15.1
O + CH4 = CH3 + OH	3.981E14	0	14.0
CH3 + O = CH2O + H	1.259E14	0	2.0
CH3 + OH = CH2O + H2	3.981E12	0	0
C2H2 + OH = C2H + H2O	6.310E12	0	7.0
H + CH2O = HCO + H2	3.162E14	0	10.5
O + CH2O = HCO + OH	1.995E13	0	3.1

* TDK reaction format is k=AT**(-N)*EXP(-1000B/RT) [cc-Kcal-K-mole-s]

† m is any molecule for a third body reaction

Table 2: Kinetic Reactions Included in One Dimensional Chemistry Simulations (ctd)

	A	N	B
OH + CH2O = HCO + H2O	7.943E12	0	0.2
H + HCO = CO + H2	1.995E14	0	0
OH + HCO = CO + H2O	1.000E14	0	0
H + C2H2 = C2H + H2	1.995E14	0	19.0
O + C2H2 = CH2 + CO	5.012E13	0	3.7
C2H + O2 = HCO + CO	1.000E13	0	7.0
CH2 + O2 = HCO + OH	1.000E14	0	3.7
H + C2H4 = C2H3 + H2	1.000E14	0	8.5
C2H2 + H = C2H3	5.500E12	0	2.39
H + C3H6 = C2H4 + CH3	3.981E12	0	0
C(GR)‡ + OH = CO + H	6.02E8	-0.5	0

4.0 ANALYSIS RESULTS

The PERCORP modelling of the Merlin 5 thrust chamber included 11.1% fuel film cooling injected at two locations down the chamber wall. The SpaceX supplied chamber wall temperature profile agreed well with the PERCORP results. The PERCORP solution for the nominal 319.36 lbf-s/lb_m thrust chamber specific impulse includes a 2.0% core mixing loss, yielding a characteristic velocity (C*) efficiency of 96.4%. The C* efficiency agrees well with SpaceX test data. The fuel-rich combustion model was used to predict the GG exhaust species mass fractions (Table 3). The PERCORP results included initial boundary conditions for the VIPER nozzle flow field simulation. The predicted thrust chamber nozzle exit species mass fractions from VIPER are listed in Table 4.

The GG exhaust species from PERCORP and the nozzle exhaust species, temperature and velocity fields from VIPER were used as initial conditions for the SPF exhaust plume flow field modelling. Three heavy hydrocarbon species ($C_{12}H_{23}$, C_7H_{14} and C_3H_6) predicted to exist in the GG exhaust were thermally cracked into smaller constituents (C_2H_2, C_2H_4, CH_4, H_2) using relationships suggested by Reference 5.

The SPF modelling stepped to 100 nozzle exit radii (Rexit = 18.3214 inches, 1.527 ft). Predicted plume contours for temperature and mass fractions of N_2, CO and soot are presented in Figure 1 through Figure 4. Since there plume entrainment and mixing field is simulated for chemically frozen flow, the N_2 contours are representative of the air entrainment, while the CO and soot contours indicate key products of incomplete combustion.

‡ C(GR) is the carbon representative of soot

Table 3: Gas Generator Exhaust Species Mass Fraction from PERCORP

Species	Mass Fraction
CO	0.3035
CO2	0.0625
H2	0.0030
H2O	0.0918
CH4	0.0476
C2H2	0.0114
C2H4	0.2098
C(GR)	0.0030
C2H6	0.0471
C3H6	0.0662
C7H14	0.0397
C12H23	0.1144

Table 4: Thrust Chamber Nozzle Exit Species Mass Fraction from VIPER Simulation

Species	Mass Fraction
CO2	0.4230
H2O	0.2538
CO	0.2536
O2	0.0367
H2	0.0086
C(GR)	0.0066
OH	0.0064
C2H2	0.0062
CH4	0.0027
O	0.0013
C2H4	7.79E-04
H	1.31E-04
HCO	1.49E-05

Figure 1: Plume Temperature Contours (degrees K)
R is radius normalized by Rexit, X is axial distance from nozzle exit normailzied by Rexit

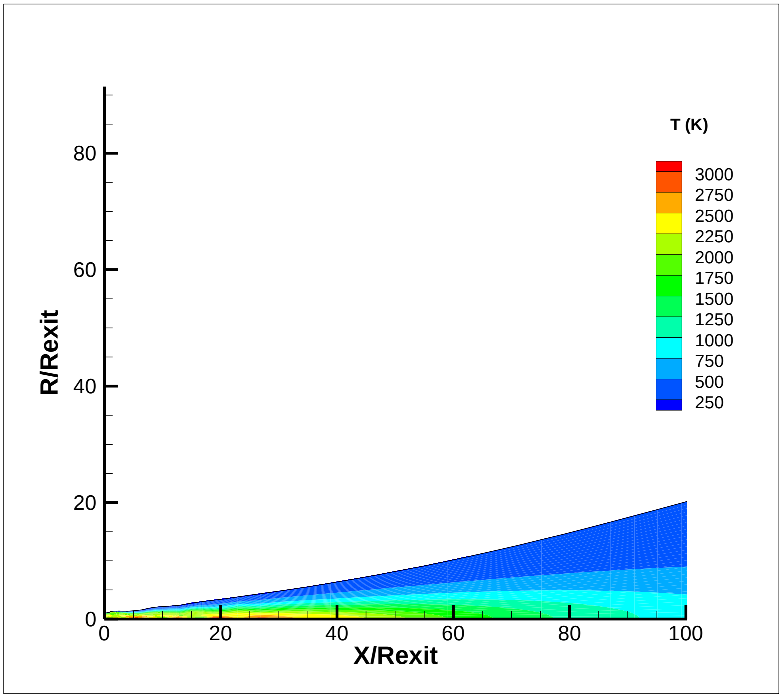


Figure 2: Plume N_2 Mass Fraction Contours (degrees K)
R is radius normalized by Rexit, X is axial distance from nozzle exit normailzied by Rexit

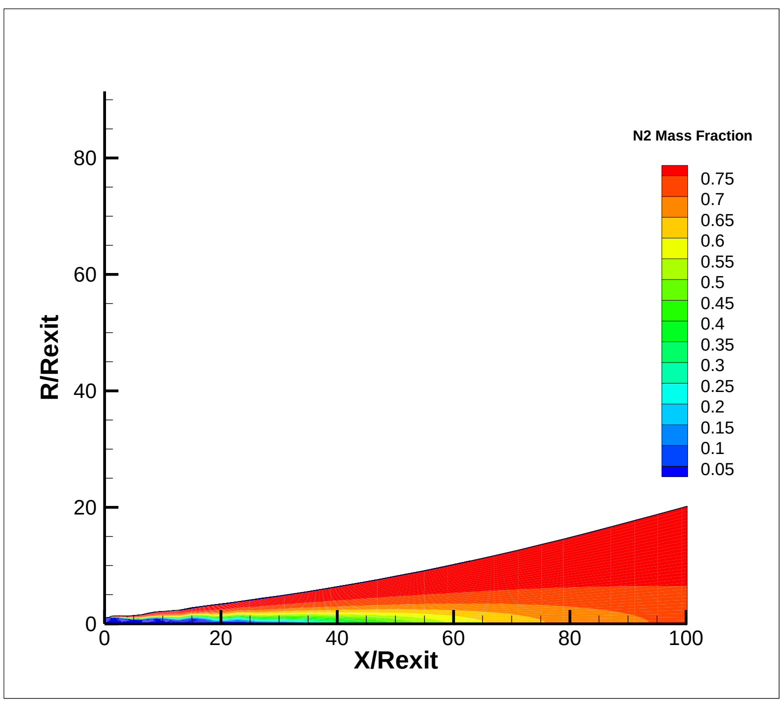


Figure 3: Plume CO Mass Fraction
R is radius normalized by Rexit, X is axial distance from nozzle exit normailzied by Rexit

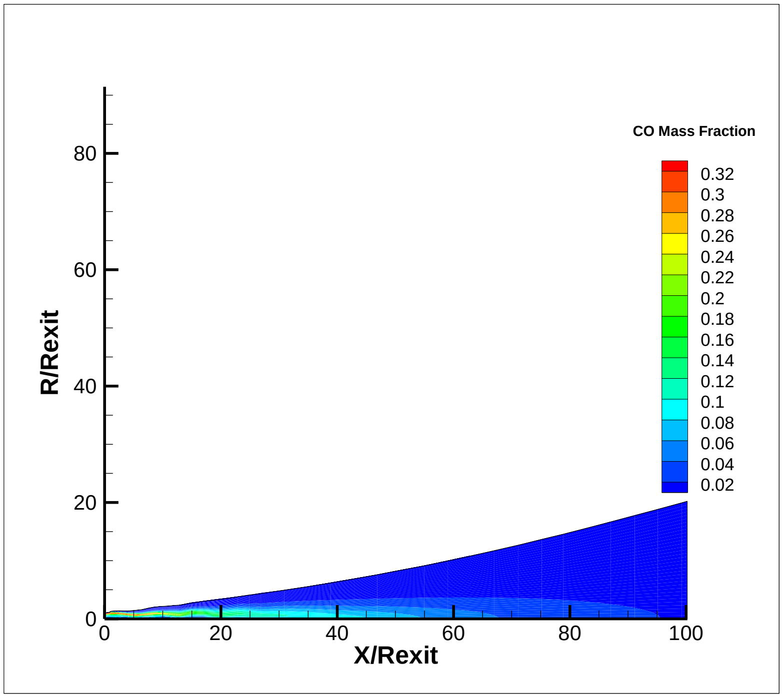
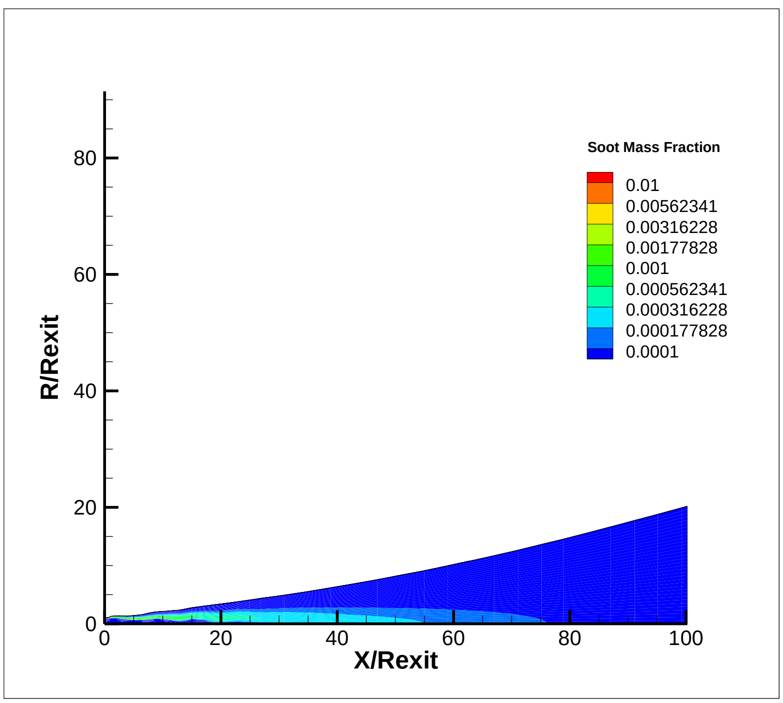


Figure 4: Plume Soot Mass Fraction Contours
R is radius normalized by Rexit, X is axial distance from nozzle exit normailzied by Rexit



The reactive plume was defined to include all flow that had a CO concentration greater than 1,000 ppm. Integration of the SPF data indicates that 18,390 lb/s air is entrained by the end of the simulation (Figure 5). It is estimated that the 153 meter entrainment end point is reached 294 msec after the plume flow exits the nozzle.

Figure 5: Axial Air Entrainment Estimates from SPF.

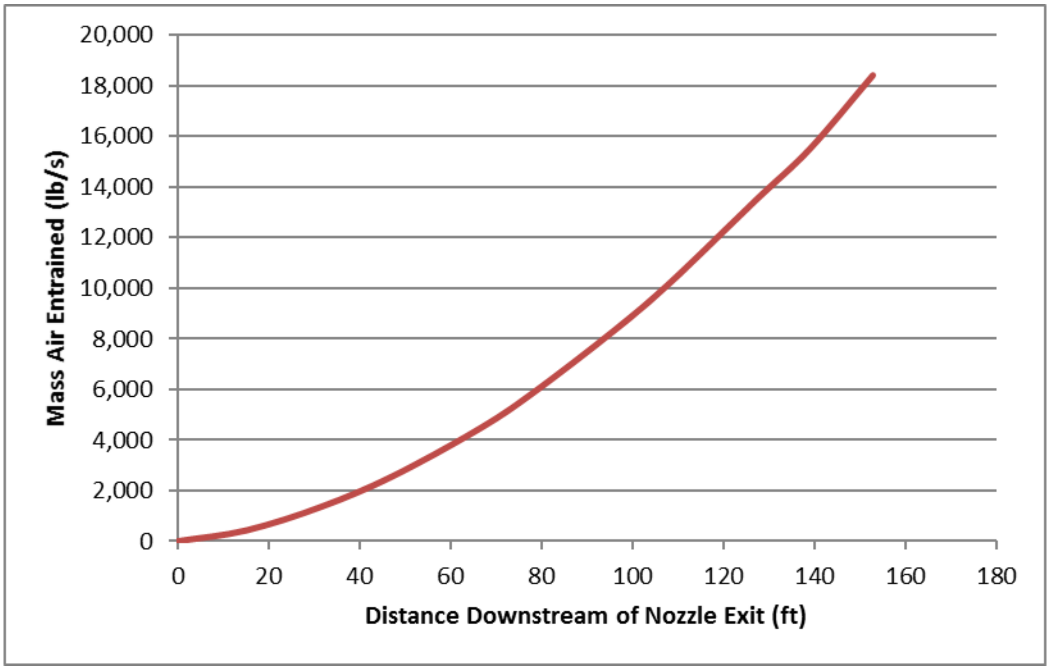
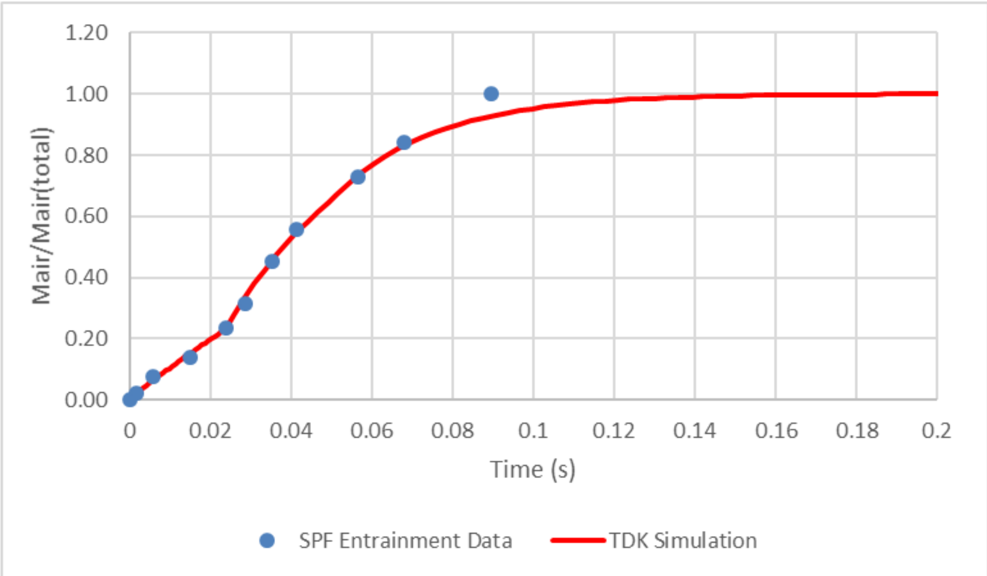


Figure 6: Approximate Air Entrainment Profile used in TDK Simulations



The subsequent TDK simulation of the plume chemistry required an approximate fit of the air entrainment rate. The SPF air entrainment profile was fit to an "availability profile" for the TDK simulations, whereby ambient air is mixed into the plume flow. Figure 6 shows that the approximate TDK air addition agrees well with the entrainment rate predicted by SPF.

The one-dimensional kinetics modeling of the after-burning characteristics of the exhaust plume was performed assuming a piecemeal constant pressure (13.6-14.7 psia) and entrainment of ambient temperature air. The model predicted that all the soot quickly (<5 msec) burns out (i.e. converts to CO). Complete CO oxidation occurs within 35 msec, with concentrations reduced to 2 ppm. The small concentration of unburnt hydrocarbons (CH_4, C_2H_2, C_2H_4, CH_3) are rapidly oxidized, surviving less than 1 msec. The limited thermal NO formation occurs during the early part of the entrainment process, with NO mass fraction constant after about 10 msec. The NO mass fraction at the end of the 157 ft long plume entrainment is 0.000055. Given the total mixed plume mass flow rate of 19041 lb/s, this corresponds to a NO mass flow of 1.047 lb/s. Figure 7 and Figure 8 show the predicted temperature and pollutant species mass fraction profiles. The pollutant flow rates were calculated in terms of lb_m generated per second of steady engine operation.

Figure 7: Predicted Profile of Bulk Plume Temperature and Species Concentration

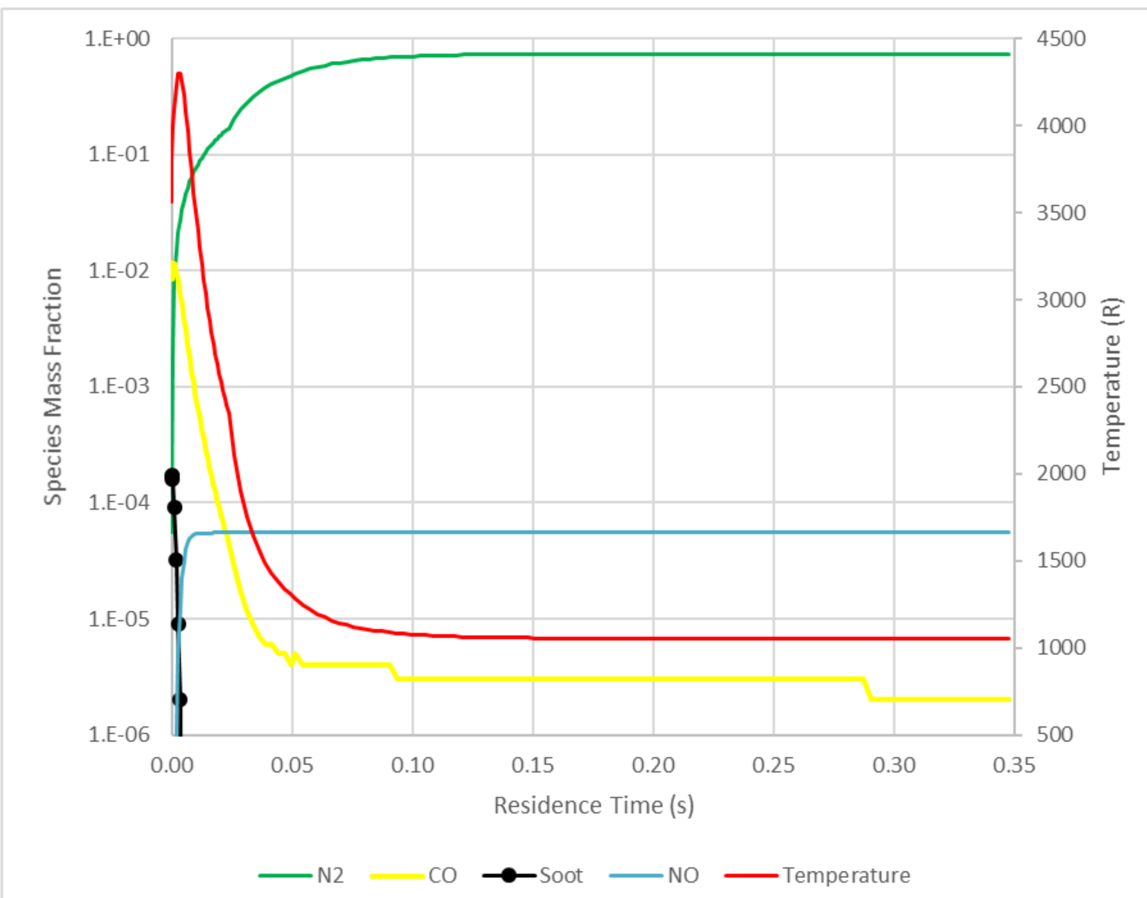
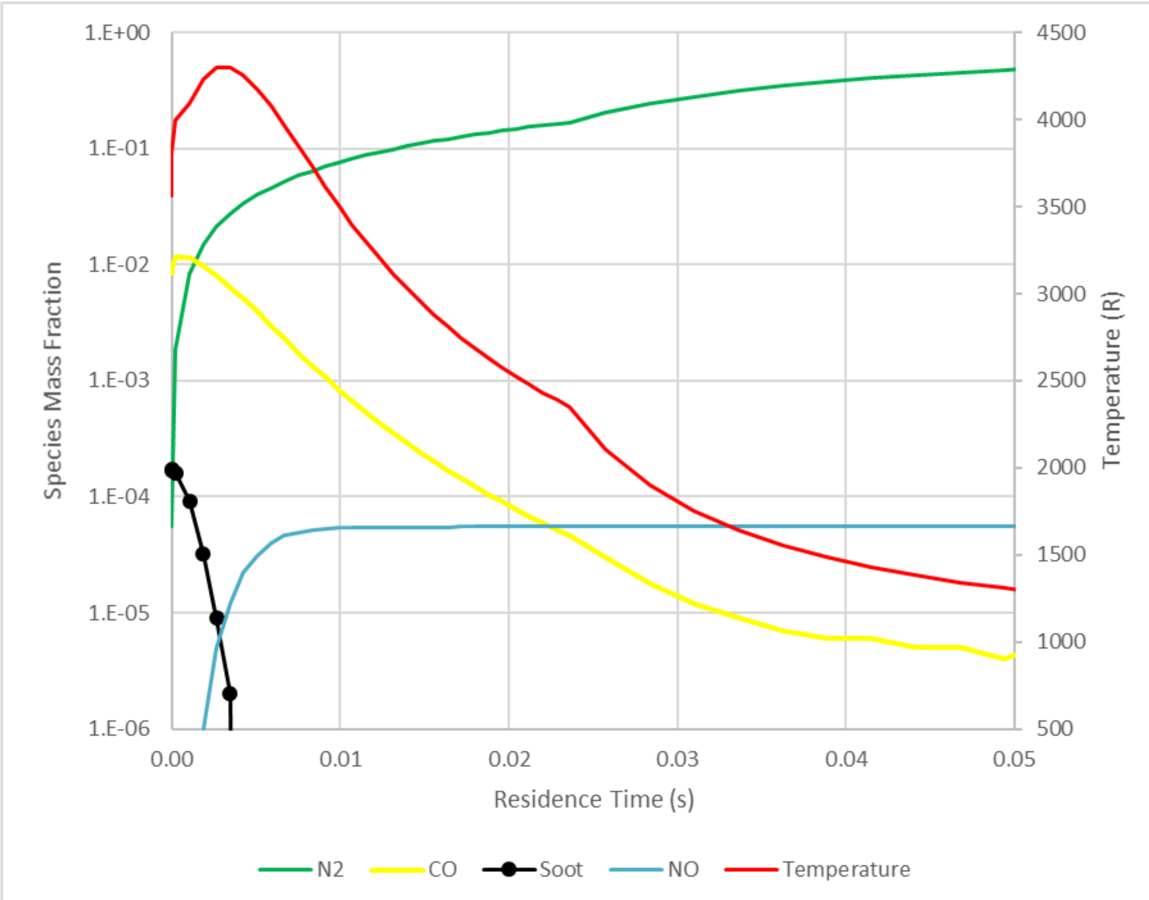


Figure 8: Predicted Profile of Bulk Plume Temperature and Species Concentration for Initial Residence Times



5.0 REFERENCES

[1] *Performance Correlation Program (PERCORP 2006) Reference and User's Manual, Version 2.0*, Sierra Engineering Inc., Carson City, NV, June 2009

[2] *Viscous Interaction Performance Evaluation Routine For Two-Phase Nozzle Flows With Finite Rate Chemistry, VIPER 4.5*, Software and Engineering Associates, Carson City, NV, 2018

[3] Taylor, M.W. and Pergament, H.S.; *Standardized Plume Flowfield Model SPF-III, Version 4.2 Program User's Manual*, PST TR-51, Propulsion Science and Technology, Inc. East Windsor, NJ, June 2000

[4] Nickerson, G. R., Dunn, S.S., Coats, D.E. and Berker, D.R.; *Two-Dimensional Kinetics (TDK) Nozzle Performance Computer Program User's Manual*, Software and Engineering Associates, Carson City, NV, Jan 1999

[5] Nickerson, G.R. and Johnson, C.W.; "A Sooting Model for Fuel Rich LOX/Hydrocarbon Combustion", 28th JANNAF Combustion Meetings, San Antonio, TX, 28 Oct-1 Nov, 1991

Attachment C

Modeling Files – 100 Launches

Table of Contents

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

1. General Information

- Action Location
Base: VANDENBERG AFB
State: California
County(s): Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Action Title: Falcon Program at Vandenberg Space Force Base Alternative 1

- Project Number/s (if applicable):

- Projected Action Start Date: 11 / 2025

- Action Purpose and Need:
Space Exploration Technologies Corporation (SpaceX) has applied to the United States Space Force (USSF) to increase Falcon flight opportunities at Vandenberg Space Force Base (VSFB) in support of manifested and anticipated vehicle operations for Falcon 9 and Falcon Heavy. SpaceX currently launches commercial and government payloads from VSFB at SLC-4 and has been allocated SLC-6 by the USSF. SpaceX supports, and is under contract for, the full spectrum of U.S. Government space mission requirements, including crew and cargo transportation for the National Aeronautics and Space Administration (NASA) and spacecraft launches for NASA and the U.S. Department of Defense (DOD).

- Action Description:
The Proposed Action is to increase the annual Falcon launch cadence at VSFB through launches at SLC-4 and SLC-6 and the modification of SLC 6 for Falcon launch vehicles to support future commercial and U.S. government launch service needs. SpaceX would launch Falcon 9 from SLC-4 and SLC-6, and Falcon Heavy from SLC-6. Falcon 9 is approximately 229 feet tall and produces approximately 1.7 million pounds of thrust at liftoff. A discussion of Falcon 9 can be found in the 2016 EA and associated supplemental environmental documents. Falcon Heavy is a heavy-lift vehicle that produces 5.12 million pounds of thrust at liftoff and has the ability to lift 141,000 pounds into low Earth orbit. Merlin engines are used on both stages of Falcon Heavy. The center core and two side boosters are essentially the same design as a Falcon 9 first stage booster, thus Falcon Heavy uses the same type of propellants as Falcon 9. Additionally, Falcon Heavy uses the same second stage as Falcon 9.

Under Alternative 1, SpaceX would implement the Proposed Action and construct an approximately 61,250 square-foot hangar north of the launch pad line to support Falcon 9 and Falcon Heavy integration and processing. Areas around the hangar would be graded to provide rear access to the hangar. As part of Alternative 1, SpaceX would demolish the Mobile Service Tower, Mobile Assembly Shelter, Fixed Umbilical Tower, and the launch crown at SLC-6. SpaceX would construct rails from the hangar to the launch pad to transport Falcon. The SLC 6 fence would be relocated and vehicular access from Luner Road to N Road would be removed.

- Point of Contact
Name: Adam Poll
Title: Civilian
Organization: Dudek
Email: apoll@dudek.com
Phone Number: 805-308-8516

Report generated with ACAM version: 5.0.23a

- Activity List:

Activity Type		Activity Title
2.	Degreaser	Solvent Use

3.	Construction / Demolition	SLC-6 Modifications
4.	Emergency Generator	ES DICE 1-3
5.	Emergency Generator	ES DICE 4
6.	Emergency Generator	ES DICE 5
7.	Emergency Generator	Prime Engine
8.	Personnel	Worker Vehicles
9.	Personnel	Fleet Vehicle Use
10.	Personnel	Vendor-Contractor Vehicles
11.	Construction / Demolition	Operational Equipment Use
12.	Emergency Generator	SLC 6 Emergency Generator
13.	Construction / Demolition	SLC-6 MAS Demo
14.	Construction / Demolition	SLC-6 FUT Demo
15.	Construction / Demolition	SLC-6 Crown Demo
16.	Construction / Demolition	SLC-6 MST Demo

Emission factors and air emission estimating methods come from the United States Air Force's Air Emissions Guide for Air Force Stationary Sources, Air Emissions Guide for Air Force Mobile Sources, and Air Emissions Guide for Air Force Transitory Sources.

2. Degreaser

2.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Solvent Use

- Activity Description:
Solvent Use

- Activity Start Date
Start Month: 12
Start Year: 2026

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	5.926830
SO_x	0.000000
NO_x	0.000000
CO	0.000000

Pollutant	Emissions Per Year (TONs)
PM 10	0.000000
PM 2.5	0.000000
Pb	0.000000
NH_3	0.000000

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.000000

Pollutant	Emissions Per Year (TONs)
CO_2	0.000000

N_2O	0.000000		CO_2e	0.000000

2.2 Degreaser Assumptions

- Degreaser
Net solvent usage (total less recycle) (gallons/year): 1820

- Default Settings Used: Yes

- Degreaser Consumption
Solvent used: Mineral Spirits CAS#64475-85-0 (default)
Specific gravity of solvent: 0.78 (default)
Solvent VOC content (%): 100 (default)
Efficiency of control device (%): 0 (default)

2.3 Degreaser Formula(s)

- Degreaser Emissions per Year
DE_{VOC}= (VOC / 100) * NS * SG * 8.35 * (1 - (CD / 100)) / 2000

DE_{VOC}: Degreaser VOC Emissions (TONs per Year)
VOC: Solvent VOC content (%)
(VOC / 100): Conversion Factor percent to decimal
NS: Net solvent usage (total less recycle) (gallons/year)
SG: Specific gravity of solvent
8.35: Conversion Factor the density of water
CD: Efficiency of control device (%)
(1 - (CD / 100)): Conversion Factor percent to decimal (Not effected by control device)
2000: Conversion Factor pounds to tons

3. Construction / Demolition

3.1 General Information & Timeline Assumptions

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: SLC-6 Modifications

- Activity Description:
SpaceX would modify SLC-6 to support Falcon 9 and Falcon Heavy launches. SpaceX would construct commodity storage tanks, a vehicle erector, a water tower, ground supporting equipment, and a rail system from the hangar to the launch pad. Where possible, existing infrastructure would be modified. This could include the liquid oxygen storage, launch pad apron and access road, and fence line. The existing flame trench would be converted to a unidirectional water-cooled diverter and a deluge/acoustic suppression system would be installed. Construction would generally occur in previously disturbed areas and on existing impervious surfaces, but some earthwork is anticipated. A new hangar or modification of an existing structure would be required for vehicle processing. A discussion of hangar alternatives is included in Section 2.2.
Approximately 143,000 square feet of commodity storage would be required. This includes storage tanks for liquid oxygen, rocket propellant-1, water, nitrogen, helium, and other launch commodities. A 200-foot water tower would be constructed on the east side of the launch complex.

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

Existing utilities such as power, communications, and fluids systems would be modified or reconstructed within the existing launch complex for Falcon as needed. Firebreaks would be incorporated as appropriate into the site design and final site layout is subject to SLD 30 review and approval.
Under Alternative 2, SpaceX would implement the Proposed Action and construct an approximately 61,250 square-foot hangar north of the launch pad line to support Falcon 9 and Falcon Heavy integration and processing. Areas around the hangar would be graded to provide rear access to the hangar. SpaceX would construct rails from the hangar to the launch pad to transport Falcon. The SLC 6 fence would be relocated and vehicular access from Luner Road to N Road would be removed.

- Activity Start Date
Start Month: 11
Start Month: 2025

- Activity End Date
Indefinite: False
End Month: 10
End Month: 2026

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	1.913658
SO_x	0.010946
NO_x	3.024966
CO	2.093272

Pollutant	Total Emissions (TONs)
PM 10	3.407791
PM 2.5	0.092356
Pb	0.000000
NH_3	0.132521

- Activity Emissions of GHG:

Pollutant	Total Emissions (TONs)
CH_4	0.015887
N_2O	0.132736

Pollutant	Total Emissions (TONs)
CO_2	1126.016589
CO_2e	1165.968430

- Global Scale Activity Emissions for SCGHG:

Pollutant	Total Emissions (TONs)
CH_4	0.015887
N_2O	0.132736

Pollutant	Total Emissions (TONs)
CO_2	1126.016589
CO_2e	1165.968430

3.1 Site Grading Phase

3.1.1 Site Grading Phase Timeline Assumptions

- Phase Start Date
Start Month: 11
Start Quarter: 1
Start Year: 2025

- Phase Duration
Number of Month: 1
Number of Days: 0

3.1.2 Site Grading Phase Assumptions

- General Site Grading Information
Area of Site to be Graded (ft^2): 328442
Amount of Material to be Hauled On-Site (yd^3): 0
Amount of Material to be Hauled Off-Site (yd^3): 0

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

- Site Grading Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Excavators Composite	1	8
Graders Composite	1	8
Other Construction Equipment Composite	1	8
Rubber Tired Dozers Composite	1	8
Tractors/Loaders/Backhoes Composite	3	8

- Vehicle Exhaust
Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

3.1.3 Site Grading Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Excavators Composite [HP: 36] [LF: 0.38]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.40191	0.00542	3.44643	4.21104	0.10704	0.09848
Graders Composite [HP: 148] [LF: 0.41]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.33951	0.00490	2.85858	3.41896	0.15910	0.14637
Other Construction Equipment Composite [HP: 82] [LF: 0.42]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.29762	0.00487	2.89075	3.51214	0.17229	0.15851
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.37086	0.00491	3.50629	2.90209	0.15396	0.14165
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.19600	0.00489	2.00960	3.48168	0.07738	0.07119

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Excavators Composite [HP: 36] [LF: 0.38]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02382	0.00476	587.13772	589.15263
Graders Composite [HP: 148] [LF: 0.41]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02155	0.00431	531.19419	533.01712

Other Construction Equipment Composite [HP: 82] [LF: 0.42]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02141	0.00428	527.74261	529.55369
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02159	0.00432	532.17175	533.99803
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02149	0.00430	529.86270	531.68105

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

3.1.4 Site Grading Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (20 * ACRE * WD) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
20: Conversion Factor Acre Day to pounds (20 lb / 1 Acre Day)
ACRE: Total acres (acres)
WD: Number of Total Work Days (days)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase
$VMT_{VE} = (HA_{OnSite} + HA_{OffSite}) * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
HA_{OnSite}: Amount of Material to be Hauled On-Site (yd^3)
$HA_{OffSite}$: Amount of Material to be Hauled Off-Site (yd^3)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

3.2 Building Construction Phase

3.2.1 Building Construction Phase Timeline Assumptions

- Phase Start Date
Start Month: 11
Start Quarter: 1
Start Year: 2025

- Phase Duration
Number of Month: 11
Number of Days: 0

3.2.2 Building Construction Phase Assumptions

- General Building Construction Information
Building Category: Office or Industrial
Area of Building (ft^2): 204250

Height of Building (ft): 200
Number of Units: N/A

- Building Construction Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Cranes Composite	1	6
Forklifts Composite	2	6
Generator Sets Composite	1	8
Tractors/Loaders/Backhoes Composite	1	8
Welders Composite	3	8

- Vehicle Exhaust
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

- Vendor Trips
Average Vendor Round Trip Commute (mile): 40 (default)

- Vendor Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

3.2.3 Building Construction Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Cranes Composite [HP: 367] [LF: 0.29]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.20113	0.00487	1.94968	1.66287	0.07909	0.07277
Forklifts Composite [HP: 82] [LF: 0.2]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.26944	0.00487	2.55142	3.59881	0.13498	0.12418
Generator Sets Composite [HP: 14] [LF: 0.74]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.54223	0.00793	4.34662	2.86938	0.17681	0.16267
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.19600	0.00489	2.00960	3.48168	0.07738	0.07119
Welders Composite [HP: 46] [LF: 0.45]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**

Emission Factors	0.49757	0.00735	3.67618	4.52476	0.11274	0.10373

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Cranes Composite [HP: 367] [LF: 0.29]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02140	0.00428	527.58451	529.39505
Forklifts Composite [HP: 82] [LF: 0.2]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02138	0.00428	527.10822	528.91712
Generator Sets Composite [HP: 14] [LF: 0.74]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02305	0.00461	568.32220	570.27253
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02149	0.00430	529.86270	531.68105
Welders Composite [HP: 46] [LF: 0.45]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02305	0.00461	568.30078	570.25105

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

3.2.4 Building Construction Phase Formula(s)

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase
$VMT_{VE} = BA * BH * (0.42 / 1000) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.42 / 1000): Conversion Factor ft^3 to trips (0.42 trip / 1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Vender Trips Emissions per Phase
$VMT_{VT} = BA * BH * (0.38 / 1000) * HT$

VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.38 / 1000): Conversion Factor ft^3 to trips (0.38 trip / 1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

3.3 Architectural Coatings Phase

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3.3.1 Architectural Coatings Phase Timeline Assumptions

- Phase Start Date
Start Month: 10
Start Quarter: 1
Start Year: 2026

- Phase Duration
Number of Month: 1
Number of Days: 0

3.3.2 Architectural Coatings Phase Assumptions

- General Architectural Coatings Information
Building Category: Non-Residential
Total Square Footage (ft^2): 143000
Number of Units: N/A

- Architectural Coatings Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

3.3.3 Architectural Coatings Phase Emission Factor(s)

- Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

3.3.4 Architectural Coatings Phase Formula(s)

- Worker Trips Emissions per Phase
$VMT_{WT} = (1 * WT * PA) / 800$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
1: Conversion Factor man days to trips (1 trip / 1 man * day)
WT: Average Worker Round Trip Commute (mile)
PA: Paint Area (ft^2)
800: Conversion Factor square feet to man days (1 ft^2 / 1 man * day)

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Off-Gassing Emissions per Phase
$VOC_{AC} = (AB * 2.0 * 0.0116) / 2000.0$

VOC_{AC}: Architectural Coating VOC Emissions (TONs)
BA: Area of Building (ft^2)
2.0: Conversion Factor total area to coated area (2.0 ft^2 coated area / total area)
0.0116: Emission Factor (lb/ft^2)
2000: Conversion Factor pounds to tons

3.4 Paving Phase

3.4.1 Paving Phase Timeline Assumptions

- Phase Start Date
Start Month: 10
Start Quarter: 1
Start Year: 2026

- Phase Duration
Number of Month: 1
Number of Days: 0

3.4.2 Paving Phase Assumptions

- General Paving Information
Paving Area (ft^2): 143000

- Paving Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Cement and Mortar Mixers Composite	4	6
Pavers Composite	1	7
Paving Equipment Composite	2	6

Rollers Composite	1	7

- Vehicle Exhaust
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

3.4.3 Paving Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Cement and Mortar Mixers Composite [HP: 10] [LF: 0.56]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.55280	0.00854	4.19778	3.25481	0.16332	0.15025
Pavers Composite [HP: 81] [LF: 0.42]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.23717	0.00486	2.53335	3.43109	0.12904	0.11872
Paving Equipment Composite [HP: 89] [LF: 0.36]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.18995	0.00487	2.06537	3.40278	0.08031	0.07388
Rollers Composite [HP: 36] [LF: 0.38]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.54202	0.00541	3.61396	4.09268	0.15387	0.14156

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Cement and Mortar Mixers Composite [HP: 10] [LF: 0.56]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02313	0.00463	570.16326	572.11992
Pavers Composite [HP: 81] [LF: 0.42]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02133	0.00427	525.80405	527.60847
Paving Equipment Composite [HP: 89] [LF: 0.36]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02141	0.00428	527.70636	529.51732
Rollers Composite [HP: 36] [LF: 0.38]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02381	0.00476	586.91372	588.92786

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048

MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

3.4.4 Paving Phase Formula(s)

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * EF_{POL}) / 2000$

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = PA * 0.25 * (1 / 27) * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
PA: Paving Area (ft^2)
0.25: Thickness of Paving Area (ft)
(1 / 27): Conversion Factor cubic feet to cubic yards (1 yd^3 / 27 ft^3)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase

$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)

WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Off-Gassing Emissions per Phase
$VOC_P = (2.62 * PA) / 43560 / 2000$

VOC_P: Paving VOC Emissions (TONs)
2.62: Emission Factor (lb/acre)
PA: Paving Area (ft^2)
43560: Conversion Factor square feet to acre (43560 ft2 / acre)^2 / acre)
2000: Conversion Factor square pounds to TONs (2000 lb / TON)

4. Emergency Generator

4.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: ES DICE 1-3

- Activity Description:
ES DICE 1-3

- Activity Start Date
Start Month: 12
Start Year: 2026

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	0.195217
SO_x	0.003408
NO_x	7.061635
CO	1.875832

Pollutant	Emissions Per Year (TONs)
PM 10	0.220574
PM 2.5	0.220574
Pb	0.000000
NH_3	0.000000

- Global Scale Activity Emissions of Greenhouse Gasses:

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Pollutant	Emissions Per Year (TONs)
CH_4	0.012623
N_2O	0.002524

Pollutant	Emissions Per Year (TONs)
CO_2	313.547500
CO_2e	362.624500

4.2 Emergency Generator Assumptions

- Emergency Generator
Type of Fuel used in Emergency Generator: Diesel
Number of Emergency Generators: 7

- Default Settings Used: No

- Emergency Generators Consumption
Emergency Generator's Horsepower: 779
Average Operating Hours Per Year (hours): 100

4.3 Emergency Generator Emission Factor(s)

- Emergency Generators Criteria Pollutant Emission Factor (lb/hp-hr)

VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3
0.000716	0.0000125	0.0259	0.00688	0.000809	0.000809		

- Emergency Generators Greenhouse Gasses Pollutant Emission Factor (lb/hp-hr)

CH_4	N_2O	CO_2	CO_2e
0.000046297	0.000009259	1.15	1.33

4.4 Emergency Generator Formula(s)

- Emergency Generator Emissions per Year
AE_{POL}= (NGEN * HP * OT * EF_{POL}) / 2000

AE_{POL}: Activity Emissions (TONs per Year)
NGEN: Number of Emergency Generators
HP: Emergency Generator's Horsepower (hp)
OT: Average Operating Hours Per Year (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hp-hr)

5. Emergency Generator

5.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: ES DICE 4

- Activity Description:
ES DICE 4

- Activity Start Date

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Start Month: 12
Start Year: 2026

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	0.051197
SO_x	0.043123
NO_x	0.211025
CO	0.140928

Pollutant	Emissions Per Year (TONs)
PM 10	0.046059
PM 2.5	0.046059
Pb	0.000000
NH_3	0.000000

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.000850
N_2O	0.000170

Pollutant	Emissions Per Year (TONs)
CO_2	21.102500
CO_2e	24.405500

5.2 Emergency Generator Assumptions

- Emergency Generator
Type of Fuel used in Emergency Generator: Diesel
Number of Emergency Generators: 1

- Default Settings Used: No

- Emergency Generators Consumption
Emergency Generator's Horsepower: 367
Average Operating Hours Per Year (hours): 100

5.3 Emergency Generator Emission Factor(s)

- Emergency Generators Criteria Pollutant Emission Factor (lb/hp-hr)

VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3
0.00279	0.00235	0.0115	0.00768	0.00251	0.00251		

- Emergency Generators Greenhouse Gasses Pollutant Emission Factor (lb/hp-hr)

CH_4	N_2O	CO_2	CO_2e
0.000046297	0.000009259	1.15	1.33

5.4 Emergency Generator Formula(s)

- Emergency Generator Emissions per Year

AE_{POL}= (NGEN * HP * OT * EF_{POL}) / 2000

AE_{POL}: Activity Emissions (TONs per Year)
NGEN: Number of Emergency Generators
HP: Emergency Generator's Horsepower (hp)
OT: Average Operating Hours Per Year (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hp-hr)

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

6. Emergency Generator

6.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: ES DICE 5

- Activity Description:
ES DICE 5

- Activity Start Date
Start Month: 12
Start Year: 2026

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	0.044640
SO_x	0.037600
NO_x	0.184000
CO	0.122880

Pollutant	Emissions Per Year (TONs)
PM 10	0.040160
PM 2.5	0.040160
Pb	0.000000
NH_3	0.000000

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.000741
N_2O	0.000148

Pollutant	Emissions Per Year (TONs)
CO_2	18.400000
CO_2e	21.280000

6.2 Emergency Generator Assumptions

- Emergency Generator
Type of Fuel used in Emergency Generator: Diesel
Number of Emergency Generators: 1

- Default Settings Used: No

- Emergency Generators Consumption
Emergency Generator's Horsepower: 320
Average Operating Hours Per Year (hours): 100

6.3 Emergency Generator Emission Factor(s)

- Emergency Generators Criteria Pollutant Emission Factor (lb/hp-hr)

VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3
0.00279	0.00235	0.0115	0.00768	0.00251	0.00251		

- Emergency Generators Greenhouse Gasses Pollutant Emission Factor (lb/hp-hr)

CH_4	N_2O	CO_2	CO_2e
0.000046297	0.000009259	1.15	1.33

6.4 Emergency Generator Formula(s)

- Emergency Generator Emissions per Year

AE_{POL}= (NGEN * HP * OT * EF_{POL}) / 2000

AE_{POL}: Activity Emissions (TONs per Year)
NGEN: Number of Emergency Generators
HP: Emergency Generator's Horsepower (hp)
OT: Average Operating Hours Per Year (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hp-hr)

7. Emergency Generator

7.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Prime Engine

- Activity Description:
Prime Engine

- Activity Start Date
Start Month: 12
Start Year: 2026

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	1.009221
SO_x	0.850061
NO_x	4.159872
CO	2.778071

Pollutant	Emissions Per Year (TONs)
PM 10	0.907937
PM 2.5	0.907937
Pb	0.000000
NH_3	0.000000

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.016747
N_2O	0.003349

Pollutant	Emissions Per Year (TONs)
CO_2	415.987200
CO_2e	481.098240

7.2 Emergency Generator Assumptions

- Emergency Generator
Type of Fuel used in Emergency Generator: Diesel
Number of Emergency Generators: 4

- Default Settings Used: No

- Emergency Generators Consumption
Emergency Generator's Horsepower: 314
Average Operating Hours Per Year (hours): 576

7.3 Emergency Generator Emission Factor(s)

- Emergency Generators Criteria Pollutant Emission Factor (lb/hp-hr)

VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3
0.00279	0.00235	0.0115	0.00768	0.00251	0.00251		

- Emergency Generators Greenhouse Gasses Pollutant Emission Factor (lb/hp-hr)

CH_4	N_2O	CO_2	CO_2e
0.000046297	0.000009259	1.15	1.33

7.4 Emergency Generator Formula(s)

- Emergency Generator Emissions per Year
AE_{POL}= (NGEN * HP * OT * EF_{POL}) / 2000

AE_{POL}: Activity Emissions (TONs per Year)
NGEN: Number of Emergency Generators
HP: Emergency Generator's Horsepower (hp)
OT: Average Operating Hours Per Year (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hp-hr)

8. Personnel

8.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Worker Vehicles

- Activity Description:
Worker Vehicles

- Activity Start Date
Start Month: 12
Start Year: 2026

- Activity End Date
Indefinite: Yes
End Month: N/A

End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	1.093346
SO_x	0.012177
NO_x	0.506601
CO	6.464211

Pollutant	Emissions Per Year (TONs)
PM 10	0.067591
PM 2.5	0.024055
Pb	0.000000
NH_3	0.144436

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.072854
N_2O	0.046911

Pollutant	Emissions Per Year (TONs)
CO_2	1232.565244
CO_2e	1248.365695

8.2 Personnel Assumptions

- Number of Personnel
- **Active Duty Personnel:** 0
- **Civilian Personnel:** 0
- **Support Contractor Personnel:** 700
- **Air National Guard (ANG) Personnel:** 0
- **Reserve Personnel:** 0

- Default Settings Used: Yes

- Average Personnel Round Trip Commute (mile): 20 (default)

- Personnel Work Schedule
- **Active Duty Personnel:** 5 Days Per Week (default)
- **Civilian Personnel:** 5 Days Per Week (default)
- **Support Contractor Personnel:** 5 Days Per Week (default)
- **Air National Guard (ANG) Personnel:** 4 Days Per Week (default)
- **Reserve Personnel:** 4 Days Per Month (default)

8.3 Personnel On Road Vehicle Mixture

- On Road Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	37.55	60.32	0	0.03	0.2	0	1.9
GOVs	54.49	37.73	4.67	0	0	3.11	0

8.4 Personnel Emission Factor(s)

- On Road Vehicle Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.14234	0.00266	0.07502	1.06799	0.01592	0.00555	0.03565
LDGT	0.18838	0.00330	0.13989	1.46024	0.01732	0.00618	0.03719
HDGV	0.24098	0.00505	0.22834	1.70597	0.02754	0.00971	0.03748
LDDV	0.02105	0.00209	0.18580	0.28873	0.02760	0.01668	0.00310
LDDT	0.01458	0.00278	0.06550	0.14150	0.02318	0.01184	0.00310
HDDV	0.09991	0.01077	2.12874	0.51062	0.11544	0.05583	0.18324
MC	5.54365	0.00204	0.71045	17.29267	0.01908	0.00809	0.00866

- On Road Vehicle Greenhouse Gasses Emission Factors (grams/mile)

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	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01109	0.00883	269.03971	271.94837
LDGT	0.01534	0.01225	334.10216	338.13590
HDGV	0.01993	0.01699	510.51978	516.08005
LDDV	0.00098	0.03476	220.63766	231.02106
LDDT	0.00068	0.04624	293.49614	307.29273
HDDV	0.00464	0.17922	1137.52260	1191.04533
MC	0.24921	0.04641	206.70657	226.76743

8.5 Personnel Formula(s)

- Personnel Vehicle Miles Travel for Work Days per Year
$VMT_P = NP * WD * AC$

VMT_P: Personnel Vehicle Miles Travel (miles/year)
NP: Number of Personnel
WD: Work Days per Year
AC: Average Commute (miles)

- Total Vehicle Miles Travel per Year
$VMT_{Total} = VMT_{AD} + VMT_C + VMT_{SC} + VMT_{ANG} + VMT_{AFRC}$

VMT_{Total}: Total Vehicle Miles Travel (miles)
VMT_{AD}: Active Duty Personnel Vehicle Miles Travel (miles)
VMT_C: Civilian Personnel Vehicle Miles Travel (miles)
VMT_{SC}: Support Contractor Personnel Vehicle Miles Travel (miles)
VMT_{ANG}: Air National Guard Personnel Vehicle Miles Travel (miles)
VMT_{AFRC}: Reserve Personnel Vehicle Miles Travel (miles)

- Vehicle Emissions per Year
$V_{POL} = (VMT_{Total} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{Total}: Total Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Personnel On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

9. Personnel

9.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Fleet Vehicle Use

- Activity Description:
Fleet Vehicle Use

- Activity Start Date
Start Month: 12
Start Year: 2026

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	0.156192
SO_x	0.001740
NO_x	0.072372
CO	0.923459

Pollutant	Emissions Per Year (TONs)
PM 10	0.009656
PM 2.5	0.003436
Pb	0.000000
NH_3	0.020634

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.010408
N_2O	0.006702

Pollutant	Emissions Per Year (TONs)
CO_2	176.080749
CO_2e	178.337956

9.2 Personnel Assumptions

- Number of Personnel
Active Duty Personnel: 0
Civilian Personnel: 0
Support Contractor Personnel: 100
Air National Guard (ANG) Personnel: 0
Reserve Personnel: 0

- Default Settings Used: Yes

- Average Personnel Round Trip Commute (mile): 20 (default)

- Personnel Work Schedule
Active Duty Personnel: 5 Days Per Week (default)
Civilian Personnel: 5 Days Per Week (default)
Support Contractor Personnel: 5 Days Per Week (default)
Air National Guard (ANG) Personnel: 4 Days Per Week (default)
Reserve Personnel: 4 Days Per Month (default)

9.3 Personnel On Road Vehicle Mixture

- On Road Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	37.55	60.32	0	0.03	0.2	0	1.9
GOVs	54.49	37.73	4.67	0	0	3.11	0

9.4 Personnel Emission Factor(s)

- On Road Vehicle Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.14234	0.00266	0.07502	1.06799	0.01592	0.00555	0.03565

LDGT	0.18838	0.00330	0.13989	1.46024	0.01732	0.00618	0.03719
HDGV	0.24098	0.00505	0.22834	1.70597	0.02754	0.00971	0.03748
LDDV	0.02105	0.00209	0.18580	0.28873	0.02760	0.01668	0.00310
LDDT	0.01458	0.00278	0.06550	0.14150	0.02318	0.01184	0.00310
HDDV	0.09991	0.01077	2.12874	0.51062	0.11544	0.05583	0.18324
MC	5.54365	0.00204	0.71045	17.29267	0.01908	0.00809	0.00866

- On Road Vehicle Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01109	0.00883	269.03971	271.94837
LDGT	0.01534	0.01225	334.10216	338.13590
HDGV	0.01993	0.01699	510.51978	516.08005
LDDV	0.00098	0.03476	220.63766	231.02106
LDDT	0.00068	0.04624	293.49614	307.29273
HDDV	0.00464	0.17922	1137.52260	1191.04533
MC	0.24921	0.04641	206.70657	226.76743

9.5 Personnel Formula(s)

- Personnel Vehicle Miles Travel for Work Days per Year

$VMT_P = NP * WD * AC$

VMT_P: Personnel Vehicle Miles Travel (miles/year)
NP: Number of Personnel
WD: Work Days per Year
AC: Average Commute (miles)

- Total Vehicle Miles Travel per Year

$VMT_{Total} = VMT_{AD} + VMT_C + VMT_{SC} + VMT_{ANG} + VMT_{AFRC}$

VMT_{Total}: Total Vehicle Miles Travel (miles)
VMT_{AD}: Active Duty Personnel Vehicle Miles Travel (miles)
VMT_C: Civilian Personnel Vehicle Miles Travel (miles)
VMT_{SC}: Support Contractor Personnel Vehicle Miles Travel (miles)
VMT_{ANG}: Air National Guard Personnel Vehicle Miles Travel (miles)
VMT_{AFRC}: Reserve Personnel Vehicle Miles Travel (miles)

- Vehicle Emissions per Year

$V_{POL} = (VMT_{Total} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{Total}: Total Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Personnel On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

10. Personnel

10.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Vendor-Contractor Vehicles

- Activity Description:
Vendor-Contractor Vehicles

- Activity Start Date
Start Month: 12
Start Year: 2026

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	0.209298
SO_x	0.002331
NO_x	0.096978
CO	1.237435

Pollutant	Emissions Per Year (TONs)
PM 10	0.012939
PM 2.5	0.004605
Pb	0.000000
NH_3	0.027649

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.013946
N_2O	0.008980

Pollutant	Emissions Per Year (TONs)
CO_2	235.948204
CO_2e	238.972862

10.2 Personnel Assumptions

- Number of Personnel
Active Duty Personnel: 0
Civilian Personnel: 0
Support Contractor Personnel: 134
Air National Guard (ANG) Personnel: 0
Reserve Personnel: 0

- Default Settings Used: Yes

- Average Personnel Round Trip Commute (mile): 20 (default)

- Personnel Work Schedule
Active Duty Personnel: 5 Days Per Week (default)
Civilian Personnel: 5 Days Per Week (default)
Support Contractor Personnel: 5 Days Per Week (default)
Air National Guard (ANG) Personnel: 4 Days Per Week (default)
Reserve Personnel: 4 Days Per Month (default)

10.3 Personnel On Road Vehicle Mixture

- On Road Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	37.55	60.32	0	0.03	0.2	0	1.9

GOVs	54.49	37.73	4.67	0	0	3.11	0

10.4 Personnel Emission Factor(s)

- On Road Vehicle Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.14234	0.00266	0.07502	1.06799	0.01592	0.00555	0.03565
LDGT	0.18838	0.00330	0.13989	1.46024	0.01732	0.00618	0.03719
HDGV	0.24098	0.00505	0.22834	1.70597	0.02754	0.00971	0.03748
LDDV	0.02105	0.00209	0.18580	0.28873	0.02760	0.01668	0.00310
LDDT	0.01458	0.00278	0.06550	0.14150	0.02318	0.01184	0.00310
HDDV	0.09991	0.01077	2.12874	0.51062	0.11544	0.05583	0.18324
MC	5.54365	0.00204	0.71045	17.29267	0.01908	0.00809	0.00866

- On Road Vehicle Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01109	0.00883	269.03971	271.94837
LDGT	0.01534	0.01225	334.10216	338.13590
HDGV	0.01993	0.01699	510.51978	516.08005
LDDV	0.00098	0.03476	220.63766	231.02106
LDDT	0.00068	0.04624	293.49614	307.29273
HDDV	0.00464	0.17922	1137.52260	1191.04533
MC	0.24921	0.04641	206.70657	226.76743

10.5 Personnel Formula(s)

- Personnel Vehicle Miles Travel for Work Days per Year

$VMT_P = NP * WD * AC$

VMT_P: Personnel Vehicle Miles Travel (miles/year)
NP: Number of Personnel
WD: Work Days per Year
AC: Average Commute (miles)

- Total Vehicle Miles Travel per Year

$VMT_{Total} = VMT_{AD} + VMT_C + VMT_{SC} + VMT_{ANG} + VMT_{AFRC}$

VMT_{Total}: Total Vehicle Miles Travel (miles)
VMT_{AD}: Active Duty Personnel Vehicle Miles Travel (miles)
VMT_C: Civilian Personnel Vehicle Miles Travel (miles)
VMT_{SC}: Support Contractor Personnel Vehicle Miles Travel (miles)
VMT_{ANG}: Air National Guard Personnel Vehicle Miles Travel (miles)
VMT_{AFRC}: Reserve Personnel Vehicle Miles Travel (miles)

- Vehicle Emissions per Year

$V_{POL} = (VMT_{Total} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{Total}: Total Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Personnel On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

11. Construction / Demolition

11.1 General Information & Timeline Assumptions

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Operational Equipment Use

- Activity Description:
Operational Equipment Use

- Activity Start Date
Start Month: 12
Start Month: 2026

- Activity End Date
Indefinite: False
End Month: 11
End Month: 2056

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	2.096774
SO_x	0.061154
NO_x	17.917458
CO	25.257392

Pollutant	Total Emissions (TONs)
PM 10	0.527869
PM 2.5	0.485617
Pb	0.000000
NH_3	0.000000

- Activity Emissions of GHG:

Pollutant	Total Emissions (TONs)
CH_4	0.268458
N_2O	0.053666

Pollutant	Total Emissions (TONs)
CO_2	6617.464867
CO_2e	6640.174335

- Global Scale Activity Emissions for SCGHG:

Pollutant	Total Emissions (TONs)
CH_4	0.268458
N_2O	0.053666

Pollutant	Total Emissions (TONs)
CO_2	6617.464867
CO_2e	6640.174335

11.1 Site Grading Phase

11.1.1 Site Grading Phase Timeline Assumptions

- Phase Start Date
Start Month: 12
Start Quarter: 1
Start Year: 2026

- Phase Duration
Number of Month: 360
Number of Days: 0

11.1.2 Site Grading Phase Assumptions

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

- General Site Grading Information

Area of Site to be Graded (ft^2): 0
Amount of Material to be Hauled On-Site (yd^3): 0
Amount of Material to be Hauled Off-Site (yd^3): 0

- Site Grading Default Settings

Default Settings Used: No
Average Day(s) worked per week: 5

- Construction Exhaust

Equipment Name	Number Of Equipment	Hours Per Day
Aerial Lifts Composite	8	1
Forklifts Composite	10	1
Off-Highway Trucks Composite	6	1
Rough Terrain Forklifts Composite	8	1

- Vehicle Exhaust

Average Hauling Truck Capacity (yd^3): 20
Average Hauling Truck Round Trip Commute (mile): 0

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips

Average Worker Round Trip Commute (mile): 0

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

11.1.3 Site Grading Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour)

Aerial Lifts Composite [HP: 46] [LF: 0.31]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.15248	0.00542	2.87377	3.07542	0.02070	0.01905
Forklifts Composite [HP: 82] [LF: 0.2]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.24594	0.00487	2.34179	3.57902	0.11182	0.10287
Off-Highway Trucks Composite [HP: 376] [LF: 0.38]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.17585	0.00489	1.01131	1.17821	0.03561	0.03276
Rough Terrain Forklifts Composite [HP: 96] [LF: 0.4]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.11505	0.00489	1.64283	3.22011	0.03306	0.03041

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour)

Aerial Lifts Composite [HP: 46] [LF: 0.31]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02381	0.00476	586.90035	588.91444
Forklifts Composite [HP: 82] [LF: 0.2]				
	CH_4	N_2O	CO_2	CO_2e

Emission Factors	0.02138	0.00428	527.09717	528.90603
Off-Highway Trucks Composite [HP: 376] [LF: 0.38]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02147	0.00429	529.16792	530.98389
Rough Terrain Forklifts Composite [HP: 96] [LF: 0.4]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02145	0.00429	528.88931	530.70433

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.14234	0.00266	0.07502	1.06799	0.01592	0.00555	0.03565
LDGT	0.18838	0.00330	0.13989	1.46024	0.01732	0.00618	0.03719
HDGV	0.24098	0.00505	0.22834	1.70597	0.02754	0.00971	0.03748
LDDV	0.02105	0.00209	0.18580	0.28873	0.02760	0.01668	0.00310
LDDT	0.01458	0.00278	0.06550	0.14150	0.02318	0.01184	0.00310
HDDV	0.09991	0.01077	2.12874	0.51062	0.11544	0.05583	0.18324
MC	5.54365	0.00204	0.71045	17.29267	0.01908	0.00809	0.00866

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01109	0.00883	269.03971	271.94837
LDGT	0.01534	0.01225	334.10216	338.13590
HDGV	0.01993	0.01699	510.51978	516.08005
LDDV	0.00098	0.03476	220.63766	231.02106
LDDT	0.00068	0.04624	293.49614	307.29273
HDDV	0.00464	0.17922	1137.52260	1191.04533
MC	0.24921	0.04641	206.70657	226.76743

11.1.4 Site Grading Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (20 * ACRE * WD) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
20: Conversion Factor Acre Day to pounds (20 lb / 1 Acre Day)
ACRE: Total acres (acres)
WD: Number of Total Work Days (days)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = (HA_{OnSite} + HA_{OffSite}) * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
HA_{OnSite}: Amount of Material to be Hauled On-Site (yd^3)
$HA_{OffSite}$: Amount of Material to be Hauled Off-Site (yd^3)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

12. Emergency Generator

12.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: SLC 6 Emergency Generator

- Activity Description:
SLC 6 Emergency Generator

- Activity Start Date
Start Month: 12
Start Year: 2026

- Activity End Date

Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	0.046540
SO_x	0.000813
NO_x	1.683500
CO	0.447200

Pollutant	Emissions Per Year (TONs)
PM 10	0.052585
PM 2.5	0.052585
Pb	0.000000
NH_3	0.000000

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.003009
N_2O	0.000602

Pollutant	Emissions Per Year (TONs)
CO_2	74.750000
CO_2e	86.450000

12.2 Emergency Generator Assumptions

- Emergency Generator
Type of Fuel used in Emergency Generator: Diesel
Number of Emergency Generators: 1

- Default Settings Used: No

- Emergency Generators Consumption
Emergency Generator's Horsepower: 1300
Average Operating Hours Per Year (hours): 100

12.3 Emergency Generator Emission Factor(s)

- Emergency Generators Criteria Pollutant Emission Factor (lb/hp-hr)

VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3
0.000716	0.0000125	0.0259	0.00688	0.000809	0.000809		

- Emergency Generators Greenhouse Gasses Pollutant Emission Factor (lb/hp-hr)

CH_4	N_2O	CO_2	CO_2e
0.000046297	0.000009259	1.15	1.33

12.4 Emergency Generator Formula(s)

- Emergency Generator Emissions per Year
AE_{POL}= (NGEN * HP * OT * EF_{POL}) / 2000

AE_{POL}: Activity Emissions (TONs per Year)
NGEN: Number of Emergency Generators
HP: Emergency Generator's Horsepower (hp)
OT: Average Operating Hours Per Year (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hp-hr)

13. Construction / Demolition

13.1 General Information & Timeline Assumptions

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: SLC-6 MAS Demo

- Activity Description:
SLC-6 MAS Demo

- Activity Start Date
Start Month: 11
Start Month: 2025

- Activity End Date
Indefinite: False
End Month: 4
End Month: 2026

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.037246
SO_x	0.001060
NO_x	0.375038
CO	0.408439

Pollutant	Total Emissions (TONs)
PM 10	0.865724
PM 2.5	0.011790
Pb	0.000000
NH_3	0.007974

- Activity Emissions of GHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002653
N_2O	0.008039

Pollutant	Total Emissions (TONs)
CO_2	106.983024
CO_2e	109.444875

- Global Scale Activity Emissions for SCGHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002653
N_2O	0.008039

Pollutant	Total Emissions (TONs)
CO_2	106.983024
CO_2e	109.444875

13.1 Demolition Phase

13.1.1 Demolition Phase Timeline Assumptions

- Phase Start Date
Start Month: 11
Start Quarter: 1
Start Year: 2025

- Phase Duration
Number of Month: 6
Number of Days: 0

13.1.2 Demolition Phase Assumptions

- General Demolition Information
Area of Building to be demolished (ft^2): 15000
Height of Building to be demolished (ft): 270

- Default Settings Used: Yes

- Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Concrete/Industrial Saws Composite	1	8
Rubber Tired Dozers Composite	1	1
Tractors/Loaders/Backhoes Composite	2	6

- Vehicle Exhaust
Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

13.1.3 Demolition Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.43930	0.00743	3.63468	4.34820	0.10060	0.09255
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.37086	0.00491	3.50629	2.90209	0.15396	0.14165
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.19600	0.00489	2.00960	3.48168	0.07738	0.07119

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02333	0.00467	575.01338	576.98668
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02159	0.00432	532.17175	533.99803
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02149	0.00430	529.86270	531.68105

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696

LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

13.1.4 Demolition Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (0.00042 * BA * BH) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
0.00042: Emission Factor (lb/ft^3)
BA: Area of Building to be demolished (ft^2)
BH: Height of Building to be demolished (ft)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = BA * BH * (1 / 27) * 0.25 * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building being demolish (ft^2)
BH: Height of Building being demolish (ft)
(1 / 27): Conversion Factor cubic feet to cubic yards ($1\ yd^3 / 27\ ft^3$)
0.25: Volume reduction factor (material reduced by 75% to account for air space)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)

0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

14. Construction / Demolition

14.1 General Information & Timeline Assumptions

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: SLC-6 FUT Demo

- Activity Description:
SLC-6 FUT Demo

- Activity Start Date
Start Month: 11
Start Month: 2025

- Activity End Date
Indefinite: False
End Month: 4
End Month: 2026

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.033815
SO_x	0.000707
NO_x	0.302386
CO	0.391393

Pollutant	Total Emissions (TONs)
PM 10	0.188477
PM 2.5	0.009921
Pb	0.000000
NH_3	0.002066

- Activity Emissions of GHG:

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Pollutant	Total Emissions (TONs)
CH_4	0.002493
N_2O	0.002156

Pollutant	Total Emissions (TONs)
CO_2	69.645164
CO_2e	70.350016

- Global Scale Activity Emissions for SCGHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002493
N_2O	0.002156

Pollutant	Total Emissions (TONs)
CO_2	69.645164
CO_2e	70.350016

14.1 Demolition Phase

14.1.1 Demolition Phase Timeline Assumptions

- Phase Start Date
Start Month: 11
Start Quarter: 1
Start Year: 2025

- Phase Duration
Number of Month: 6
Number of Days: 0

14.1.2 Demolition Phase Assumptions

- General Demolition Information
Area of Building to be demolished (ft^2): 4216
Height of Building to be demolished (ft): 200

- Default Settings Used: Yes

- Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Concrete/Industrial Saws Composite	1	8
Rubber Tired Dozers Composite	1	1
Tractors/Loaders/Backhoes Composite	2	6

- Vehicle Exhaust
Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

14.1.3 Demolition Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.43930	0.00743	3.63468	4.34820	0.10060	0.09255
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.37086	0.00491	3.50629	2.90209	0.15396	0.14165
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.19600	0.00489	2.00960	3.48168	0.07738	0.07119

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02333	0.00467	575.01338	576.98668
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02159	0.00432	532.17175	533.99803
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02149	0.00430	529.86270	531.68105

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**NH_3**
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	**N_2O**	**CO_2**	**CO_2e**
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

14.1.4 Demolition Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (0.00042 * BA * BH) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
0.00042: Emission Factor (lb/ft^3)
BA: Area of Building to be demolished (ft^2)
BH: Height of Building to be demolished (ft)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase
$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase
$VMT_{VE} = BA * BH * (1 / 27) * 0.25 * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building being demolish (ft^2)
BH: Height of Building being demolish (ft)
(1 / 27): Conversion Factor cubic feet to cubic yards (1 yd^3 / 27 ft^3)
0.25: Volume reduction factor (material reduced by 75% to account for air space)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

15. Construction / Demolition

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

15.1 General Information & Timeline Assumptions

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: SLC-6 Crown Demo

- Activity Description:
SLC-6 Crown Demo

- Activity Start Date
Start Month: 11
Start Month: 2025

- Activity End Date
Indefinite: False
End Month: 4
End Month: 2026

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.033393
SO_x	0.000663
NO_x	0.293450
CO	0.389296

Pollutant	Total Emissions (TONs)
PM 10	0.105184
PM 2.5	0.009692
Pb	0.000000
NH_3	0.001339

- Activity Emissions of GHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002474
N_2O	0.001433

Pollutant	Total Emissions (TONs)
CO_2	65.053031
CO_2e	65.541793

- Global Scale Activity Emissions for SCGHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002474
N_2O	0.001433

Pollutant	Total Emissions (TONs)
CO_2	65.053031
CO_2e	65.541793

15.1 Demolition Phase

15.1.1 Demolition Phase Timeline Assumptions

- Phase Start Date
Start Month: 11
Start Quarter: 1
Start Year: 2025

- Phase Duration
Number of Month: 6
Number of Days: 0

15.1.2 Demolition Phase Assumptions

- General Demolition Information

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

Area of Building to be demolished (ft^2): 10200
Height of Building to be demolished (ft): 44

- Default Settings Used: Yes

- Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Concrete/Industrial Saws Composite	1	8
Rubber Tired Dozers Composite	1	1
Tractors/Loaders/Backhoes Composite	2	6

- Vehicle Exhaust
Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

15.1.3 Demolition Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.43930	0.00743	3.63468	4.34820	0.10060	0.09255
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.37086	0.00491	3.50629	2.90209	0.15396	0.14165
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.19600	0.00489	2.00960	3.48168	0.07738	0.07119

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02333	0.00467	575.01338	576.98668
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02159	0.00432	532.17175	533.99803
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02149	0.00430	529.86270	531.68105

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

15.1.4 Demolition Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (0.00042 * BA * BH) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
0.00042: Emission Factor (lb/ft^3)
BA: Area of Building to be demolished (ft^2)
BH: Height of Building to be demolished (ft)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = BA * BH * (1 / 27) * 0.25 * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building being demolish (ft^2)
BH: Height of Building being demolish (ft)
(1 / 27): Conversion Factor cubic feet to cubic yards (1 yd^3 / 27 ft^3)
0.25: Volume reduction factor (material reduced by 75% to account for air space)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
VMT_{WT} = WD * WT * 1.25 * NE

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

16. Construction / Demolition

16.1 General Information & Timeline Assumptions

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: SLC-6 MST Demo

- Activity Description:
SLC-6 MST Demo

- Activity Start Date
Start Month: 11
Start Month: 2025

- Activity End Date
Indefinite: False
End Month: 4
End Month: 2026

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.040446
SO_x	0.001390
NO_x	0.442779

Pollutant	Total Emissions (TONs)
PM 10	1.497185
PM 2.5	0.013532
Pb	0.000000

CO	0.424332		NH_3	0.013483

- Activity Emissions of GHG:

Pollutant	Total Emissions (TONs)		Pollutant	Total Emissions (TONs)
CH_4	0.002801		CO_2	141.796609
N_2O	0.013524		CO_2e	145.896674

- Global Scale Activity Emissions for SCGHG:

Pollutant	Total Emissions (TONs)		Pollutant	Total Emissions (TONs)
CH_4	0.002801		CO_2	141.796609
N_2O	0.013524		CO_2e	145.896674

16.1 Demolition Phase

16.1.1 Demolition Phase Timeline Assumptions

- Phase Start Date
Start Month: 11
Start Quarter: 1
Start Year: 2025

- Phase Duration
Number of Month: 6
Number of Days: 0

16.1.2 Demolition Phase Assumptions

- General Demolition Information
Area of Building to be demolished (ft^2): 25600
Height of Building to be demolished (ft): 275

- Default Settings Used: Yes

- Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Concrete/Industrial Saws Composite	1	8
Rubber Tired Dozers Composite	1	1
Tractors/Loaders/Backhoes Composite	2	6

- Vehicle Exhaust
Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

16.1.3 Demolition Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.43930	0.00743	3.63468	4.34820	0.10060	0.09255
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.37086	0.00491	3.50629	2.90209	0.15396	0.14165
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.19600	0.00489	2.00960	3.48168	0.07738	0.07119

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02333	0.00467	575.01338	576.98668
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02159	0.00432	532.17175	533.99803
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02149	0.00430	529.86270	531.68105

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

16.1.4 Demolition Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (0.00042 * BA * BH) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
0.00042: Emission Factor (lb/ft^3)

BA: Area of Building to be demolished (ft^2)
BH: Height of Building to be demolished (ft)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase
$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase
$VMT_{VE} = BA * BH * (1 / 27) * 0.25 * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building being demolish (ft^2)
BH: Height of Building being demolish (ft)
(1 / 27): Conversion Factor cubic feet to cubic yards (1 yd^3 / 27 ft^3)
0.25: Volume reduction factor (material reduced by 75% to account for air space)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

1. General Information

- Action Location

Base: VANDENBERG AFB
State: California
County(s): Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Action Title: Falcon Program at Vandenberg Space Force Base Proposed Action

- Project Number/s (if applicable):

- Projected Action Start Date: 11 / 2025

- Action Purpose and Need:

Space Exploration Technologies Corporation (SpaceX) has applied to the United States Space Force (USSF) to increase Falcon flight opportunities at Vandenberg Space Force Base (VSFB) in support of manifested and anticipated vehicle operations for Falcon 9 and Falcon Heavy. SpaceX currently launches commercial and government payloads from VSFB at SLC-4 and has been allocated SLC-6 by the USSF. SpaceX supports, and is under contract for, the full spectrum of U.S. Government space mission requirements, including crew and cargo transportation for the National Aeronautics and Space Administration (NASA) and spacecraft launches for NASA and the U.S. Department of Defense (DOD).

- Action Description:

The Proposed Action is to increase the annual Falcon launch cadence at VSFB through launches at SLC-4 and SLC-6 and the modification of SLC 6 for Falcon launch vehicles to support future commercial and U.S. government launch service needs. SpaceX would launch Falcon 9 from SLC-4 and SLC-6, and Falcon Heavy from SLC-6. Falcon 9 is approximately 229 feet tall and produces approximately 1.7 million pounds of thrust at liftoff. A discussion of Falcon 9 can be found in the 2016 EA and associated supplemental environmental documents. Falcon Heavy is a heavy-lift vehicle that produces 5.12 million pounds of thrust at liftoff and has the ability to lift 141,000 pounds into low Earth orbit. Merlin engines are used on both stages of Falcon Heavy. The center core and two side boosters are essentially the same design as a Falcon 9 first stage booster, thus Falcon Heavy uses the same type of propellants as Falcon 9. Additionally, Falcon Heavy uses the same second stage as Falcon 9.

Under the Proposed Action, SpaceX would implement the Proposed Action and would modify the horizontal integration facility (HIF) located north of SLC 6 to support Falcon 9 and Falcon Heavy operations. As part of this Proposed Action, SpaceX would demolish the Mobile Service Tower, Mobile Assembly Shelter, Fixed Umbilical Tower, and the launch crown at SLC-6. Modifications would include interior work, construction of an approximately 5,000 square foot annex on the south side of the building, and construction of an approximately 42,000 square foot paved area north of the building to provide rear access into the hangar. SpaceX would construct rails from the hangar to the launch pad to transport Falcon.

- Point of Contact

Name: Adam Poll
Title: Civilian
Organization: Dudek
Email: apoll@dudek.com
Phone Number: 805-308-8516

Report generated with ACAM version: 5.0.23a

- Activity List:

	Activity Type	Activity Title
2.	Degreaser	Solvent Use

3.	Construction / Demolition	SLC-6 Modifications
4.	Emergency Generator	ES DICE 1-3
5.	Emergency Generator	ES DICE 4
6.	Emergency Generator	ES DICE 5
7.	Emergency Generator	Prime Engine
8.	Personnel	Worker Vehicles
9.	Personnel	Fleet Vehicle Use
10.	Personnel	Vendor-Contractor Vehicles
11.	Construction / Demolition	Operational Equipment Use
12.	Emergency Generator	SLC 6 Emergency Generator
13.	Construction / Demolition	SLC-6 MAS Demo
14.	Construction / Demolition	SLC-6 FUT Demo
15.	Construction / Demolition	SLC-6 Crown Demo
16.	Construction / Demolition	SLC-6 MST Demo

Emission factors and air emission estimating methods come from the United States Air Force's Air Emissions Guide for Air Force Stationary Sources, Air Emissions Guide for Air Force Mobile Sources, and Air Emissions Guide for Air Force Transitory Sources.

2. Degreaser

2.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Solvent Use

- Activity Description:
Solvent Use

- Activity Start Date
Start Month: 12
Start Year: 2026

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	5.926830
SO_x	0.000000
NO_x	0.000000
CO	0.000000

Pollutant	Emissions Per Year (TONs)
PM 10	0.000000
PM 2.5	0.000000
Pb	0.000000
NH_3	0.000000

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.000000

Pollutant	Emissions Per Year (TONs)
CO_2	0.000000

N_2O	0.000000		CO_2e	0.000000

2.2 Degreaser Assumptions

- Degreaser
Net solvent usage (total less recycle) (gallons/year): 1820

- Default Settings Used: Yes

- Degreaser Consumption
Solvent used: Mineral Spirits CAS#64475-85-0 (default)
Specific gravity of solvent: 0.78 (default)
Solvent VOC content (%): 100 (default)
Efficiency of control device (%): 0 (default)

2.3 Degreaser Formula(s)

- Degreaser Emissions per Year
DE_{VOC}= (VOC / 100) * NS * SG * 8.35 * (1 - (CD / 100)) / 2000

DE_{VOC}: Degreaser VOC Emissions (TONs per Year)
VOC: Solvent VOC content (%)
(VOC / 100): Conversion Factor percent to decimal
NS: Net solvent usage (total less recycle) (gallons/year)
SG: Specific gravity of solvent
8.35: Conversion Factor the density of water
CD: Efficiency of control device (%)
(1 - (CD / 100)): Conversion Factor percent to decimal (Not effected by control device)
2000: Conversion Factor pounds to tons

3. Construction / Demolition

3.1 General Information & Timeline Assumptions

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: SLC-6 Modifications

- Activity Description:
SpaceX would modify SLC-6 to support Falcon 9 and Falcon Heavy launches. SpaceX would construct commodity storage tanks, a vehicle erector, a water tower, ground supporting equipment, and a rail system from the hangar to the launch pad. Where possible, existing infrastructure would be modified. This could include the liquid oxygen storage, launch pad apron and access road, and fence line. The existing flame trench would be converted to a unidirectional water-cooled diverter and a deluge/acoustic suppression system would be installed. Construction would generally occur in previously disturbed areas and on existing impervious surfaces, but some earthwork is anticipated. A new hangar or modification of an existing structure would be required for vehicle processing. A discussion of hangar alternatives is included in Section 2.2.
Approximately 143,000 square feet of commodity storage would be required. This includes storage tanks for liquid oxygen, rocket propellant-1, water, nitrogen, helium, and other launch commodities. A 200-foot water tower would be constructed on the east side of the launch complex.

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Existing utilities such as power, communications, and fluids systems would be modified or reconstructed within the existing launch complex for Falcon as needed. Firebreaks would be incorporated as appropriate into the site design and final site layout is subject to SLD 30 review and approval.
Under Alternative 1, SpaceX would implement the Proposed Action and would modify the horizontal integration facility (HIF) located north of SLC 6 to support Falcon 9 and Falcon Heavy operations. Modifications would include interior work, construction of an approximately 5,000 square foot annex on the south side of the building, and construction of an approximately 42,000 square foot paved area north of the building to provide rear access into the hangar. SpaceX would construct rails from the hangar to the launch pad to transport Falcon.

- Activity Start Date
Start Month: 11
Start Month: 2025

- Activity End Date
Indefinite: False
End Month: 10
End Month: 2026

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	1.891449
SO_x	0.008753
NO_x	2.561380
CO	1.951662

Pollutant	Total Emissions (TONs)
PM 10	3.223485
PM 2.5	0.080259
Pb	0.000000
NH_3	0.096741

- Activity Emissions of GHG:

Pollutant	Total Emissions (TONs)
CH_4	0.014683
N_2O	0.097093

Pollutant	Total Emissions (TONs)
CO_2	894.320351
CO_2e	923.620848

- Global Scale Activity Emissions for SCGHG:

Pollutant	Total Emissions (TONs)
CH_4	0.014683
N_2O	0.097093

Pollutant	Total Emissions (TONs)
CO_2	894.320351
CO_2e	923.620848

3.1 Site Grading Phase

3.1.1 Site Grading Phase Timeline Assumptions

- Phase Start Date
Start Month: 11
Start Quarter: 1
Start Year: 2025

- Phase Duration
Number of Month: 1
Number of Days: 0

3.1.2 Site Grading Phase Assumptions

- General Site Grading Information
Area of Site to be Graded (ft^2): 312325
Amount of Material to be Hauled On-Site (yd^3): 0
Amount of Material to be Hauled Off-Site (yd^3): 0

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

- Site Grading Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Graders Composite	1	8
Other Construction Equipment Composite	1	8
Rubber Tired Dozers Composite	1	8
Tractors/Loaders/Backhoes Composite	2	7

- Vehicle Exhaust
Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

3.1.3 Site Grading Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Graders Composite [HP: 148] [LF: 0.41]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.33951	0.00490	2.85858	3.41896	0.15910	0.14637
Other Construction Equipment Composite [HP: 82] [LF: 0.42]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.29762	0.00487	2.89075	3.51214	0.17229	0.15851
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.37086	0.00491	3.50629	2.90209	0.15396	0.14165
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.19600	0.00489	2.00960	3.48168	0.07738	0.07119

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Graders Composite [HP: 148] [LF: 0.41]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02155	0.00431	531.19419	533.01712
Other Construction Equipment Composite [HP: 82] [LF: 0.42]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02141	0.00428	527.74261	529.55369
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02159	0.00432	532.17175	533.99803

Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02149	0.00430	529.86270	531.68105

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

3.1.4 Site Grading Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (20 * ACRE * WD) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
20: Conversion Factor Acre Day to pounds (20 lb / 1 Acre Day)
ACRE: Total acres (acres)
WD: Number of Total Work Days (days)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = (HA_{OnSite} + HA_{OffSite}) * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
HA_{OnSite}: Amount of Material to be Hauled On-Site (yd^3)
$HA_{OffSite}$: Amount of Material to be Hauled Off-Site (yd^3)
HC: Average Hauling Truck Capacity (yd^3)

(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

3.2 Building Construction Phase

3.2.1 Building Construction Phase Timeline Assumptions

- Phase Start Date
Start Month: 11
Start Quarter: 1
Start Year: 2025

- Phase Duration
Number of Month: 11
Number of Days: 0

3.2.2 Building Construction Phase Assumptions

- General Building Construction Information
Building Category: Office or Industrial
Area of Building (ft^2): 148000
Height of Building (ft): 200
Number of Units: N/A

- Building Construction Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Cranes Composite	1	6
Forklifts Composite	2	6
Generator Sets Composite	1	8
Tractors/Loaders/Backhoes Composite	1	8
Welders Composite	3	8

- Vehicle Exhaust

Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips

Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

- Vendor Trips

Average Vendor Round Trip Commute (mile): 40 (default)

- Vendor Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

3.2.3 Building Construction Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Cranes Composite [HP: 367] [LF: 0.29]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.20113	0.00487	1.94968	1.66287	0.07909	0.07277
Forklifts Composite [HP: 82] [LF: 0.2]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.26944	0.00487	2.55142	3.59881	0.13498	0.12418
Generator Sets Composite [HP: 14] [LF: 0.74]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.54223	0.00793	4.34662	2.86938	0.17681	0.16267
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.19600	0.00489	2.00960	3.48168	0.07738	0.07119
Welders Composite [HP: 46] [LF: 0.45]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.49757	0.00735	3.67618	4.52476	0.11274	0.10373

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Cranes Composite [HP: 367] [LF: 0.29]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02140	0.00428	527.58451	529.39505
Forklifts Composite [HP: 82] [LF: 0.2]				

	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02138	0.00428	527.10822	528.91712
Generator Sets Composite [HP: 14] [LF: 0.74]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02305	0.00461	568.32220	570.27253
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02149	0.00430	529.86270	531.68105
Welders Composite [HP: 46] [LF: 0.45]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02305	0.00461	568.30078	570.25105

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

3.2.4 Building Construction Phase Formula(s)

- Construction Exhaust Emissions per Phase

CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL}* 0.002205) / 2000

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

VMT_{VE} = BA * BH * (0.42 / 1000) * HT

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.42 / 1000): Conversion Factor ft^3 to trips (0.42 trip / 1000 ft^3)

HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Vender Trips Emissions per Phase
$VMT_{VT} = BA * BH * (0.38 / 1000) * HT$

VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.38 / 1000): Conversion Factor ft^3 to trips (0.38 trip / 1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

3.3 Architectural Coatings Phase

3.3.1 Architectural Coatings Phase Timeline Assumptions

- Phase Start Date
Start Month: 10
Start Quarter: 1
Start Year: 2026

- Phase Duration
Number of Month: 1
Number of Days: 0

3.3.2 Architectural Coatings Phase Assumptions

- General Architectural Coatings Information
Building Category: Non-Residential
Total Square Footage (ft^2): 143000
Number of Units: N/A

- Architectural Coatings Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

3.3.3 Architectural Coatings Phase Emission Factor(s)

- Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

3.3.4 Architectural Coatings Phase Formula(s)

- Worker Trips Emissions per Phase
$VMT_{WT} = (1 * WT * PA) / 800$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
1: Conversion Factor man days to trips (1 trip / 1 man * day)
WT: Average Worker Round Trip Commute (mile)
PA: Paint Area (ft^2)

800: Conversion Factor square feet to man days (1 ft^2 / 1 man * day)

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Off-Gassing Emissions per Phase
$VOC_{AC} = (AB * 2.0 * 0.0116) / 2000.0$

VOC_{AC}: Architectural Coating VOC Emissions (TONs)
BA: Area of Building (ft^2)
2.0: Conversion Factor total area to coated area (2.0 ft^2 coated area / total area)
0.0116: Emission Factor (lb/ft^2)
2000: Conversion Factor pounds to tons

3.4 Paving Phase

3.4.1 Paving Phase Timeline Assumptions

- Phase Start Date
Start Month: 10
Start Quarter: 1
Start Year: 2026

- Phase Duration
Number of Month: 1
Number of Days: 0

3.4.2 Paving Phase Assumptions

- General Paving Information
Paving Area (ft^2): 185000

- Paving Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Cement and Mortar Mixers Composite	4	6
Pavers Composite	1	7
Paving Equipment Composite	2	6
Rollers Composite	1	7

- Vehicle Exhaust
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC

POVs	0	0	0	0	0	100.00	0

- Worker Trips

Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

3.4.3 Paving Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Cement and Mortar Mixers Composite [HP: 10] [LF: 0.56]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.55280	0.00854	4.19778	3.25481	0.16332	0.15025
Pavers Composite [HP: 81] [LF: 0.42]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.23717	0.00486	2.53335	3.43109	0.12904	0.11872
Paving Equipment Composite [HP: 89] [LF: 0.36]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.18995	0.00487	2.06537	3.40278	0.08031	0.07388
Rollers Composite [HP: 36] [LF: 0.38]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.54202	0.00541	3.61396	4.09268	0.15387	0.14156

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Cement and Mortar Mixers Composite [HP: 10] [LF: 0.56]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02313	0.00463	570.16326	572.11992
Pavers Composite [HP: 81] [LF: 0.42]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02133	0.00427	525.80405	527.60847
Paving Equipment Composite [HP: 89] [LF: 0.36]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02141	0.00428	527.70636	529.51732
Rollers Composite [HP: 36] [LF: 0.38]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02381	0.00476	586.91372	588.92786

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564

LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

3.4.4 Paving Phase Formula(s)

- Construction Exhaust Emissions per Phase
$CEE_{POL} = (NE * WD * H * EF_{POL}) / 2000$

- Construction Exhaust Emissions per Phase
$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase
$VMT_{VE} = PA * 0.25 * (1 / 27) * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
PA: Paving Area (ft^2)
0.25: Thickness of Paving Area (ft)
(1 / 27): Conversion Factor cubic feet to cubic yards (1 yd^3 / 27 ft^3)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)

VMT_{VE}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Off-Gassing Emissions per Phase
$VOC_P = (2.62 * PA) / 43560 / 2000$

VOC_P: Paving VOC Emissions (TONs)
2.62: Emission Factor (lb/acre)
PA: Paving Area (ft^2)
43560: Conversion Factor square feet to acre (43560 ft2 / acre)^2 / acre)
2000: Conversion Factor square pounds to TONs (2000 lb / TON)

4. Emergency Generator

4.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: ES DICE 1-3

- Activity Description:
ES DICE 1-3

- Activity Start Date
Start Month: 12
Start Year: 2026

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	0.195217
SO_x	0.003408
NO_x	7.061635
CO	1.875832

Pollutant	Emissions Per Year (TONs)
PM 10	0.220574
PM 2.5	0.220574
Pb	0.000000
NH_3	0.000000

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.012623
N_2O	0.002524

Pollutant	Emissions Per Year (TONs)
CO_2	313.547500
CO_2e	362.624500

4.2 Emergency Generator Assumptions

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

- Emergency Generator
Type of Fuel used in Emergency Generator: Diesel
Number of Emergency Generators: 7

- Default Settings Used: No

- Emergency Generators Consumption
Emergency Generator's Horsepower: 779
Average Operating Hours Per Year (hours): 100

4.3 Emergency Generator Emission Factor(s)

- Emergency Generators Criteria Pollutant Emission Factor (lb/hp-hr)

VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3
0.000716	0.0000125	0.0259	0.00688	0.000809	0.000809		

- Emergency Generators Greenhouse Gasses Pollutant Emission Factor (lb/hp-hr)

CH_4	N_2O	CO_2	CO_2e
0.000046297	0.000009259	1.15	1.33

4.4 Emergency Generator Formula(s)

- Emergency Generator Emissions per Year
AE_{POL}= (NGEN * HP * OT * EF_{POL}) / 2000

AE_{POL}: Activity Emissions (TONs per Year)
NGEN: Number of Emergency Generators
HP: Emergency Generator's Horsepower (hp)
OT: Average Operating Hours Per Year (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hp-hr)

5. Emergency Generator

5.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: ES DICE 4

- Activity Description:
ES DICE 4

- Activity Start Date
Start Month: 12
Start Year: 2026

- Activity End Date
Indefinite: Yes
End Month: N/A

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	0.051197
SO_x	0.043123
NO_x	0.211025
CO	0.140928

Pollutant	Emissions Per Year (TONs)
PM 10	0.046059
PM 2.5	0.046059
Pb	0.000000
NH_3	0.000000

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.000850
N_2O	0.000170

Pollutant	Emissions Per Year (TONs)
CO_2	21.102500
CO_2e	24.405500

5.2 Emergency Generator Assumptions

- Emergency Generator
Type of Fuel used in Emergency Generator: Diesel
Number of Emergency Generators: 1

- Default Settings Used: No

- Emergency Generators Consumption
Emergency Generator's Horsepower: 367
Average Operating Hours Per Year (hours): 100

5.3 Emergency Generator Emission Factor(s)

- Emergency Generators Criteria Pollutant Emission Factor (lb/hp-hr)

VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3
0.00279	0.00235	0.0115	0.00768	0.00251	0.00251		

- Emergency Generators Greenhouse Gasses Pollutant Emission Factor (lb/hp-hr)

CH_4	N_2O	CO_2	CO_2e
0.000046297	0.000009259	1.15	1.33

5.4 Emergency Generator Formula(s)

- Emergency Generator Emissions per Year
AE_{POL}= (NGEN * HP * OT * EF_{POL}) / 2000

AE_{POL}: Activity Emissions (TONs per Year)
NGEN: Number of Emergency Generators
HP: Emergency Generator's Horsepower (hp)
OT: Average Operating Hours Per Year (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hp-hr)

6. Emergency Generator

6.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: ES DICE 5

- Activity Description:
ES DICE 5

- Activity Start Date
Start Month: 12
Start Year: 2026

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	0.044640
SO_x	0.037600
NO_x	0.184000
CO	0.122880

Pollutant	Emissions Per Year (TONs)
PM 10	0.040160
PM 2.5	0.040160
Pb	0.000000
NH_3	0.000000

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.000741
N_2O	0.000148

Pollutant	Emissions Per Year (TONs)
CO_2	18.400000
CO_2e	21.280000

6.2 Emergency Generator Assumptions

- Emergency Generator
Type of Fuel used in Emergency Generator: Diesel
Number of Emergency Generators: 1

- Default Settings Used: No

- Emergency Generators Consumption
Emergency Generator's Horsepower: 320
Average Operating Hours Per Year (hours): 100

6.3 Emergency Generator Emission Factor(s)

- Emergency Generators Criteria Pollutant Emission Factor (lb/hp-hr)

VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3
0.00279	0.00235	0.0115	0.00768	0.00251	0.00251		

- Emergency Generators Greenhouse Gasses Pollutant Emission Factor (lb/hp-hr)

CH_4	N_2O	CO_2	CO_2e
0.000046297	0.000009259	1.15	1.33

6.4 Emergency Generator Formula(s)

- Emergency Generator Emissions per Year

AE_{POL}= (NGEN * HP * OT * EF_{POL}) / 2000

AE_{POL}: Activity Emissions (TONs per Year)
NGEN: Number of Emergency Generators
HP: Emergency Generator's Horsepower (hp)
OT: Average Operating Hours Per Year (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hp-hr)

7. Emergency Generator

7.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Prime Engine

- Activity Description:
Prime Engine

- Activity Start Date
Start Month: 12
Start Year: 2026

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	1.009221
SO_x	0.850061
NO_x	4.159872
CO	2.778071

Pollutant	Emissions Per Year (TONs)
PM 10	0.907937
PM 2.5	0.907937
Pb	0.000000
NH_3	0.000000

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.016747
N_2O	0.003349

Pollutant	Emissions Per Year (TONs)
CO_2	415.987200
CO_2e	481.098240

7.2 Emergency Generator Assumptions

- Emergency Generator
Type of Fuel used in Emergency Generator: Diesel
Number of Emergency Generators: 4

- Default Settings Used: No

- Emergency Generators Consumption

Emergency Generator's Horsepower: 314
Average Operating Hours Per Year (hours): 576

7.3 Emergency Generator Emission Factor(s)

- Emergency Generators Criteria Pollutant Emission Factor (lb/hp-hr)

VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3
0.00279	0.00235	0.0115	0.00768	0.00251	0.00251		

- Emergency Generators Greenhouse Gasses Pollutant Emission Factor (lb/hp-hr)

CH_4	N_2O	CO_2	CO_2e
0.000046297	0.000009259	1.15	1.33

7.4 Emergency Generator Formula(s)

- Emergency Generator Emissions per Year

AE_{POL}= (NGEN * HP * OT * EF_{POL}) / 2000

AE_{POL}: Activity Emissions (TONs per Year)
NGEN: Number of Emergency Generators
HP: Emergency Generator's Horsepower (hp)
OT: Average Operating Hours Per Year (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hp-hr)

8. Personnel

8.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Worker Vehicles

- Activity Description:
Worker Vehicles

- Activity Start Date
Start Month: 12
Start Year: 2026

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	1.093346
SO_x	0.012177
NO_x	0.506601

Pollutant	Emissions Per Year (TONs)
PM 10	0.067591
PM 2.5	0.024055
Pb	0.000000

CO	6.464211		NH_3	0.144436

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)		Pollutant	Emissions Per Year (TONs)
CH_4	0.072854		CO_2	1232.565244
N_2O	0.046911		CO_2e	1248.365695

8.2 Personnel Assumptions

- Number of Personnel

Active Duty Personnel: 0
Civilian Personnel: 0
Support Contractor Personnel: 700
Air National Guard (ANG) Personnel: 0
Reserve Personnel: 0

- Default Settings Used: Yes

- Average Personnel Round Trip Commute (mile): 20 (default)

- Personnel Work Schedule

Active Duty Personnel: 5 Days Per Week (default)
Civilian Personnel: 5 Days Per Week (default)
Support Contractor Personnel: 5 Days Per Week (default)
Air National Guard (ANG) Personnel: 4 Days Per Week (default)
Reserve Personnel: 4 Days Per Month (default)

8.3 Personnel On Road Vehicle Mixture

- On Road Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	37.55	60.32	0	0.03	0.2	0	1.9
GOVs	54.49	37.73	4.67	0	0	3.11	0

8.4 Personnel Emission Factor(s)

- On Road Vehicle Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.14234	0.00266	0.07502	1.06799	0.01592	0.00555	0.03565
LDGT	0.18838	0.00330	0.13989	1.46024	0.01732	0.00618	0.03719
HDGV	0.24098	0.00505	0.22834	1.70597	0.02754	0.00971	0.03748
LDDV	0.02105	0.00209	0.18580	0.28873	0.02760	0.01668	0.00310
LDDT	0.01458	0.00278	0.06550	0.14150	0.02318	0.01184	0.00310
HDDV	0.09991	0.01077	2.12874	0.51062	0.11544	0.05583	0.18324
MC	5.54365	0.00204	0.71045	17.29267	0.01908	0.00809	0.00866

- On Road Vehicle Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01109	0.00883	269.03971	271.94837
LDGT	0.01534	0.01225	334.10216	338.13590
HDGV	0.01993	0.01699	510.51978	516.08005
LDDV	0.00098	0.03476	220.63766	231.02106
LDDT	0.00068	0.04624	293.49614	307.29273
HDDV	0.00464	0.17922	1137.52260	1191.04533

MC	0.24921	0.04641	206.70657	226.76743

8.5 Personnel Formula(s)

- Personnel Vehicle Miles Travel for Work Days per Year
$VMT_P = NP * WD * AC$

VMT_P: Personnel Vehicle Miles Travel (miles/year)
NP: Number of Personnel
WD: Work Days per Year
AC: Average Commute (miles)

- Total Vehicle Miles Travel per Year
$VMT_{Total} = VMT_{AD} + VMT_C + VMT_{SC} + VMT_{ANG} + VMT_{AFRC}$

VMT_{Total}: Total Vehicle Miles Travel (miles)
VMT_{AD}: Active Duty Personnel Vehicle Miles Travel (miles)
VMT_C: Civilian Personnel Vehicle Miles Travel (miles)
VMT_{SC}: Support Contractor Personnel Vehicle Miles Travel (miles)
VMT_{ANG}: Air National Guard Personnel Vehicle Miles Travel (miles)
VMT_{AFRC}: Reserve Personnel Vehicle Miles Travel (miles)

- Vehicle Emissions per Year
$V_{POL} = (VMT_{Total} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{Total}: Total Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Personnel On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

9. Personnel

9.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Fleet Vehicle Use

- Activity Description:
Fleet Vehicle Use

- Activity Start Date
Start Month: 12
Start Year: 2026

- Activity End Date
Indefinite: Yes

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End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	0.156192
SO_x	0.001740
NO_x	0.072372
CO	0.923459

Pollutant	Emissions Per Year (TONs)
PM 10	0.009656
PM 2.5	0.003436
Pb	0.000000
NH_3	0.020634

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.010408
N_2O	0.006702

Pollutant	Emissions Per Year (TONs)
CO_2	176.080749
CO_2e	178.337956

9.2 Personnel Assumptions

- Number of Personnel

Active Duty Personnel: 0
Civilian Personnel: 0
Support Contractor Personnel: 100
Air National Guard (ANG) Personnel: 0
Reserve Personnel: 0

- Default Settings Used: Yes

- Average Personnel Round Trip Commute (mile): 20 (default)

- Personnel Work Schedule

Active Duty Personnel: 5 Days Per Week (default)
Civilian Personnel: 5 Days Per Week (default)
Support Contractor Personnel: 5 Days Per Week (default)
Air National Guard (ANG) Personnel: 4 Days Per Week (default)
Reserve Personnel: 4 Days Per Month (default)

9.3 Personnel On Road Vehicle Mixture

- On Road Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	37.55	60.32	0	0.03	0.2	0	1.9
GOVs	54.49	37.73	4.67	0	0	3.11	0

9.4 Personnel Emission Factor(s)

- On Road Vehicle Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.14234	0.00266	0.07502	1.06799	0.01592	0.00555	0.03565
LDGT	0.18838	0.00330	0.13989	1.46024	0.01732	0.00618	0.03719
HDGV	0.24098	0.00505	0.22834	1.70597	0.02754	0.00971	0.03748
LDDV	0.02105	0.00209	0.18580	0.28873	0.02760	0.01668	0.00310
LDDT	0.01458	0.00278	0.06550	0.14150	0.02318	0.01184	0.00310
HDDV	0.09991	0.01077	2.12874	0.51062	0.11544	0.05583	0.18324
MC	5.54365	0.00204	0.71045	17.29267	0.01908	0.00809	0.00866

- On Road Vehicle Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01109	0.00883	269.03971	271.94837
LDGT	0.01534	0.01225	334.10216	338.13590
HDGV	0.01993	0.01699	510.51978	516.08005
LDDV	0.00098	0.03476	220.63766	231.02106
LDDT	0.00068	0.04624	293.49614	307.29273
HDDV	0.00464	0.17922	1137.52260	1191.04533
MC	0.24921	0.04641	206.70657	226.76743

9.5 Personnel Formula(s)

- Personnel Vehicle Miles Travel for Work Days per Year
$VMT_P = NP * WD * AC$

VMT_P: Personnel Vehicle Miles Travel (miles/year)
NP: Number of Personnel
WD: Work Days per Year
AC: Average Commute (miles)

- Total Vehicle Miles Travel per Year
$VMT_{Total} = VMT_{AD} + VMT_C + VMT_{SC} + VMT_{ANG} + VMT_{AFRC}$

VMT_{Total}: Total Vehicle Miles Travel (miles)
VMT_{AD}: Active Duty Personnel Vehicle Miles Travel (miles)
VMT_C: Civilian Personnel Vehicle Miles Travel (miles)
VMT_{SC}: Support Contractor Personnel Vehicle Miles Travel (miles)
VMT_{ANG}: Air National Guard Personnel Vehicle Miles Travel (miles)
VMT_{AFRC}: Reserve Personnel Vehicle Miles Travel (miles)

- Vehicle Emissions per Year
$V_{POL} = (VMT_{Total} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{Total}: Total Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Personnel On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

10. Personnel

10.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Vendor-Contractor Vehicles

- Activity Description:

Vendor-Contractor Vehicles

- Activity Start Date
Start Month: 12
Start Year: 2026

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	0.209298
SO_x	0.002331
NO_x	0.096978
CO	1.237435

Pollutant	Emissions Per Year (TONs)
PM 10	0.012939
PM 2.5	0.004605
Pb	0.000000
NH_3	0.027649

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)
CH_4	0.013946
N_2O	0.008980

Pollutant	Emissions Per Year (TONs)
CO_2	235.948204
CO_2e	238.972862

10.2 Personnel Assumptions

- Number of Personnel
Active Duty Personnel: 0
Civilian Personnel: 0
Support Contractor Personnel: 134
Air National Guard (ANG) Personnel: 0
Reserve Personnel: 0

- Default Settings Used: Yes

- Average Personnel Round Trip Commute (mile): 20 (default)

- Personnel Work Schedule
Active Duty Personnel: 5 Days Per Week (default)
Civilian Personnel: 5 Days Per Week (default)
Support Contractor Personnel: 5 Days Per Week (default)
Air National Guard (ANG) Personnel: 4 Days Per Week (default)
Reserve Personnel: 4 Days Per Month (default)

10.3 Personnel On Road Vehicle Mixture

- On Road Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	37.55	60.32	0	0.03	0.2	0	1.9
GOVs	54.49	37.73	4.67	0	0	3.11	0

10.4 Personnel Emission Factor(s)

- On Road Vehicle Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.14234	0.00266	0.07502	1.06799	0.01592	0.00555	0.03565

LDGT	0.18838	0.00330	0.13989	1.46024	0.01732	0.00618	0.03719
HDGV	0.24098	0.00505	0.22834	1.70597	0.02754	0.00971	0.03748
LDDV	0.02105	0.00209	0.18580	0.28873	0.02760	0.01668	0.00310
LDDT	0.01458	0.00278	0.06550	0.14150	0.02318	0.01184	0.00310
HDDV	0.09991	0.01077	2.12874	0.51062	0.11544	0.05583	0.18324
MC	5.54365	0.00204	0.71045	17.29267	0.01908	0.00809	0.00866

- On Road Vehicle Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01109	0.00883	269.03971	271.94837
LDGT	0.01534	0.01225	334.10216	338.13590
HDGV	0.01993	0.01699	510.51978	516.08005
LDDV	0.00098	0.03476	220.63766	231.02106
LDDT	0.00068	0.04624	293.49614	307.29273
HDDV	0.00464	0.17922	1137.52260	1191.04533
MC	0.24921	0.04641	206.70657	226.76743

10.5 Personnel Formula(s)

- Personnel Vehicle Miles Travel for Work Days per Year

$VMT_P = NP * WD * AC$

VMT_P: Personnel Vehicle Miles Travel (miles/year)
NP: Number of Personnel
WD: Work Days per Year
AC: Average Commute (miles)

- Total Vehicle Miles Travel per Year

$VMT_{Total} = VMT_{AD} + VMT_C + VMT_{SC} + VMT_{ANG} + VMT_{AFRC}$

VMT_{Total}: Total Vehicle Miles Travel (miles)
VMT_{AD}: Active Duty Personnel Vehicle Miles Travel (miles)
VMT_C: Civilian Personnel Vehicle Miles Travel (miles)
VMT_{SC}: Support Contractor Personnel Vehicle Miles Travel (miles)
VMT_{ANG}: Air National Guard Personnel Vehicle Miles Travel (miles)
VMT_{AFRC}: Reserve Personnel Vehicle Miles Travel (miles)

- Vehicle Emissions per Year

$V_{POL} = (VMT_{Total} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{Total}: Total Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Personnel On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

11. Construction / Demolition

11.1 General Information & Timeline Assumptions

- Activity Location

County: Santa Barbara

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Operational Equipment Use

- Activity Description:
Operational Equipment Use

- Activity Start Date
Start Month: 12
Start Month: 2026

- Activity End Date
Indefinite: False
End Month: 11
End Month: 2056

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	2.096774
SO_x	0.061154
NO_x	17.917458
CO	25.257392

Pollutant	Total Emissions (TONs)
PM 10	0.527869
PM 2.5	0.485617
Pb	0.000000
NH_3	0.000000

- Activity Emissions of GHG:

Pollutant	Total Emissions (TONs)
CH_4	0.268458
N_2O	0.053666

Pollutant	Total Emissions (TONs)
CO_2	6617.464867
CO_2e	6640.174335

- Global Scale Activity Emissions for SCGHG:

Pollutant	Total Emissions (TONs)
CH_4	0.268458
N_2O	0.053666

Pollutant	Total Emissions (TONs)
CO_2	6617.464867
CO_2e	6640.174335

11.1 Site Grading Phase

11.1.1 Site Grading Phase Timeline Assumptions

- Phase Start Date
Start Month: 12
Start Quarter: 1
Start Year: 2026

- Phase Duration
Number of Month: 360
Number of Days: 0

11.1.2 Site Grading Phase Assumptions

- General Site Grading Information
Area of Site to be Graded (ft^2): 0
Amount of Material to be Hauled On-Site (yd^3): 0
Amount of Material to be Hauled Off-Site (yd^3): 0

- Site Grading Default Settings
Default Settings Used: No

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

Average Day(s) worked per week: 5

- Construction Exhaust

Equipment Name	Number Of Equipment	Hours Per Day
Aerial Lifts Composite	8	1
Forklifts Composite	10	1
Off-Highway Trucks Composite	6	1
Rough Terrain Forklifts Composite	8	1

- Vehicle Exhaust

Average Hauling Truck Capacity (yd^3): 20

Average Hauling Truck Round Trip Commute (mile): 0

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips

Average Worker Round Trip Commute (mile): 0

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

11.1.3 Site Grading Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour)

Aerial Lifts Composite [HP: 46] [LF: 0.31]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.15248	0.00542	2.87377	3.07542	0.02070	0.01905
Forklifts Composite [HP: 82] [LF: 0.2]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.24594	0.00487	2.34179	3.57902	0.11182	0.10287
Off-Highway Trucks Composite [HP: 376] [LF: 0.38]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.17585	0.00489	1.01131	1.17821	0.03561	0.03276
Rough Terrain Forklifts Composite [HP: 96] [LF: 0.4]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.11505	0.00489	1.64283	3.22011	0.03306	0.03041

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour)

Aerial Lifts Composite [HP: 46] [LF: 0.31]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02381	0.00476	586.90035	588.91444
Forklifts Composite [HP: 82] [LF: 0.2]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02138	0.00428	527.09717	528.90603
Off-Highway Trucks Composite [HP: 376] [LF: 0.38]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02147	0.00429	529.16792	530.98389
Rough Terrain Forklifts Composite [HP: 96] [LF: 0.4]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02145	0.00429	528.88931	530.70433

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.14234	0.00266	0.07502	1.06799	0.01592	0.00555	0.03565
LDGT	0.18838	0.00330	0.13989	1.46024	0.01732	0.00618	0.03719
HDGV	0.24098	0.00505	0.22834	1.70597	0.02754	0.00971	0.03748
LDDV	0.02105	0.00209	0.18580	0.28873	0.02760	0.01668	0.00310
LDDT	0.01458	0.00278	0.06550	0.14150	0.02318	0.01184	0.00310
HDDV	0.09991	0.01077	2.12874	0.51062	0.11544	0.05583	0.18324
MC	5.54365	0.00204	0.71045	17.29267	0.01908	0.00809	0.00866

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01109	0.00883	269.03971	271.94837
LDGT	0.01534	0.01225	334.10216	338.13590
HDGV	0.01993	0.01699	510.51978	516.08005
LDDV	0.00098	0.03476	220.63766	231.02106
LDDT	0.00068	0.04624	293.49614	307.29273
HDDV	0.00464	0.17922	1137.52260	1191.04533
MC	0.24921	0.04641	206.70657	226.76743

11.1.4 Site Grading Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (20 * ACRE * WD) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
20: Conversion Factor Acre Day to pounds (20 lb / 1 Acre Day)
ACRE: Total acres (acres)
WD: Number of Total Work Days (days)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = (HA_{OnSite} + HA_{OffSite}) * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
HA_{OnSite}: Amount of Material to be Hauled On-Site (yd^3)
$HA_{OffSite}$: Amount of Material to be Hauled Off-Site (yd^3)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

12. Emergency Generator

12.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: SLC 6 Emergency Generator

- Activity Description:
SLC 6 Emergency Generator

- Activity Start Date
Start Month: 12
Start Year: 2026

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions of Criteria Pollutants:

Pollutant	Emissions Per Year (TONs)
VOC	0.046540

Pollutant	Emissions Per Year (TONs)
PM 10	0.052585

SO_x	0.000813		PM 2.5	0.052585
NO_x	1.683500		Pb	0.000000
CO	0.447200		NH_3	0.000000

- Global Scale Activity Emissions of Greenhouse Gasses:

Pollutant	Emissions Per Year (TONs)		Pollutant	Emissions Per Year (TONs)
CH_4	0.003009		CO_2	74.750000
N_2O	0.000602		CO_2e	86.450000

12.2 Emergency Generator Assumptions

- Emergency Generator
Type of Fuel used in Emergency Generator: Diesel
Number of Emergency Generators: 1

- Default Settings Used: No

- Emergency Generators Consumption
Emergency Generator's Horsepower: 1300
Average Operating Hours Per Year (hours): 100

12.3 Emergency Generator Emission Factor(s)

- Emergency Generators Criteria Pollutant Emission Factor (lb/hp-hr)

VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3
0.000716	0.0000125	0.0259	0.00688	0.000809	0.000809		

- Emergency Generators Greenhouse Gasses Pollutant Emission Factor (lb/hp-hr)

CH_4	N_2O	CO_2	CO_2e
0.000046297	0.000009259	1.15	1.33

12.4 Emergency Generator Formula(s)

- Emergency Generator Emissions per Year
AE_{POL}= (NGEN * HP * OT * EF_{POL}) / 2000

AE_{POL}: Activity Emissions (TONs per Year)
NGEN: Number of Emergency Generators
HP: Emergency Generator's Horsepower (hp)
OT: Average Operating Hours Per Year (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hp-hr)

13. Construction / Demolition

13.1 General Information & Timeline Assumptions

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: SLC-6 MAS Demo

- Activity Description:

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

SLC-6 MAS Demo

- Activity Start Date
Start Month: 11
Start Month: 2025

- Activity End Date
Indefinite: False
End Month: 4
End Month: 2026

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.037246
SO_x	0.001060
NO_x	0.375038
CO	0.408439

Pollutant	Total Emissions (TONs)
PM 10	0.865724
PM 2.5	0.011790
Pb	0.000000
NH_3	0.007974

- Activity Emissions of GHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002653
N_2O	0.008039

Pollutant	Total Emissions (TONs)
CO_2	106.983024
CO_2e	109.444875

- Global Scale Activity Emissions for SCGHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002653
N_2O	0.008039

Pollutant	Total Emissions (TONs)
CO_2	106.983024
CO_2e	109.444875

13.1 Demolition Phase

13.1.1 Demolition Phase Timeline Assumptions

- Phase Start Date
Start Month: 11
Start Quarter: 1
Start Year: 2025

- Phase Duration
Number of Month: 6
Number of Days: 0

13.1.2 Demolition Phase Assumptions

- General Demolition Information
Area of Building to be demolished (ft^2): 15000
Height of Building to be demolished (ft): 270

- Default Settings Used: Yes

- Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Concrete/Industrial Saws Composite	1	8

Rubber Tired Dozers Composite	1	1
Tractors/Loaders/Backhoes Composite	2	6

- Vehicle Exhaust
Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

POVs	50.00	50.00	0	0	0	0	0

13.1.3 Demolition Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.43930	0.00743	3.63468	4.34820	0.10060	0.09255
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.37086	0.00491	3.50629	2.90209	0.15396	0.14165
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.19600	0.00489	2.00960	3.48168	0.07738	0.07119

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02333	0.00467	575.01338	576.98668
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02159	0.00432	532.17175	533.99803
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02149	0.00430	529.86270	531.68105

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	**N_2O**	**CO_2**	**CO_2e**

LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

13.1.4 Demolition Phase Formula(s)

- Fugitive Dust Emissions per Phase
$PM10_{FD} = (0.00042 * BA * BH) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
0.00042: Emission Factor (lb/ft^3)
BA: Area of Building to be demolished (ft^2)
BH: Height of Building to be demolished (ft)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase
$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase
$VMT_{VE} = BA * BH * (1 / 27) * 0.25 * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building being demolish (ft^2)
BH: Height of Building being demolish (ft)
(1 / 27): Conversion Factor cubic feet to cubic yards (1 yd^3 / 27 ft^3)
0.25: Volume reduction factor (material reduced by 75% to account for air space)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

14. Construction / Demolition

14.1 General Information & Timeline Assumptions

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: SLC-6 FUT Demo

- Activity Description:
SLC-6 FUT Demo

- Activity Start Date
Start Month: 11
Start Month: 2025

- Activity End Date
Indefinite: False
End Month: 4
End Month: 2026

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.033815
SO_x	0.000707
NO_x	0.302386
CO	0.391393

Pollutant	Total Emissions (TONs)
PM 10	0.188477
PM 2.5	0.009921
Pb	0.000000
NH_3	0.002066

- Activity Emissions of GHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002493
N_2O	0.002156

Pollutant	Total Emissions (TONs)
CO_2	69.645164
CO_2e	70.350016

- Global Scale Activity Emissions for SCGHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002493

Pollutant	Total Emissions (TONs)
CO_2	69.645164

N_2O	0.002156		CO_2e	70.350016

14.1 Demolition Phase

14.1.1 Demolition Phase Timeline Assumptions

- Phase Start Date
Start Month: 11
Start Quarter: 1
Start Year: 2025

- Phase Duration
Number of Month: 6
Number of Days: 0

14.1.2 Demolition Phase Assumptions

- General Demolition Information
Area of Building to be demolished (ft^2): 4216
Height of Building to be demolished (ft): 200

- Default Settings Used: Yes

- Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Concrete/Industrial Saws Composite	1	8
Rubber Tired Dozers Composite	1	1
Tractors/Loaders/Backhoes Composite	2	6

- Vehicle Exhaust
Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

14.1.3 Demolition Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.43930	0.00743	3.63468	4.34820	0.10060	0.09255
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]						

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.37086	0.00491	3.50629	2.90209	0.15396	0.14165
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.19600	0.00489	2.00960	3.48168	0.07738	0.07119

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02333	0.00467	575.01338	576.98668
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02159	0.00432	532.17175	533.99803
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02149	0.00430	529.86270	531.68105

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

14.1.4 Demolition Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (0.00042 * BA * BH) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
0.00042: Emission Factor (lb/ft^3)
BA: Area of Building to be demolished (ft^2)
BH: Height of Building to be demolished (ft)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)

H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase
$VMT_{VE} = BA * BH * (1 / 27) * 0.25 * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building being demolish (ft^2)
BH: Height of Building being demolish (ft)
(1 / 27): Conversion Factor cubic feet to cubic yards (1 yd^3 / 27 ft^3)
0.25: Volume reduction factor (material reduced by 75% to account for air space)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

15. Construction / Demolition

15.1 General Information & Timeline Assumptions

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

- Activity Title: SLC-6 Crown Demo

- Activity Description:
SLC-6 Crown Demo

- Activity Start Date
Start Month: 11
Start Month: 2025

- Activity End Date
Indefinite: False
End Month: 4
End Month: 2026

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.033393
SO_x	0.000663
NO_x	0.293450
CO	0.389296

Pollutant	Total Emissions (TONs)
PM 10	0.105184
PM 2.5	0.009692
Pb	0.000000
NH_3	0.001339

- Activity Emissions of GHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002474
N_2O	0.001433

Pollutant	Total Emissions (TONs)
CO_2	65.053031
CO_2e	65.541793

- Global Scale Activity Emissions for SCGHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002474
N_2O	0.001433

Pollutant	Total Emissions (TONs)
CO_2	65.053031
CO_2e	65.541793

15.1 Demolition Phase

15.1.1 Demolition Phase Timeline Assumptions

- Phase Start Date
Start Month: 11
Start Quarter: 1
Start Year: 2025

- Phase Duration
Number of Month: 6
Number of Days: 0

15.1.2 Demolition Phase Assumptions

- General Demolition Information
Area of Building to be demolished (ft^2): 10200
Height of Building to be demolished (ft): 44

- Default Settings Used: Yes

- Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Concrete/Industrial Saws Composite	1	8
Rubber Tired Dozers Composite	1	1
Tractors/Loaders/Backhoes Composite	2	6

- Vehicle Exhaust

Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips

Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

15.1.3 Demolition Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.43930	0.00743	3.63468	4.34820	0.10060	0.09255
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.37086	0.00491	3.50629	2.90209	0.15396	0.14165
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.19600	0.00489	2.00960	3.48168	0.07738	0.07119

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02333	0.00467	575.01338	576.98668
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02159	0.00432	532.17175	533.99803
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	N_2O	CO_2	CO_2e
Emission Factors	0.02149	0.00430	529.86270	531.68105

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

15.1.4 Demolition Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (0.00042 * BA * BH) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
0.00042: Emission Factor (lb/ft^3)
BA: Area of Building to be demolished (ft^2)
BH: Height of Building to be demolished (ft)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = BA * BH * (1 / 27) * 0.25 * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building being demolish (ft^2)
BH: Height of Building being demolish (ft)
(1 / 27): Conversion Factor cubic feet to cubic yards ($1\ yd^3 / 27\ ft^3$)
0.25: Volume reduction factor (material reduced by 75% to account for air space)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
VMT_{WT} = WD * WT * 1.25 * NE

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

16. Construction / Demolition

16.1 General Information & Timeline Assumptions

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: SLC-6 MST Demo

- Activity Description:
SLC-6 MST Demo

- Activity Start Date
Start Month: 11
Start Month: 2025

- Activity End Date
Indefinite: False
End Month: 4
End Month: 2026

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.040446
SO_x	0.001390
NO_x	0.442779
CO	0.424332

Pollutant	Total Emissions (TONs)
PM 10	1.497185
PM 2.5	0.013532
Pb	0.000000
NH_3	0.013483

- Activity Emissions of GHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002801
N_2O	0.013524

Pollutant	Total Emissions (TONs)
CO_2	141.796609
CO_2e	145.896674

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

- Global Scale Activity Emissions for SCGHG:

Pollutant	Total Emissions (TONs)
CH_4	0.002801
N_2O	0.013524

Pollutant	Total Emissions (TONs)
CO_2	141.796609
CO_2e	145.896674

16.1 Demolition Phase

16.1.1 Demolition Phase Timeline Assumptions

- Phase Start Date
Start Month: 11
Start Quarter: 1
Start Year: 2025

- Phase Duration
Number of Month: 6
Number of Days: 0

16.1.2 Demolition Phase Assumptions

- General Demolition Information
Area of Building to be demolished (ft^2): 25600
Height of Building to be demolished (ft): 275

- Default Settings Used: Yes

- Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Concrete/Industrial Saws Composite	1	8
Rubber Tired Dozers Composite	1	1
Tractors/Loaders/Backhoes Composite	2	6

- Vehicle Exhaust
Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

16.1.3 Demolition Phase Emission Factor(s)

- Construction Exhaust Criteria Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5
Emission Factors	0.43930	0.00743	3.63468	4.34820	0.10060	0.09255
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.37086	0.00491	3.50629	2.90209	0.15396	0.14165
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]						
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**
Emission Factors	0.19600	0.00489	2.00960	3.48168	0.07738	0.07119

- Construction Exhaust Greenhouse Gasses Pollutant Emission Factors (g/hp-hour) (default)

Concrete/Industrial Saws Composite [HP: 33] [LF: 0.73]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02333	0.00467	575.01338	576.98668
Rubber Tired Dozers Composite [HP: 367] [LF: 0.4]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02159	0.00432	532.17175	533.99803
Tractors/Loaders/Backhoes Composite [HP: 84] [LF: 0.37]				
	CH_4	**N_2O**	**CO_2**	**CO_2e**
Emission Factors	0.02149	0.00430	529.86270	531.68105

- Vehicle Exhaust & Worker Trips Criteria Pollutant Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	NH_3
LDGV	0.15014	0.00272	0.08183	1.15414	0.01648	0.00579	0.03482
LDGT	0.19850	0.00338	0.15423	1.58574	0.01798	0.00647	0.03664
HDGV	0.25262	0.00518	0.25160	1.83327	0.02830	0.01002	0.03696
LDDV	0.02453	0.00212	0.21377	0.31526	0.03028	0.01896	0.00310
LDDT	0.01608	0.00283	0.07126	0.15320	0.02417	0.01248	0.00310
HDDV	0.10482	0.01080	2.21934	0.52071	0.11665	0.05708	0.18048
MC	5.55535	0.00206	0.72741	17.74481	0.01913	0.00815	0.00862

- Vehicle Exhaust & Worker Trips Greenhouse Gasses Emission Factors (grams/mile)

	CH_4	N_2O	CO_2	CO_2e
LDGV	0.01196	0.00928	275.34289	278.40759
LDGT	0.01652	0.01302	342.02606	346.32025
HDGV	0.02149	0.01816	523.58650	529.53564
LDDV	0.00114	0.03522	223.57891	234.10442
LDDT	0.00075	0.04708	298.82532	312.87385
HDDV	0.00487	0.17970	1140.57202	1194.24362
MC	0.25786	0.04719	207.94492	228.45331

16.1.4 Demolition Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (0.00042 * BA * BH) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
0.00042: Emission Factor (lb/ft^3)
BA: Area of Building to be demolished (ft^2)
BH: Height of Building to be demolished (ft)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * HP * LF * EF_{POL} * 0.002205) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
HP: Equipment Horsepower
LF: Equipment Load Factor
EF_{POL}: Emission Factor for Pollutant (g/hp-hour)
0.002205: Conversion Factor grams to pounds
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase
$VMT_{VE} = BA * BH * (1 / 27) * 0.25 * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building being demolish (ft^2)
BH: Height of Building being demolish (ft)
(1 / 27): Conversion Factor cubic feet to cubic yards (1 yd^3 / 27 ft^3)
0.25: Volume reduction factor (material reduced by 75% to account for air space)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

AIR CONFORMITY APPLICABILITY MODEL REPORT
RECORD OF AIR ANALYSIS (ROAA)

1. General Information: The Air Force's Air Conformity Applicability Model (ACAM) was used to perform a net change in emissions analysis to assess the potential air quality impact/s associated with the action. The analysis was performed in accordance with the Air Force Manual 32-7002, *Environmental Compliance and Pollution Prevention*; the *Environmental Impact Analysis Process* (EIAP, 32 CFR 989); the *General Conformity Rule* (GCR, 40 CFR 93 Subpart B); and the *USAF Air Quality Environmental Impact Analysis Process (EIAP) Guide*. This report provides a summary of the ACAM analysis.

Report generated with ACAM version: 5.0.23a

a. Action Location:
Base: VANDENBERG AFB
State: California
County(s): Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

b. Action Title: Falcon Program at Vandenberg Space Force Base Alternative 1

c. Project Number/s (if applicable):

d. Projected Action Start Date: 11 / 2025

e. Action Description:

The Proposed Action is to increase the annual Falcon launch cadence at VSFB through launches at SLC-4 and SLC-6 and the modification of SLC 6 for Falcon launch vehicles to support future commercial and U.S. government launch service needs. SpaceX would launch Falcon 9 from SLC-4 and SLC-6, and Falcon Heavy from SLC-6. Falcon 9 is approximately 229 feet tall and produces approximately 1.7 million pounds of thrust at liftoff. A discussion of Falcon 9 can be found in the 2016 EA and associated supplemental environmental documents. Falcon Heavy is a heavy-lift vehicle that produces 5.12 million pounds of thrust at liftoff and has the ability to lift 141,000 pounds into low Earth orbit. Merlin engines are used on both stages of Falcon Heavy. The center core and two side boosters are essentially the same design as a Falcon 9 first stage booster, thus Falcon Heavy uses the same type of propellants as Falcon 9. Additionally, Falcon Heavy uses the same second stage as Falcon 9.

Under Alternative 1, SpaceX would implement the Proposed Action and construct an approximately 61,250 square-foot hangar north of the launch pad line to support Falcon 9 and Falcon Heavy integration and processing. Areas around the hangar would be graded to provide rear access to the hangar. As part of Alternative 1, SpaceX would demolish the Mobile Service Tower, Mobile Assembly Shelter, Fixed Umbilical Tower, and the launch crown at SLC-6. SpaceX would construct rails from the hangar to the launch pad to transport Falcon. The SLC 6 fence would be relocated and vehicular access from Luner Road to N Road would be removed.

f. Point of Contact:
Name: Adam Poll
Title: Civilian
Organization: Dudek
Email: apoll@dudek.com
Phone Number: 805-308-8516

2. Air Impact Analysis: Based on the attainment status at the action location, the requirements of the GCR are:

_____ applicable

AIR CONFORMITY APPLICABILITY MODEL REPORT
RECORD OF AIR ANALYSIS (ROAA)

__X__ not applicable

Total reasonably foreseeable net direct and indirect emissions associated with the action were estimated through ACAM on a calendar-year basis for the start of the action through achieving “steady state” (hsba.e., no net gain/loss in emission stabilized and the action is fully implemented) emissions. The ACAM analysis uses the latest and most accurate emission estimation techniques available; all algorithms, emission factors, and methodologies used are described in detail in the *USAF Air Emissions Guide for Air Force Stationary Sources*, the *USAF Air Emissions Guide for Air Force Mobile Sources*, and the *USAF Air Emissions Guide for Air Force Transitory Sources*.

"Insignificance Indicators" were used in the analysis to provide an indication of the significance of the proposed Action’s potential impacts to local air quality. The insignificance indicators are trivial (de minimis) rate thresholds that have been demonstrated to have little to no impact to air quality. These insignificance indicators are the 250 ton/yr Prevention of Significant Deterioration (PSD) major source threshold and 25 ton/yr for lead for actions occurring in areas that are "Attainment" (hsba.e., not exceeding any National Ambient Air Quality Standard (NAAQS)). These indicators do not define a significant impact; however, they do provide a threshold to identify actions that are insignificant. Any action with net emissions below the insignificance indicators for all criteria pollutants is considered so insignificant that the action will not cause or contribute to an exceedance on one or more NAAQS. For further detail on insignificance indicators, refer to *Level II, Air Quality Quantitative Assessment, Insignificance Indicators*.

The action’s net emissions for every year through achieving steady state were compared against the Insignificance Indicators and are summarized below.

Analysis Summary:

2025

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.110	250	No
NOx	1.171	250	No
CO	1.087	250	No
SOx	0.004	250	No
PM 10	4.185	250	No
PM 2.5	0.038	250	No
Pb	0.000	25	No
NH3	0.032	250	No

2026

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	2.682	250	No
NOx	4.482	250	No
CO	3.856	250	No
SOx	0.091	250	No
PM 10	1.994	250	No
PM 2.5	0.209	250	No
Pb	0.000	25	No
NH3	0.141	250	No

2027

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)

AIR CONFORMITY APPLICABILITY MODEL REPORT
RECORD OF AIR ANALYSIS (ROAA)

NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2028

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2029

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2030

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2031

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			

VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2032

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2033

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2034

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2035

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No

NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2036

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2037

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2038

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2039

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No

CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2040

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2041

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2042

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2043

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No

SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2044

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2045

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2046

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2047

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No

PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2048

Pollutant	**Action Emissions (ton/yr)**	**INSIGNIFICANCE INDICATOR**	
		Indicator (ton/yr)	**Exceedance (Yes or No)**
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2049

Pollutant	**Action Emissions (ton/yr)**	**INSIGNIFICANCE INDICATOR**	
		Indicator (ton/yr)	**Exceedance (Yes or No)**
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2050

Pollutant	**Action Emissions (ton/yr)**	**INSIGNIFICANCE INDICATOR**	
		Indicator (ton/yr)	**Exceedance (Yes or No)**
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2051

Pollutant	**Action Emissions (ton/yr)**	**INSIGNIFICANCE INDICATOR**	
		Indicator (ton/yr)	**Exceedance (Yes or No)**
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No

PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2052

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2053

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2054

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2055

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No

Pb	0.000	25	No
NH3	0.193	250	No

2056

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.797	250	No
NOx	14.523	250	No
CO	14.762	250	No
SOx	0.953	250	No
PM 10	1.374	250	No
PM 2.5	1.314	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2057 - (Steady State)

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.732	250	No
NOx	13.976	250	No
CO	13.990	250	No
SOx	0.951	250	No
PM 10	1.358	250	No
PM 2.5	1.299	250	No
Pb	0.000	25	No
NH3	0.193	250	No

None of the estimated annual net emissions associated with this action are above the insignificance indicators; therefore, the action will not cause or contribute to an exceedance of one or more NAAQSs and will have an insignificant impact on air quality. No further air assessment is needed.

Adam Poll, Civilian — Feb 07 2025

Name, Title — **Date**

AIR CONFORMITY APPLICABILITY MODEL REPORT
RECORD OF AIR ANALYSIS (ROAA)

1. General Information: The Air Force's Air Conformity Applicability Model (ACAM) was used to perform a net change in emissions analysis to assess the potential air quality impact/s associated with the action. The analysis was performed in accordance with the Air Force Manual 32-7002, *Environmental Compliance and Pollution Prevention*; the *Environmental Impact Analysis Process* (EIAP, 32 CFR 989); the *General Conformity Rule* (GCR, 40 CFR 93 Subpart B); and the *USAF Air Quality Environmental Impact Analysis Process (EIAP) Guide*. This report provides a summary of the ACAM analysis.

Report generated with ACAM version: 5.0.23a

a. Action Location:
Base: VANDENBERG AFB
State: California
County(s): Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

b. Action Title: Falcon Program at Vandenberg Space Force Base Proposed Action

c. Project Number/s (if applicable):

d. Projected Action Start Date: 11 / 2025

e. Action Description:

The Proposed Action is to increase the annual Falcon launch cadence at VSFB through launches at SLC-4 and SLC-6 and the modification of SLC 6 for Falcon launch vehicles to support future commercial and U.S. government launch service needs. SpaceX would launch Falcon 9 from SLC-4 and SLC-6, and Falcon Heavy from SLC-6. Falcon 9 is approximately 229 feet tall and produces approximately 1.7 million pounds of thrust at liftoff. A discussion of Falcon 9 can be found in the 2016 EA and associated supplemental environmental documents. Falcon Heavy is a heavy-lift vehicle that produces 5.12 million pounds of thrust at liftoff and has the ability to lift 141,000 pounds into low Earth orbit. Merlin engines are used on both stages of Falcon Heavy. The center core and two side boosters are essentially the same design as a Falcon 9 first stage booster, thus Falcon Heavy uses the same type of propellants as Falcon 9. Additionally, Falcon Heavy uses the same second stage as Falcon 9.

Under the Proposed Action, SpaceX would implement the Proposed Action and would modify the horizontal integration facility (HIF) located north of SLC 6 to support Falcon 9 and Falcon Heavy operations. As part of this Proposed Action, SpaceX would demolish the Mobile Service Tower, Mobile Assembly Shelter, Fixed Umbilical Tower, and the launch crown at SLC-6. Modifications would include interior work, construction of an approximately 5,000 square foot annex on the south side of the building, and construction of an approximately 42,000 square foot paved area north of the building to provide rear access into the hangar. SpaceX would construct rails from the hangar to the launch pad to transport Falcon.

f. Point of Contact:
Name: Adam Poll
Title: Civilian
Organization: Dudek
Email: apoll@dudek.com
Phone Number: 805-308-8516

2. Air Impact Analysis: Based on the attainment status at the action location, the requirements of the GCR are:

_____ applicable

AIR CONFORMITY APPLICABILITY MODEL REPORT
RECORD OF AIR ANALYSIS (ROAA)

__X__ not applicable

Total reasonably foreseeable net direct and indirect emissions associated with the action were estimated through ACAM on a calendar-year basis for the start of the action through achieving “steady state” (hsba.e., no net gain/loss in emission stabilized and the action is fully implemented) emissions. The ACAM analysis uses the latest and most accurate emission estimation techniques available; all algorithms, emission factors, and methodologies used are described in detail in the *USAF Air Emissions Guide for Air Force Stationary Sources*, the *USAF Air Emissions Guide for Air Force Mobile Sources*, and the *USAF Air Emissions Guide for Air Force Transitory Sources*.

"Insignificance Indicators" were used in the analysis to provide an indication of the significance of the proposed Action’s potential impacts to local air quality. The insignificance indicators are trivial (de minimis) rate thresholds that have been demonstrated to have little to no impact to air quality. These insignificance indicators are the 250 ton/yr Prevention of Significant Deterioration (PSD) major source threshold and 25 ton/yr for lead for actions occurring in areas that are "Attainment" (hsba.e., not exceeding any National Ambient Air Quality Standard (NAAQS)). These indicators do not define a significant impact; however, they do provide a threshold to identify actions that are insignificant. Any action with net emissions below the insignificance indicators for all criteria pollutants is considered so insignificant that the action will not cause or contribute to an exceedance on one or more NAAQS. For further detail on insignificance indicators, refer to *Level II, Air Quality Quantitative Assessment, Insignificance Indicators*.

The action’s net emissions for every year through achieving steady state were compared against the Insignificance Indicators and are summarized below.

Analysis Summary:

2025

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.104	250	No
NOx	1.067	250	No
CO	1.029	250	No
SOx	0.003	250	No
PM 10	4.020	250	No
PM 2.5	0.035	250	No
Pb	0.000	25	No
NH3	0.026	250	No

2026

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	2.666	250	No
NOx	4.123	250	No
CO	3.772	250	No
SOx	0.089	250	No
PM 10	1.975	250	No
PM 2.5	0.200	250	No
Pb	0.000	25	No
NH3	0.112	250	No

2027

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)

NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2028

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2029

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2030

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2031

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			

VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2032

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2033

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2034

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2035

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No

NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2036

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2037

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2038

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2039

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No

CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2040

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2041

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2042

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2043

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No

SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2044

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2045

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2046

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2047

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No

PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2048

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2049

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2050

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2051

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No

PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2052

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2053

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2054

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2055

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.802	250	No
NOx	14.573	250	No
CO	14.832	250	No
SOx	0.953	250	No
PM 10	1.375	250	No
PM 2.5	1.316	250	No

Pb	0.000	25	No
NH3	0.193	250	No

2056

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.797	250	No
NOx	14.523	250	No
CO	14.762	250	No
SOx	0.953	250	No
PM 10	1.374	250	No
PM 2.5	1.314	250	No
Pb	0.000	25	No
NH3	0.193	250	No

2057 - (Steady State)

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	8.732	250	No
NOx	13.976	250	No
CO	13.990	250	No
SOx	0.951	250	No
PM 10	1.358	250	No
PM 2.5	1.299	250	No
Pb	0.000	25	No
NH3	0.193	250	No

None of the estimated annual net emissions associated with this action are above the insignificance indicators; therefore, the action will not cause or contribute to an exceedance of one or more NAAQSs and will have an insignificant impact on air quality. No further air assessment is needed.

Adam Poll, Civilian Feb 07 2025

Name, Title **Date**

AIR CONFORMITY APPLICABILITY MODEL REPORT
GREENHOUSE GAS (GHG) EMISSIONS

1. General Information: The Air Force's Air Conformity Applicability Model (ACAM) was used to perform an analysis to estimate GHG emissions and assess the theoretical Social Cost of Greenhouse Gases (SC GHG) associated with the action. The analysis was performed in accordance with the Air Force Manual 32-7002, Environmental Compliance and Pollution Prevention; the Environmental Impact Analysis Process (EIAP, 32 CFR 989); and the USAF Air Quality Environmental Impact Analysis Process (EIAP) Guide. This report provides a summary of GHG emissions and SC GHG analysis.

Report generated with ACAM version: 5.0.23a

a. Action Location:
- **Base:** VANDENBERG AFB
- **State:** California
- **County(s):** Santa Barbara
- **Regulatory Area(s):** NOT IN A REGULATORY AREA

b. Action Title: Falcon Program at Vandenberg Space Force Base Alternative 1

c. Project Number/s (if applicable):

d. Projected Action Start Date: 11 / 2025

e. Action Description:

The Proposed Action is to increase the annual Falcon launch cadence at VSFB through launches at SLC-4 and SLC-6 and the modification of SLC 6 for Falcon launch vehicles to support future commercial and U.S. government launch service needs. SpaceX would launch Falcon 9 from SLC-4 and SLC-6, and Falcon Heavy from SLC-6. Falcon 9 is approximately 229 feet tall and produces approximately 1.7 million pounds of thrust at liftoff. A discussion of Falcon 9 can be found in the 2016 EA and associated supplemental environmental documents. Falcon Heavy is a heavy-lift vehicle that produces 5.12 million pounds of thrust at liftoff and has the ability to lift 141,000 pounds into low Earth orbit. Merlin engines are used on both stages of Falcon Heavy. The center core and two side boosters are essentially the same design as a Falcon 9 first stage booster, thus Falcon Heavy uses the same type of propellants as Falcon 9. Additionally, Falcon Heavy uses the same second stage as Falcon 9.

Under Alternative 1, SpaceX would implement the Proposed Action and construct an approximately 61,250 square-foot hangar north of the launch pad line to support Falcon 9 and Falcon Heavy integration and processing. Areas around the hangar would be graded to provide rear access to the hangar. As part of Alternative 1, SpaceX would demolish the Mobile Service Tower, Mobile Assembly Shelter, Fixed Umbilical Tower, and the launch crown at SLC-6. SpaceX would construct rails from the hangar to the launch pad to transport Falcon. The SLC 6 fence would be relocated and vehicular access from Luner Road to N Road would be removed.

f. Point of Contact:
- **Name:** Adam Poll
- **Title:** Civilian
- **Organization:** Dudek
- **Email:** apoll@dudek.com
- **Phone Number:** 805-308-8516

2. Analysis: Total combined direct and indirect GHG emissions associated with the action were estimated through ACAM on a calendar-year basis from the action start through the expected life cycle of the action. The life cycle for Air Force actions with "steady state" emissions (SS, net gain/loss in emission stabilized and the action is

fully implemented) is assumed to be 10 years beyond the SS emissions year or 20 years beyond SS emissions year for aircraft operations related actions.

GHG Emissions Analysis Summary:

GHGs produced by fossil-fuel combustion are primarily carbon dioxide (CO2), methane (CH4), and nitrous oxide (NO2). These three GHGs represent more than 97 percent of all U.S. GHG emissions. Emissions of GHGs are typically quantified and regulated in units of CO2 equivalents (CO2e). The CO2e takes into account the global warming potential (GWP) of each GHG. The GWP is the measure of a particular GHG's ability to absorb solar radiation as well as its residence time within the atmosphere. All GHG emissions estimates were derived from various emission sources using the methods, algorithms, emission factors, and GWPs from the most current Air Emissions Guide for Air Force Stationary Sources, Air Emissions Guide for Air Force Mobile Sources, and/or Air Emissions Guide for Air Force Transitory Sources.

The Air Force has adopted the Prevention of Significant Deterioration (PSD) threshold for GHG of 75,000 ton per year (ton/yr) of CO2e (or 68,039 metric ton per year, mton/yr) as an indicator or "threshold of insignificance" for NEPA air quality impacts in all areas. This indicator does not define a significant impact; however, it provides a threshold to identify actions that are insignificant (de minimis, too trivial or minor to merit consideration). Actions with a net change in GHG (CO2e) emissions below the insignificance indicator (threshold) are considered too insignificant on a global scale to warrant any further analysis. Note that actions with a net change in GHG (CO2e) emissions above the insignificance indicator (threshold) are only considered potentially significant and require further assessment to determine if the action poses a significant impact. For further detail on insignificance indicators see Level II, Air Quality Quantitative Assessment, Insignificance Indicators (April 2023).

The following table summarizes the action-related GHG emissions on a calendar-year basis through the projected life cycle of the action.

Action-Related Annual GHG Emissions (mton/yr)						
YEAR	**CO2**	**CH4**	**N2O**	**CO2e**	**Threshold**	**Exceedance**
2025	327	0.00680087	0.02968214	336	68,039	No
2026	1,247	0.02765901	0.11893213	1,293	68,039	No
2027	2,458	0.12712015	0.06456947	2,597	68,039	No
2028	2,458	0.12712015	0.06456947	2,597	68,039	No
2029	2,458	0.12712015	0.06456947	2,597	68,039	No
2030	2,458	0.12712015	0.06456947	2,597	68,039	No
2031	2,458	0.12712015	0.06456947	2,597	68,039	No
2032	2,458	0.12712015	0.06456947	2,597	68,039	No
2033	2,458	0.12712015	0.06456947	2,597	68,039	No
2034	2,458	0.12712015	0.06456947	2,597	68,039	No
2035	2,458	0.12712015	0.06456947	2,597	68,039	No
2036	2,458	0.12712015	0.06456947	2,597	68,039	No
2037	2,458	0.12712015	0.06456947	2,597	68,039	No
2038	2,458	0.12712015	0.06456947	2,597	68,039	No
2039	2,458	0.12712015	0.06456947	2,597	68,039	No
2040	2,458	0.12712015	0.06456947	2,597	68,039	No
2041	2,458	0.12712015	0.06456947	2,597	68,039	No
2042	2,458	0.12712015	0.06456947	2,597	68,039	No
2043	2,458	0.12712015	0.06456947	2,597	68,039	No
2044	2,458	0.12712015	0.06456947	2,597	68,039	No
2045	2,458	0.12712015	0.06456947	2,597	68,039	No
2046	2,458	0.12712015	0.06456947	2,597	68,039	No
2047	2,458	0.12712015	0.06456947	2,597	68,039	No

2048	2,458	0.12712015	0.06456947	2,597	68,039	No
2049	2,458	0.12712015	0.06456947	2,597	68,039	No
2050	2,458	0.12712015	0.06456947	2,597	68,039	No
2051	2,458	0.12712015	0.06456947	2,597	68,039	No
2052	2,458	0.12712015	0.06456947	2,597	68,039	No
2053	2,458	0.12712015	0.06456947	2,597	68,039	No
2054	2,458	0.12712015	0.06456947	2,597	68,039	No
2055	2,458	0.12712015	0.06456947	2,597	68,039	No
2056	2,441	0.12644365	0.06443423	2,580	68,039	No
2057 [SS Year]	2,257	0.11900213	0.06294664	2,396	68,039	No
2058	2,257	0.11900213	0.06294664	2,396	68,039	No
2059	2,257	0.11900213	0.06294664	2,396	68,039	No
2060	2,257	0.11900213	0.06294664	2,396	68,039	No
2061	2,257	0.11900213	0.06294664	2,396	68,039	No
2062	2,257	0.11900213	0.06294664	2,396	68,039	No
2063	2,257	0.11900213	0.06294664	2,396	68,039	No
2064	2,257	0.11900213	0.06294664	2,396	68,039	No
2065	2,257	0.11900213	0.06294664	2,396	68,039	No
2066	2,257	0.11900213	0.06294664	2,396	68,039	No
2067	2,257	0.11900213	0.06294664	2,396	68,039	No

The following U.S. and State's GHG emissions estimates (next two tables) are based on a five-year average (2016 through 2020) of individual state-reported GHG emissions (Reference: State Climate Summaries 2022, NOAA National Centers for Environmental Information, National Oceanic and Atmospheric Administration. https://statesummaries.ncics.org/downloads/).

YEAR	CO2	CH4	N2O	CO2e
2025	336,950,322	1,567,526	55,459	338,573,307
2026	336,950,322	1,567,526	55,459	338,573,307
2027	336,950,322	1,567,526	55,459	338,573,307
2028	336,950,322	1,567,526	55,459	338,573,307
2029	336,950,322	1,567,526	55,459	338,573,307
2030	336,950,322	1,567,526	55,459	338,573,307
2031	336,950,322	1,567,526	55,459	338,573,307
2032	336,950,322	1,567,526	55,459	338,573,307
2033	336,950,322	1,567,526	55,459	338,573,307
2034	336,950,322	1,567,526	55,459	338,573,307
2035	336,950,322	1,567,526	55,459	338,573,307
2036	336,950,322	1,567,526	55,459	338,573,307
2037	336,950,322	1,567,526	55,459	338,573,307
2038	336,950,322	1,567,526	55,459	338,573,307
2039	336,950,322	1,567,526	55,459	338,573,307
2040	336,950,322	1,567,526	55,459	338,573,307
2041	336,950,322	1,567,526	55,459	338,573,307
2042	336,950,322	1,567,526	55,459	338,573,307
2043	336,950,322	1,567,526	55,459	338,573,307
2044	336,950,322	1,567,526	55,459	338,573,307
2045	336,950,322	1,567,526	55,459	338,573,307
2046	336,950,322	1,567,526	55,459	338,573,307
2047	336,950,322	1,567,526	55,459	338,573,307
2048	336,950,322	1,567,526	55,459	338,573,307
2049	336,950,322	1,567,526	55,459	338,573,307
2050	336,950,322	1,567,526	55,459	338,573,307

AIR CONFORMITY APPLICABILITY MODEL REPORT
GREENHOUSE GAS (GHG) EMISSIONS

2051	336,950,322	1,567,526	55,459	338,573,307
2052	336,950,322	1,567,526	55,459	338,573,307
2053	336,950,322	1,567,526	55,459	338,573,307
2054	336,950,322	1,567,526	55,459	338,573,307
2055	336,950,322	1,567,526	55,459	338,573,307
2056	336,950,322	1,567,526	55,459	338,573,307
2057 [SS Year]	336,950,322	1,567,526	55,459	338,573,307
2058	336,950,322	1,567,526	55,459	338,573,307
2059	336,950,322	1,567,526	55,459	338,573,307
2060	336,950,322	1,567,526	55,459	338,573,307
2061	336,950,322	1,567,526	55,459	338,573,307
2062	336,950,322	1,567,526	55,459	338,573,307
2063	336,950,322	1,567,526	55,459	338,573,307
2064	336,950,322	1,567,526	55,459	338,573,307
2065	336,950,322	1,567,526	55,459	338,573,307
2066	336,950,322	1,567,526	55,459	338,573,307
2067	336,950,322	1,567,526	55,459	338,573,307

U.S. Annual GHG Emissions (mton/yr)				
YEAR	CO2	CH4	N2O	CO2e
2025	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2026	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2027	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2028	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2029	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2030	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2031	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2032	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2033	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2034	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2035	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2036	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2037	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2038	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2039	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2040	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2041	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2042	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2043	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2044	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2045	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2046	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2047	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2048	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2049	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2050	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2051	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2052	5,136,454,179	25,626,912	1,500,708	5,163,581,798
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2063	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2064	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2065	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2066	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2067	5,136,454,179	25,626,912	1,500,708	5,163,581,798

GHG Relative Significance Assessment:

A Relative Significance Assessment uses the rule of reason and the concept of proportionality along with the consideration of the affected area (yGba.e., global, national, and regional) and the degree (intensity) of the proposed action’s effects. The Relative Significance Assessment provides real-world context and allows for a reasoned choice against alternatives through a relative comparison analysis. The analysis weighs each alternative’s annual net change in GHG emissions proportionally against (or relative to) global, national, and regional emissions.

The action’s surroundings, circumstances, environment, and background (context associated with an action) provide the setting for evaluating the GHG intensity (impact significance). From an air quality perspective, context of an action is the local area’s ambient air quality relative to meeting the NAAQSs, expressed as attainment, nonattainment, or maintenance areas (this designation is considered the attainment status). GHGs are non-hazardous to health at normal ambient concentrations and, at a cumulative global scale, action-related GHG emissions can only potentially cause warming of the climatic system. Therefore, the action-related GHGs generally have an insignificant impact to local air quality.

However, the affected area (context) of GHG is global. Therefore, the intensity or degree of the proposed action’s GHG effects are gauged through the quantity of GHG associated with the action as compared to a baseline of the state, U.S., and global GHG inventories. Each action (or alternative) has significance, based on their annual net change in GHG emissions, in relation to or proportionally to the global, national, and regional annual GHG emissions.

To provide real-world context to the GHG effects on a global scale, an action’s net change in GHG emissions is compared relative to the state (where action will occur) and U.S. annual emissions. The following table provides a relative comparison of an action’s net change in GHG emissions vs. state and U.S. projected GHG emissions for the same time period.

Total GHG Relative Significance (mton)					
		CO2	**CH4**	**N2O**	**CO2e**
2025-2067	State Total	14,488,863,826	67,403,622	2,384,752	14,558,652,199
2025-2067	U.S. Total	220,867,529,697	1,101,957,202	64,530,428	222,034,017,328
2025-2067	Action	100,115	5.156411	2.777976	105,887
Percent of State Totals		0.00069098%	0.00000765%	0.00011649%	0.00072731%
Percent of U.S. Totals		0.00004533%	0.00000047%	0.00000430%	0.00004769%

From a global context, the action's total GHG percentage of total global GHG for the same time period is: 0.00000639%.*

* Global value based on the U.S. emits 13.4% of all global GHG annual emissions (2018 Emissions Data, Center for Climate and Energy Solutions, accessed 7-6-2023, https://www.c2es.org/content/international-emissions).

AIR CONFORMITY APPLICABILITY MODEL REPORT
GREENHOUSE GAS (GHG) EMISSIONS

1. General Information: The Air Force's Air Conformity Applicability Model (ACAM) was used to perform an analysis to estimate GHG emissions and assess the theoretical Social Cost of Greenhouse Gases (SC GHG) associated with the action. The analysis was performed in accordance with the Air Force Manual 32-7002, Environmental Compliance and Pollution Prevention; the Environmental Impact Analysis Process (EIAP, 32 CFR 989); and the USAF Air Quality Environmental Impact Analysis Process (EIAP) Guide. This report provides a summary of GHG emissions and SC GHG analysis.

Report generated with ACAM version: 5.0.23a

a. Action Location:
Base: VANDENBERG AFB
State: California
County(s): Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

b. Action Title: Falcon Program at Vandenberg Space Force Base Proposed Action

c. Project Number/s (if applicable):

d. Projected Action Start Date: 11 / 2025

e. Action Description:

The Proposed Action is to increase the annual Falcon launch cadence at VSFB through launches at SLC-4 and SLC-6 and the modification of SLC 6 for Falcon launch vehicles to support future commercial and U.S. government launch service needs. SpaceX would launch Falcon 9 from SLC-4 and SLC-6, and Falcon Heavy from SLC-6. Falcon 9 is approximately 229 feet tall and produces approximately 1.7 million pounds of thrust at liftoff. A discussion of Falcon 9 can be found in the 2016 EA and associated supplemental environmental documents. Falcon Heavy is a heavy-lift vehicle that produces 5.12 million pounds of thrust at liftoff and has the ability to lift 141,000 pounds into low Earth orbit. Merlin engines are used on both stages of Falcon Heavy. The center core and two side boosters are essentially the same design as a Falcon 9 first stage booster, thus Falcon Heavy uses the same type of propellants as Falcon 9. Additionally, Falcon Heavy uses the same second stage as Falcon 9.

Under the Proposed Action, SpaceX would implement the Proposed Action and would modify the horizontal integration facility (HIF) located north of SLC 6 to support Falcon 9 and Falcon Heavy operations. As part of this Proposed Action, SpaceX would demolish the Mobile Service Tower, Mobile Assembly Shelter, Fixed Umbilical Tower, and the launch crown at SLC-6. Modifications would include interior work, construction of an approximately 5,000 square foot annex on the south side of the building, and construction of an approximately 42,000 square foot paved area north of the building to provide rear access into the hangar. SpaceX would construct rails from the hangar to the launch pad to transport Falcon.

f. Point of Contact:
Name: Adam Poll
Title: Civilian
Organization: Dudek
Email: apoll@dudek.com
Phone Number: 805-308-8516

2. Analysis: Total combined direct and indirect GHG emissions associated with the action were estimated through ACAM on a calendar-year basis from the action start through the expected life cycle of the action. The life cycle for Air Force actions with "steady state" emissions (SS, net gain/loss in emission stabilized and the action is

fully implemented) is assumed to be 10 years beyond the SS emissions year or 20 years beyond SS emissions year for aircraft operations related actions.

GHG Emissions Analysis Summary:

GHGs produced by fossil-fuel combustion are primarily carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (NO_2). These three GHGs represent more than 97 percent of all U.S. GHG emissions. Emissions of GHGs are typically quantified and regulated in units of CO_2 equivalents (CO_2e). The CO_2e takes into account the global warming potential (GWP) of each GHG. The GWP is the measure of a particular GHG's ability to absorb solar radiation as well as its residence time within the atmosphere. All GHG emissions estimates were derived from various emission sources using the methods, algorithms, emission factors, and GWPs from the most current Air Emissions Guide for Air Force Stationary Sources, Air Emissions Guide for Air Force Mobile Sources, and/or Air Emissions Guide for Air Force Transitory Sources.

The Air Force has adopted the Prevention of Significant Deterioration (PSD) threshold for GHG of 75,000 ton per year (ton/yr) of CO_2e (or 68,039 metric ton per year, mton/yr) as an indicator or "threshold of insignificance" for NEPA air quality impacts in all areas. This indicator does not define a significant impact; however, it provides a threshold to identify actions that are insignificant (de minimis, too trivial or minor to merit consideration). Actions with a net change in GHG (CO_2e) emissions below the insignificance indicator (threshold) are considered too insignificant on a global scale to warrant any further analysis. Note that actions with a net change in GHG (CO_2e) emissions above the insignificance indicator (threshold) are only considered potentially significant and require further assessment to determine if the action poses a significant impact. For further detail on insignificance indicators see Level II, Air Quality Quantitative Assessment, Insignificance Indicators (April 2023).

The following table summarizes the action-related GHG emissions on a calendar-year basis through the projected life cycle of the action.

Action-Related Annual GHG Emissions (mton/yr)						
YEAR	**CO2**	**CH4**	**N2O**	**CO2e**	**Threshold**	**Exceedance**
2025	284	0.00642481	0.02374771	291	68,039	No
2026	1,080	0.02694347	0.0925324	1,118	68,039	No
2027	2,458	0.12712015	0.06456947	2,597	68,039	No
2028	2,458	0.12712015	0.06456947	2,597	68,039	No
2029	2,458	0.12712015	0.06456947	2,597	68,039	No
2030	2,458	0.12712015	0.06456947	2,597	68,039	No
2031	2,458	0.12712015	0.06456947	2,597	68,039	No
2032	2,458	0.12712015	0.06456947	2,597	68,039	No
2033	2,458	0.12712015	0.06456947	2,597	68,039	No
2034	2,458	0.12712015	0.06456947	2,597	68,039	No
2035	2,458	0.12712015	0.06456947	2,597	68,039	No
2036	2,458	0.12712015	0.06456947	2,597	68,039	No
2037	2,458	0.12712015	0.06456947	2,597	68,039	No
2038	2,458	0.12712015	0.06456947	2,597	68,039	No
2039	2,458	0.12712015	0.06456947	2,597	68,039	No
2040	2,458	0.12712015	0.06456947	2,597	68,039	No
2041	2,458	0.12712015	0.06456947	2,597	68,039	No
2042	2,458	0.12712015	0.06456947	2,597	68,039	No
2043	2,458	0.12712015	0.06456947	2,597	68,039	No
2044	2,458	0.12712015	0.06456947	2,597	68,039	No
2045	2,458	0.12712015	0.06456947	2,597	68,039	No
2046	2,458	0.12712015	0.06456947	2,597	68,039	No
2047	2,458	0.12712015	0.06456947	2,597	68,039	No

2048	2,458	0.12712015	0.06456947	2,597	68,039	No
2049	2,458	0.12712015	0.06456947	2,597	68,039	No
2050	2,458	0.12712015	0.06456947	2,597	68,039	No
2051	2,458	0.12712015	0.06456947	2,597	68,039	No
2052	2,458	0.12712015	0.06456947	2,597	68,039	No
2053	2,458	0.12712015	0.06456947	2,597	68,039	No
2054	2,458	0.12712015	0.06456947	2,597	68,039	No
2055	2,458	0.12712015	0.06456947	2,597	68,039	No
2056	2,441	0.12644365	0.06443423	2,580	68,039	No
2057 [SS Year]	2,257	0.11900213	0.06294664	2,396	68,039	No
2058	2,257	0.11900213	0.06294664	2,396	68,039	No
2059	2,257	0.11900213	0.06294664	2,396	68,039	No
2060	2,257	0.11900213	0.06294664	2,396	68,039	No
2061	2,257	0.11900213	0.06294664	2,396	68,039	No
2062	2,257	0.11900213	0.06294664	2,396	68,039	No
2063	2,257	0.11900213	0.06294664	2,396	68,039	No
2064	2,257	0.11900213	0.06294664	2,396	68,039	No
2065	2,257	0.11900213	0.06294664	2,396	68,039	No
2066	2,257	0.11900213	0.06294664	2,396	68,039	No
2067	2,257	0.11900213	0.06294664	2,396	68,039	No

The following U.S. and State's GHG emissions estimates (next two tables) are based on a five-year average (2016 through 2020) of individual state-reported GHG emissions (Reference: State Climate Summaries 2022, NOAA National Centers for Environmental Information, National Oceanic and Atmospheric Administration. https://statesummaries.ncics.org/downloads/).

YEAR	CO2	CH4	N2O	CO2e
2025	336,950,322	1,567,526	55,459	338,573,307
2026	336,950,322	1,567,526	55,459	338,573,307
2027	336,950,322	1,567,526	55,459	338,573,307
2028	336,950,322	1,567,526	55,459	338,573,307
2029	336,950,322	1,567,526	55,459	338,573,307
2030	336,950,322	1,567,526	55,459	338,573,307
2031	336,950,322	1,567,526	55,459	338,573,307
2032	336,950,322	1,567,526	55,459	338,573,307
2033	336,950,322	1,567,526	55,459	338,573,307
2034	336,950,322	1,567,526	55,459	338,573,307
2035	336,950,322	1,567,526	55,459	338,573,307
2036	336,950,322	1,567,526	55,459	338,573,307
2037	336,950,322	1,567,526	55,459	338,573,307
2038	336,950,322	1,567,526	55,459	338,573,307
2039	336,950,322	1,567,526	55,459	338,573,307
2040	336,950,322	1,567,526	55,459	338,573,307
2041	336,950,322	1,567,526	55,459	338,573,307
2042	336,950,322	1,567,526	55,459	338,573,307
2043	336,950,322	1,567,526	55,459	338,573,307
2044	336,950,322	1,567,526	55,459	338,573,307
2045	336,950,322	1,567,526	55,459	338,573,307
2046	336,950,322	1,567,526	55,459	338,573,307
2047	336,950,322	1,567,526	55,459	338,573,307
2048	336,950,322	1,567,526	55,459	338,573,307
2049	336,950,322	1,567,526	55,459	338,573,307
2050	336,950,322	1,567,526	55,459	338,573,307

AIR CONFORMITY APPLICABILITY MODEL REPORT
GREENHOUSE GAS (GHG) EMISSIONS

2051	336,950,322	1,567,526	55,459	338,573,307
2052	336,950,322	1,567,526	55,459	338,573,307
2053	336,950,322	1,567,526	55,459	338,573,307
2054	336,950,322	1,567,526	55,459	338,573,307
2055	336,950,322	1,567,526	55,459	338,573,307
2056	336,950,322	1,567,526	55,459	338,573,307
2057 [SS Year]	336,950,322	1,567,526	55,459	338,573,307
2058	336,950,322	1,567,526	55,459	338,573,307
2059	336,950,322	1,567,526	55,459	338,573,307
2060	336,950,322	1,567,526	55,459	338,573,307
2061	336,950,322	1,567,526	55,459	338,573,307
2062	336,950,322	1,567,526	55,459	338,573,307
2063	336,950,322	1,567,526	55,459	338,573,307
2064	336,950,322	1,567,526	55,459	338,573,307
2065	336,950,322	1,567,526	55,459	338,573,307
2066	336,950,322	1,567,526	55,459	338,573,307
2067	336,950,322	1,567,526	55,459	338,573,307

U.S. Annual GHG Emissions (mton/yr)				
YEAR	**CO2**	**CH4**	**N2O**	**CO2e**
2025	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2026	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2027	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2028	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2029	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2030	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2031	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2032	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2033	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2034	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2035	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2036	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2037	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2038	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2039	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2040	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2041	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2042	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2043	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2044	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2045	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2046	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2047	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2048	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2049	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2050	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2051	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2052	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2053	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2054	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2055	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2056	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2057 [SS Year]	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2058	5,136,454,179	25,626,912	1,500,708	5,163,581,798

2059	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2060	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2061	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2062	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2063	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2064	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2065	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2066	5,136,454,179	25,626,912	1,500,708	5,163,581,798
2067	5,136,454,179	25,626,912	1,500,708	5,163,581,798

GHG Relative Significance Assessment:

A Relative Significance Assessment uses the rule of reason and the concept of proportionality along with the consideration of the affected area (yGba.e., global, national, and regional) and the degree (intensity) of the proposed action's effects. The Relative Significance Assessment provides real-world context and allows for a reasoned choice against alternatives through a relative comparison analysis. The analysis weighs each alternative's annual net change in GHG emissions proportionally against (or relative to) global, national, and regional emissions.

The action's surroundings, circumstances, environment, and background (context associated with an action) provide the setting for evaluating the GHG intensity (impact significance). From an air quality perspective, context of an action is the local area's ambient air quality relative to meeting the NAAQSs, expressed as attainment, nonattainment, or maintenance areas (this designation is considered the attainment status). GHGs are non-hazardous to health at normal ambient concentrations and, at a cumulative global scale, action-related GHG emissions can only potentially cause warming of the climatic system. Therefore, the action-related GHGs generally have an insignificant impact to local air quality.

However, the affected area (context) of GHG is global. Therefore, the intensity or degree of the proposed action's GHG effects are gauged through the quantity of GHG associated with the action as compared to a baseline of the state, U.S., and global GHG inventories. Each action (or alternative) has significance, based on their annual net change in GHG emissions, in relation to or proportionally to the global, national, and regional annual GHG emissions.

To provide real-world context to the GHG effects on a global scale, an action's net change in GHG emissions is compared relative to the state (where action will occur) and U.S. annual emissions. The following table provides a relative comparison of an action's net change in GHG emissions vs. state and U.S. projected GHG emissions for the same time period.

Total GHG Relative Significance (mton)					
		CO2	**CH4**	**N2O**	**CO2e**
2025-2067	State Total	14,488,863,826	67,403,622	2,384,752	14,558,652,199
2025-2067	U.S. Total	220,867,529,697	1,101,957,202	64,530,428	222,034,017,328
2025-2067	Action	99,905	5.15532	2.745642	105,667
Percent of State Totals		0.00068953%	0.00000765%	0.00011513%	0.00072580%
Percent of U.S. Totals		0.00004523%	0.00000047%	0.00000425%	0.00004759%

From a global context, the action's total GHG percentage of total global GHG for the same time period is: 0.00000638%.*

* Global value based on the U.S. emits 13.4% of all global GHG annual emissions (2018 Emissions Data, Center for Climate and Energy Solutions, accessed 7-6-2023, https://www.c2es.org/content/international-emissions).

Launch, Landing, and Static Fire

						Emission Factors						Emissions							Emissions						
			<3,000ft			Pounds per burn second						Tons emitted per launch						Metric tons per Activity	Tons per year						Metric tons per year
Type	Stage	Fuel	Burn time (seconds)	Number of Engines	Annual Activities	VOC	NOx	CO	SOx	PM10	PM2.5	VOC	NOx	CO	SOx	PM10	PM2.5	CO2e	VOC	NOx	CO	SOx	PM10	PM2.5	CO2e
Launch Falcon 9	1	RP1/LOX	23	9	95	0.00	9.42	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	273.96	0.00	10.29	0.00	0.00	0.00	0.00	26,025.80
Launch Falcon Heavy	1	RP1/LOX	21	27	5	0.00	28.27	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.00	821.87	0.00	1.48	0.00	0.00	0.00	0.00	4,109.34
Landing (Offshore) Falcon 9	1	RP1/LOX	18	3	66	0.00	3.14	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	90.41	0.00	1.87	0.00	0.00	0.00	0.00	5,966.76
Landing (VSFB) Falcon 9	1	RP1/LOX	18	3	29	0.00	3.14	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	90.41	0.00	0.82	0.00	0.00	0.00	0.00	2,621.76
Landing (VSFB) Falcon Heavy	1	RP1/LOX	18	6	5	0.00	6.28	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	90.41	0.00	0.28	0.00	0.00	0.00	0.00	452.03
Static Fire Falcon 9	1	RP1/LOX	7	9	45	0.00	9.42	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	18.26	0.00	1.48	0.00	0.00	0.00	0.00	821.87
Static Fire Falcon Heavy	1	RP1/LOX	7	27	5	0.00	28.27	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	54.79	0.00	0.49	0.00	0.00	0.00	0.00	273.96
																		Total	**0.00**	**16.73**	**0.00**	**0.00**	**0.00**	**0.00**	**40,271.50**

Emission Factors Per Engine

	Emission Factors (pounds per second per engine)						
Propellant	VOC	NOx	CO	SOx	PM10	PM2.5	CO2
RP-1/LOX	0.00	1.05	0.00	0.00	0.00	0.00	639.12

Source: Exhaust Plume Calculations for SpaceX Merlin5 Booster Engine, Sierra Engineering & Software, Inc. (June 14, 2019)

Notes:

Launch emissions include fuel spent up to 3,000 ft AGL.

Landing emissions include all intermittent burns below 3,000 ft AGL.

Static fire assumes all 9 engines with a 7 second burn time.

Landing emissions assumed to be 33% of nominal power (only 3 engines used).

Launch GHG emissions include fuel spent up to 100,000ft MSL (approximately 105 seconds).

Landing GHG emissions include all intermittent burns below 100,000 ft MSL.

Booster Recovery Operations

																Emissions (<3 nm)											Emissions (3-12 nm)										
Vessel	Operations Per Year	Total Ship time on Range	Engines and Generators		Horsepower	Emission Factors (g/kWh)										Tons							Metric Tons				Tons							Metric Tons			
		Hours	No.	Load		VOCs	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O	VOCs	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O	CO2e	VOCs	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O	CO2e
Tugboat	100	68	2	0.5	850	0.53	2.60	1.10	0.41	0.19	0.19	0.00	656.12	0.01	0.03	0.02	0.09	0.04	0.01	0.01	0.01	0.00	19.68	0.00	0.00	19.95	0.05	0.26	0.11	0.04	0.02	0.02	0.00	59.05	0.00	0.00	59.85
	100	68	2	0.31	133	0.53	2.60	1.10	0.41	0.19	0.19	0.00	656.12	0.01	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00	1.91	0.00	0.00	1.94	0.01	0.03	0.01	0.00	0.00	0.00	0.00	5.73	0.00	0.00	5.81
Support Boat	100	68	1	0.5	3,900	0.53	2.60	1.10	0.41	0.19	0.19	0.00	656.12	0.01	0.03	0.04	0.20	0.08	0.03	0.01	0.01	0.00	45.16	0.00	0.00	45.77	0.12	0.59	0.25	0.09	0.04	0.04	0.00	135.47	0.00	0.01	137.30
	100	68	2	0.31	114	0.53	2.60	1.10	0.41	0.19	0.19	0.00	656.12	0.01	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00	1.64	0.00	0.00	1.66	0.00	0.02	0.01	0.00	0.00	0.00	0.00	4.91	0.00	0.00	4.98
Barge	100	12	1	0.6	2,600	0.53	2.60	1.10	0.41	0.19	0.19	0.00	656.12	0.01	0.03	0.01	0.03	0.01	0.00	0.00	0.00	0.00	6.37	0.00	0.00	6.46	0.02	0.08	0.04	0.01	0.01	0.01	0.00	19.12	0.00	0.00	19.38
	100	68	1	0.6	268	0.18	2.50	0.90	0.16	0.22	0.22	0.00	568.30	0.03	0.03	0.00	0.02	0.01	0.00	0.00	0.00	0.00	3.23	0.00	0.00	3.28	0.00	0.05	0.02	0.00	0.00	0.00	0.00	9.68	0.00	0.00	9.84
															Total	**0.07**	**0.34**	**0.14**	**0.05**	**0.02**	**0.02**	**0.00**	**77.99**	**0.00**	**0.00**	**79.05**	**0.20**	**1.03**	**0.43**	**0.16**	**0.07**	**0.07**	**0.00**	**233.96**	**0.00**	**0.01**	**237.16**

Notes:

Total ship time, engine specifics, and emission factors consistent with the 2023 SEA.

Fairing Recovery Operations

Vessel	Operations Per Year	Total Ship time on Range	Engines and Generators		Horsepower	Emission Factors (g/kWh)									
		Hours	No.	Load		VOCs	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
Support Boat	100	68	2	0.6	820	0.53	2.60	1.10	0.41	0.19	0.19	0.00	656.12	0.01	0.03

Vessel	Emissions (<3 nm)										
	Tons							Metric Tons			
	VOCs	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O	CO2e
Support Boat	0.02	0.10	0.04	0.02	0.01	0.01	0.00	22.79	0.00	0.00	23.10

Vessel	Emissions (3-12 nm)										
	Tons							Metric Tons			
	VOCs	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O	CO2e
Support Boat	0.06	0.30	0.13	0.05	0.02	0.02	0.00	68.36	0.00	0.00	69.29

Notes:

Total ship time, engine specifics, and emission factors consistent with the 2023 SEA.

RP-1, RSV Loading, Payload Fueling, and Solvent Emissions

Equipment	NO_x	ROC	CO	SO_x	PM	PM_{10}	$PM_{2.5}$
Falcon 9 RP-1							
lb/day		0.68					
TPY		0.01					
Falcon Heavy RP-1							
lb/day		11.61					
TPY		0.03					
RSV Loading							
lb/day		14.47					
TPY		0.11					
Payload Fueling							
lb/day	14.84	0.15					
TPY	0.22	0.00					
Solvent Use							
lb/day		45.54					
TPY		5.93					
Total Emissions							
lb/day	**14.84**	**72.46**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
TPY	**0.22**	**6.08**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Falcon 9 Potential to Emit Calculations

Attachment: A-1
Permit Number: PTO 15069
Facility: SpaceX

RP-1 and System Input Data

Information	*Value*	*Units*	*Reference*
Specific Gravity at System Temp................	0.840	--	Material Specifications
Vapor Pressure @ 20 °F.............................	0.00088	psi	Material Specifications
Vapor Molecular Weight............................	148.00	lb/lb-mol	Material Specifications
Gas Constant...	10.73	scf-psi/°R-lb-mol	Ideal Gas Laws
System and RP-1 Temperature..................	474.67	°R	Permit Application
RP-1 Emission Factor..........................	0.00003	lb/ft^3	Calculated Value

Maximum Process Event Summary

Event Name	*Value*	*Units*	*Reference*
Events..	95	events/year	Permit Application
Static Launch and Abort Events.....................	45	events/year	Permit Application
Events per day	2	events/day	Permit Application
Event Vehicle RP-1 Throughput Volume..........	48,500	gals/event	Permit Application
Event Fill Line Throughput Volume................	1,543	gals/event	Permit Application
Daily Launch Volume.................................	50,043	gals/day	Calculated Value
Daily Static Launch and Abort Volume..........	50,043	gals/day	Calculated Value
Daily Launch Volume.................................	6,690	ft^3/day	Calculated Value
Daily Static Launch and Abort Volume..........	13,380	ft^3/day	Calculated Value
Annual Launch Volume...............................	4,754,085	gals/year	Calculated Value
Annual Static Launch and Abort Volume..........	2,251,935	gals/year	Calculated Value
Annual Launch Volume...............................	635,531	ft^3/yr	Calculated Value
Annual Static Launch and Abort Volume.........	301,041	ft^3/yr	Calculated Value

ROC Potential to Emit

Process	lb/day	TPY
Launches	0.34	0.01
Static Launches/Abort	0.68	0.00
Total PTE	**0.68**	**0.01**

Notes:
1. One Falcon 9 launch or static launch/abort permitted per day. PTE reflects the worst case scenario.

Processed By: KMB Date: 2/11/2020

Falcon Heavy Potential to Emit Calculations

Attachment: A-2
Permit Number: PTO 15069
Facility: SpaceX

RP-1 and System Input Data

Information	*Value*	*Units*	*Reference*
Specific Gravity at System Temp……………	0.809	--	Material Specifications
Vapor Pressure @ 70 °F………………………..	0.01100	psi	Material Specifications
Vapor Molecular Weight………………………	148.00	lb/lb-mol	Material Specifications
Gas Constant……………………………………	10.73	scf-psi/°R-lb-mol	Ideal Gas Laws
System and RP-1 Temperature……..…….	529.67	°R	Permit Application
RP-1 Emission Factor………………………	0.00029	lb/ft^3	Calculated Value

Maximum Process Event Summary

Event Name	*Value*	*Units*	*Reference*
Launches…………………………………………	5	events/year	Permit Application
Static Launch and Abort Events…………………	5	events/year	Permit Application
Event Vehicle RP-1 Throughput Volume……….	150,000	gals/event	Permit Application
Event Fill Line Throughput Volume…………….	1,543	gals/event	Permit Application
Daily Launch Volume……………………………..	151,543	gals/day	Calculated Value
Daily Static Launch and Abort Volume……….	151,543	gals/day	Calculated Value
Daily Launch Volume……………………………	20,258	ft^3/day	Calculated Value
Daily Static Launch and Abort Volume……….	40,517	ft^3/day	Calculated Value
Annual Launch Volume………………………….	757,715	gals/year	Calculated Value
Annual Static Launch and Abort Volume……….	757,715	gals/year	Calculated Value
Annual Launch Volume………………………….	101,292	ft^3/yr	Calculated Value
Annual Static Launch and Abort Volume………	101,292	ft^3/yr	Calculated Value

ROC Potential to Emit

Process	lb/day	TPY
Launches	5.80	0.01
Static Launches/Abort	11.61	0.01
Total PTE	**11.61**	**0.03**

Notes:

1. One Falcon Heavy launch or static launch/abort permitted per day. PTE reflects the worst case scenario.

Processed By: KMB

Date: 2/11/2020

RSV Loading Potential to Emit Calculations

Attachment: A-3
Permit Number: PTO 15069
Facility: SpaceX

RP-1 and System Input Data

Information	*Value*	*Units*	*Reference*
Specific Gravity at System Temp…………….	0.809	--	Material Specifications
Vapor Pressure @ 70 °F………………………..	0.011	psi	Material Specifications
Vapor Molecular Weight……………………….	148.00	lb/lb-mol	Material Specifications
Gas Constant………………………………………	10.73	scf-psi/°R-lb-mol	Ideal Gas Laws
System and RP-1 Temperature……..……..	529.67	°R	Permit Application
RP-1 Emission Factor………………………	0.00029	lb/ft^3	Calculated Value

RP-1 Fuel Consumption

Consumption Operations	*Value*	*Units*	*Reference*
Worst Case Daily RP-1 Consumption…………	378,000	gals/day	Equal to Total RP-1 Tank Calcs
Worst Case Annual RP-1 Consumption…….	5,511,800	gals	Combined Falcon 9 / Heavy Annual Launch Volume
Falcon Heavy RP-1 Consumption……………..	50,531	ft^3	Calculated Values
Falcon 9 RP-1 Consumption…………………….	736,823	ft^3	Calculated Values

ROC Potential to Emit

lb/day	TPY
14.47	0.11

Processed By: KMB

Date: 2/11/2020

Payload Fueling Potential to Emit Calculations

Attachment: A-4
Permit Number: PTO 15069
Facility: SpaceX

Payload/Unloading Input Data

Information	*Value*	*Units*	*Reference*
Flow Rate (loading/unloading).............	5.00	scf/min	Permit Application
MMH Molecular Weight.....................	60.10	lb/lb-mol	Permit Application
N_2O_4 Molecular Weight..................	92.01	lb/lb-mol	Permit Application
Molar Denisty..........................	0.00264	lb-mole/scf	Permit Application
Processing Time........................	4	hours	Permit Application
Loading Annual Operations................	20	events/year	Permit Application
Unloading Annual Operations.............	10	events/year	Permit Application
Loading Control Efficiency..........	99.95	%	Permit Application
Unloading Control Efficiency.........	95.70	%	Permit Application
NO_x Fugitives Per Event.................	2.31	lb/event	Permit Application
ROC Fugitives Per Event.................	0.058	lb/event	Permit Application

Payload Loading Controlled Potential to Emit

Propellant	Pollutant	lb/day	TPY
N_2O_4	NO_x	12.53	0.13
MMH	ROC	0.10	0.00
N_2O_4	NO_x (Fugitives)	2.31	0.02
MMH	ROC (Fugitives)	0.06	0.00

Payload Unloading Controlled Potential to Emit

Propellant	Pollutant	lb/day	TPY
N_2O_4	NO_x	12.53	0.06
MMH	ROC	0.10	0.00
N_2O_4	NO_x (Fugitives)	2.31	0.01
MMH	ROC (Fugitives)	0.06	0.00

Total Potential to Emit

Propellant	Pollutant	lb/day	TPY
N_2O_4	NO_x	14.84	0.22
MMH	ROC	0.15	0.00

Notes:

1. One payload loading or unloading event permitted per day.
   PTE reflects the worst case scenario.

Processed By: KMB Date: 2/11/2020

Roll-On Roll-Off Emissions - Los Angeles County Elizabeth C

Source Category	VOC	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$	Pb	CO2	CH4	N2O	CO2e
	ton/yr							MT/yr			
Marine Vessel	1.40	15.73	28.21	0.38	0.34	0.34	0.00	3657.70	0.05	0.15	3703.03
Off-Road	0.07	1.33	1.75	0.00	0.04	0.04	0.00	297.21	0.09	0.04	311.02
Total	**1.47**	**17.06**	**29.96**	**0.38**	**0.38**	**0.38**	**0.00**	**3,954.92**	**0.14**	**0.19**	**4,014.05**

SpaceX Marine Emissions - Los Angeles County

Marine Emission Estimates - Elizabeth C

Boat Classification	Phase	Engine	Engine Tier	Fuel	# Engines	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)
Tugboat	Transit	Propulsion	4	0.1%S	2	1,300	969	1.00	10.70	1862
Tugboat	Transit	Auxiliary	3	0.1%S	1	99	74	0.31	10.70	1862
Generator-Barge	Transit	Generator Sets	4	0.1%S	1	49	37	0.74	10.70	1862
Emission Subtotals										

Boat Classification	Engine	Emission Factors									
		VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
		(g/kW-hr)									
Tugboat	Propulsion	0.19	1.80	5.00	0.07	0.04	0.04	0.00	715.76	0.01	0.03
Tugboat	Auxiliary	0.38	5.02	5.00	0.07	0.12	0.12	0.00	656.00	0.01	0.03
		(g/hp-hr)									
Generator-Barge	Generator Sets	0.12	2.75	4.10	0.01	0.01	0.01	-	568.30	0.02	0.01

Boat Classification	Engine	Maximum Daily Emissions									
		VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
		(lb/day)									
Tugboat	Propulsion	8.69	82.32	228.68	3.11	1.83	1.83	0.03	32,735.78	1.33	0.46
Tugboat	Auxiliary	0.20	2.72	2.71	0.04	0.06	0.06	0.00	354.98	0.02	0.01
Generator-Barge	Generator Sets	0.10	2.35	3.51	0.00	0.01	0.01	-	486.09	0.01	0.02
Emission Subtotals		**9.00**	**87.39**	**234.89**	**3.15**	**1.90**	**1.90**	**0.03**	**33,576.85**	**1.35**	**0.48**

Boat Classification	Engine	Annual Emissions										
		VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20	CO2E
		(ton/yr)							(MT/yr)			
Tugboat	Propulsion	0.76	7.16	19.90	0.27	0.16	0.16	0.00	2,583.68	0.04	0.10	2,615.77
Tugboat	Auxiliary	0.02	0.24	0.24	0.00	0.01	0.01	0.00	28.02	0.00	0.00	28.40
Generator-Barge	Generator Sets	0.01	0.13	0.19	0.00	0.00	0.00	-	24.27	0.00	0.00	24.39
Emission Subtotals		**0.78**	**7.53**	**20.32**	**0.27**	**0.17**	**0.17**	**0.00**	**2,635.97**	**0.04**	**0.11**	**2,668.56**

Note:

Marine Emission Estimates - Bernardine C

Boat Classification	Phase	Engine	Engine Tier	Fuel	# Engines	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)
Tugboat	Transit	Propulsion	3	0.1%S	2	500	373	1.00	10.70	1862
Tugboat	Transit	Auxiliary	3	0.1%S	1	99	74	0.31	10.70	1862
Emission Subtotals										

Boat Classification	Engine	Emission Factors									
		VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
		(g/kW-hr)									
Tugboat	Propulsion	0.39	5.21	5.00	0.07	0.11	0.11	0.00	715.76	0.01	0.03
Tugboat	Auxiliary	0.38	5.02	5.00	0.07	0.12	0.12	0.00	656.00	0.01	0.03

Boat Classification	Engine	Maximum Daily Emissions									
		VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
		(lb/day)									
Tugboat	Propulsion	6.90	91.61	87.95	1.20	1.93	1.93	0.01	12,590.69	0.51	0.18
Tugboat	Auxiliary	0.20	2.72	2.71	0.04	0.06	0.06	0.00	354.98	0.02	0.01
Emission Subtotals		**7.10**	**94.33**	**90.66**	**1.23**	**2.00**	**2.00**	**0.01**	**12,945.67**	**0.53**	**0.18**

Boat Classification	Engine	Annual Emissions										
		VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20	CO2E
		(ton/yr)							(MT/yr)			
Tugboat	Propulsion	0.60	7.97	7.65	0.10	0.17	0.17	0.00	993.72	0.01	0.04	1,006.07
Tugboat	Auxiliary	0.02	0.24	0.24	0.00	0.01	0.01	0.00	28.02	0.00	0.00	28.40
Emission Subtotals		**0.62**	**8.21**	**7.89**	**0.11**	**0.17**	**0.17**	**0.00**	**1,021.74**	**0.01**	**0.04**	**1,034.46**

Note:

Emission Factors

Marine Propulsion

Engine Type	Engine Family	Model	Tier	Fuel	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
					(g/kW-hr)									
Slow Speed Diesel		<=1999	Tier 0	0.1%S	0.600	17.01	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		<=1999	Tier 0	0.1%S	0.500	13.16	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2000-2010	Tier 1	0.1%S	0.600	15.98	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2000-2010	Tier 1	0.1%S	0.500	12.22	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2011-2015	Tier 2	0.1%S	0.600	14.38	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2011-2015	Tier 2	0.1%S	0.500	10.53	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2016+	Tier 3	0.1%S	0.600	3.38	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2016+	Tier 3	0.1%S	0.500	2.63	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
EPA Certification	HCEXN19.0AAA		Tier 3	0.1%S	0.392	5.21	5.0	0.07	0.11	0.11	0.0006067	716		
EPA Certification	D233051MX03		Tier 4	0.1%S	0.190	1.80	5.0	0.07	0.04	0.04	0.0006067	716		

Notes:
Emission factors from Table 2.3 and 2.4 of the 2019 Port of Los Angeles Emission Inventory Methodology Report
EPA certification based on Tier 3 rating for the engine family from Table 1 to CFR §1042.101.
Emission factor for Pb from the Santa Barbara Air Pollution Control District Approved TAC Emission Factors, December 2023.

Marine Auxiliary

Engine Type	Model	Tier	Fuel	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
				(g/kW-hr)									
Aux High Speed Diesel	<=1999	Tier 0	0.1%S	0.600	10.9	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	<=1999	Tier 0	0.1%S	0.600	13.82	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel	2000-2010	Tier 1	0.1%S	0.600	9.78	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	2000-2010	Tier 1	0.1%S	0.600	12.22	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel	2011-2015	Tier 2	0.1%S	0.600	7.71	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	2011-2015	Tier 2	0.1%S	0.600	10.53	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel	2011-2015	Tier 3	0.1%S	0.600	1.97	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	2011-2015	Tier 3	0.1%S	0.600	2.63	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux Med Speed Diesel Tier 3 Standard	2011-2015	Tier 3	0.1%S	0.378	5.022	5	0.068	0.12	0.12	0.0006067			
				(g/hp-hr)									
Generator Sets		Tier 4 Final	0.1%S	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	-	568.2990	0.0180	0.0081

Notes:
Emission factors from Table 2.9 and 2.10 of the 2019 Port of Los Angeles Emission Inventory Methodology Report
Load factors for auxiliary engines based on Table 3.1 of the of the 2019 Port of Los Angeles Emission Inventory Methodology Report
EPA certification based on Tier 3 rating for the engine family from Table 5 to CFR §1042.101.
Emission factor for Pb from the Santa Barbara Air Pollution Control District Approved TAC Emission Factors, December 2023.

Marine exhaust emissions were calculated using the following equation:

$$Emissions_{diesel} = \Sigma\, EF_i \times Eng_i \times AvgHP \times Load_i \times Activity_i$$

Where:

EF	=	*Emission factor in grams per horse-power hour*
Eng	=	*Number of engines*
AvgHP	=	*Maximum rated average horsepower*
Load	=	*Load factor*
Activity	=	*Hours of operation*
i	=	*Equipment type*

SpaceX Offroad Emissions - Los Angeles County

Off-Road Emission Estimates

Construction Equipment	OFFROAD Model Category	Engine Tier	Quantity	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (day/yr)	Emission Factors (g/BHP-hr) VOC	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N2O	Daily Emissions (lb/day) VOC	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N20	Annual Emissions (MT/yr) CO2	CH4	N2O	CO2E
Crane-LR 1300	Crane	3	1	603	450	0.29	16	150	0.12	2.32	2.6	0.005	0.088	0.088	510.334	0.152	0.068138	0.74	14.31	16.04	0.03	0.54	0.54	3,147.87	0.94	0.42	214.18	0.06	0.03	224.29
Crane-Tadano ATF 220G	Crane	4	1	197	147	0.29	8	150	0.0600	0.2600	3.7000	0.0050	0.0080	0.0080	514.2600	0.1540	0.0690	0.06	0.26	3.73	0.01	0.01	0.01	518.16	0.16	0.07	35.26	0.01	0.00	36.93
KMAG	NA	3	1	453	338	0.3	4.0	150	0.1200	2.3200	2.6000	0.0050	0.0088	0.0088	528.8080	0.1540	0.0690	0.14	2.78	3.12	0.01	0.01	0.01	634	0.18	0.08	43.14	0.01	0.01	45.14
Generator-Barge	Generator Sets	4	1	49	37	0.74	1.5	150	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	568.2990	0.0180	0.0081	0.01	0.33	0.49	0.00	0.00	0.00	68	0.00	0.00	4.64	0.00	0.00	4.66
Emission Subtotals																		**0.96**	**17.68**	**23.37**	**0.04**	**0.56**	**0.56**	**4,368.26**	**1.28**	**0.57**	**297.21**	**0.09**	**0.04**	**311.02**

Notes:

Emission factors are default emission factors from CalEEMod 2016.3.2, which relies on OFFROAD 2011.

Load factor for generator and cranes are defaults from CalEEMod 2016.3.2.

Load factor for KMAG based on average speed over route compared to rated maximum travel speed.

Emission Factors

Equipment Type	Year	Low HP	High HP	VOC (g/BHP-hr)	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N2O
KMAG	Tier 3	300	599	0.1200	2.3200	2.6000	0.0050	0.0088	0.0088	528.8080	0.1540	0.0690
Generator Sets	Tier 4 Final	25	49	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	568.2990	0.0180	0.0081
Crane-LR 1300	Tier 3	600	750	0.1200	2.3200	2.6000	0.0050	0.0880	0.0880	510.3340	0.1520	0.0681
Crane-Tadano ATF 220G	Tier 4 Final	120	174	0.0600	0.2600	3.7000	0.0050	0.0080	0.0080	514.2600	0.1540	0.0690

Off-road mobile equipment exhaust emissions were calculated using the following equation:

$$Emissions_{diesel} = \Sigma\, EF_i \times Pop_i \times AvgHP \times Load_i \times Activity_i$$

Where:

EF	=	*Emission factor in grams per horse-power hour*
Pop	=	*Population, or the number of pieces of equipment*
AvgHP	=	*Maximum rated average horsepower*
Load	=	*Load factor*
Activity	=	*Hours of operation*
i	=	*Equipment type*

Roll-On Roll-Off Emissions Kelly C - Los Angeles County

Source Category	VOC	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$	Pb	CO2	CH4	N2O	CO2e
	ton/yr							MT/yr			
Marine Vessel	0.70	9.31	8.97	0.12	0.20	0.20	0.00	1164.15	0.02	0.05	1178.55
Off-Road	0.02	0.44	0.58	0.00	0.01	0.01	0.00	99.07	0.03	0.01	103.67
Total	**0.72**	**9.75**	**9.56**	**0.12**	**0.21**	**0.21**	**0.00**	**1,263.22**	**0.05**	**0.06**	**1,282.22**

SpaceX Marine Roll-On Roll-Off Emissions

Marine Emission Estimates - Kelly C

Boat Classification	Phase	Engine	Engine Tier	Fuel	# Engines	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)	Emission Factors VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
											(g/kW-hr)									
Tugboat	Transit	Propulsion	3	0.1%S	2	1,000	746	1.00	10.70	706	0.39	5.21	5.00	0.07	0.11	0.11	0.00	715.76	0.01	0.03
Tugboat	Transit	Auxiliary	3	0.1%S	1	99	74	0.31	10.70	706	0.38	5.02	5.00	0.07	0.12	0.12	0.00	656.00	0.01	0.03
											(g/hp-hr)									
Generator-Barge	Transit	Generator Sets	4	0.1%S	1	49	37	0.74	10.70	706	0.12	2.75	4.10	0.01	0.01	0.01	-	568.30	0.02	0.01
Emission Subtotals																				

Boat Classification	Maximum Daily Emissions VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
	(lb/day)									
Tugboat	13.79	183.22	175.91	2.39	3.87	3.87	0.02	25,181.37	1.02	0.35
Tugboat	0.20	2.72	2.71	0.04	0.06	0.06	0.00	354.98	0.02	0.01
Generator-Barge	0.10	2.35	3.51	0.00	0.01	0.01	-	486.09	0.01	0.02
Emission Subtotals	**14.10**	**188.29**	**182.12**	**2.43**	**3.94**	**3.94**	**0.02**	**26,022.44**	**1.04**	**0.37**

Boat Classification	Annual Emissions VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20	CO2E
	(ton/yr)							(MT/yr)			
Tugboat	0.46	6.05	5.80	0.08	0.13	0.13	0.00	753.86	0.01	0.03	763.22
Tugboat	0.01	0.09	0.09	0.00	0.00	0.00	0.00	10.63	0.00	0.00	10.77
Generator-Barge	0.00	0.06	0.09	0.00	0.00	0.00	-	12.11	0.00	0.00	12.17
Emission Subtotals	**0.46**	**6.19**	**5.98**	**0.08**	**0.13**	**0.13**	**0.00**	**776.60**	**0.01**	**0.03**	**786.17**

Note:

Marine Emission Estimates - Bernardine C

Boat Classification	Phase	Engine	Engine Tier	Fuel	# Engines	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)	Emission Factors VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
											(g/kW-hr)									
Tugboat	Transit	Propulsion	3	0.1%S	2	500	373	1.00	10.70	706	0.39	5.21	5.00	0.07	0.11	0.11	0.00	715.76	0.01	0.03
Tugboat	Transit	Auxiliary	3	0.1%S	1	99	74	0.31	10.70	706	0.38	5.02	5.00	0.07	0.12	0.12	0.00	656.00	0.01	0.03
Emission Subtotals																				

Boat Classification	Maximum Daily Emissions VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
	(lb/day)									
Tugboat	6.90	91.61	87.95	1.20	1.93	1.93	0.01	12,590.69	0.51	0.18
Tugboat	0.20	2.72	2.71	0.04	0.06	0.06	0.00	354.98	0.02	0.01
Emission Subtotals	**7.10**	**94.33**	**90.66**	**1.23**	**2.00**	**2.00**	**0.01**	**12,945.67**	**0.53**	**0.18**

Boat Classification	Annual Emissions VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20	CO2E
	(ton/yr)							(MT/yr)			
Tugboat	0.23	3.02	2.90	0.04	0.06	0.06	0.00	376.93	0.01	0.02	381.61
Tugboat	0.01	0.09	0.09	0.00	0.00	0.00	0.00	10.63	0.00	0.00	10.77
Emission Subtotals	**0.23**	**3.11**	**2.99**	**0.04**	**0.07**	**0.07**	**0.00**	**387.56**	**0.01**	**0.02**	**392.38**

Note:

Emission Factors

Marine Propulsion

Engine Type	Engine Family	Model	Tier	Fuel	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
					(g/kW-hr)									
Slow Speed Diesel		<=1999	Tier 0	0.1%S	0.600	17.01	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		<=1999	Tier 0	0.1%S	0.500	13.16	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2000-2010	Tier 1	0.1%S	0.600	15.98	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2000-2010	Tier 1	0.1%S	0.500	12.22	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2011-2015	Tier 2	0.1%S	0.600	14.38	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2011-2015	Tier 2	0.1%S	0.500	10.53	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2016+	Tier 3	0.1%S	0.600	3.38	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2016+	Tier 3	0.1%S	0.500	2.63	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
EPA Certification	HCEXN19.0AAA		Tier 3	0.1%S	0.392	5.21	5.0	0.07	0.11	0.11	0.0006067	716		
EPA Certification	D233051MX03		Tier 4	0.1%S	0.190	1.80	5.0	0.07	0.04	0.04	0.0006067	716		

Notes:
Emission factors from Table 2.3 and 2.4 of the 2019 Port of Los Angeles Emission Inventory Methodology Report
EPA certification based on Tier 3 rating for the engine family from Table 1 to CFR §1042.101.
Emission factor for Pb from the Santa Barbara Air Pollution Control District Approved TAC Emission Factors, December 2023.

Marine Auxiliary

Engine Type		Model	Tier	Fuel	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
					(g/kW-hr)									
Aux High Speed Diesel		<=1999	Tier 0	0.1%S	0.600	10.9	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel		<=1999	Tier 0	0.1%S	0.600	13.82	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel		2000-2010	Tier 1	0.1%S	0.600	9.78	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel		2000-2010	Tier 1	0.1%S	0.600	12.22	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel		2011-2015	Tier 2	0.1%S	0.600	7.71	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel		2011-2015	Tier 2	0.1%S	0.600	10.53	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel		2011-2015	Tier 3	0.1%S	0.600	1.97	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel		2011-2015	Tier 3	0.1%S	0.600	2.63	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux Med Speed Diesel	Tier 3 Standard	2011-2015	Tier 3	0.1%S	0.378	5.022	5	0.068	0.12	0.12	0.0006067			
					(g/hp-hr)									
Generator Sets			Tier 4 Final	0.1%S	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	-	568.2990	0.0180	0.0081

Notes:
Emission factors from Table 2.9 and 2.10 of the 2019 Port of Los Angeles Emission Inventory Methodology Report
Load factors for auxiliary engines based on Table 3.1 of the of the 2019 Port of Los Angeles Emission Inventory Methodology Report
EPA certification based on Tier 3 rating for the engine family from Table 5 to CFR §1042.101.
Emission factor for Pb from the Santa Barbara Air Pollution Control District Approved TAC Emission Factors, December 2023.

Marine exhaust emissions were calculated using the following equation:

$$Emissions_{diesel} = \Sigma\, EF_i \times Eng_i \times AvgHP \times Load_i \times Activity_i$$

Where:

EF = *Emission factor in grams per horse-power hour*
Eng = *Number of engines*
AvgHP = *Maximum rated average horsepower*
Load = *Load factor*
Activity = *Hours of operation*
i = *Equipment type*

SpaceX Offroad Roll-On Roll-Off Emissions

Off-Road Emission Estimates

Construction Equipment	OFFROAD Model Category	Engine Tier	Quantity	Engine Rating	Engine Rating	Load Factor	Operation	Operation	Emission Factors VOC	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N2O
				(hp)	(kW)		(hr/day)	(day/yr)	(g/BHP-hr)								
Crane-LR 1300	Crane	3	1	603	450	0.29	16	50	0.12	2.32	2.6	0.005	0.088	0.088	510.334	0.152	0.068138
Crane-Tadano ATF 220G	Crane	4	1	197	147	0.29	8	50	0.0600	0.2600	3.7000	0.0050	0.0080	0.0080	514.2600	0.1540	0.0690
KMAG	NA	3	1	453	338	0.3	4.0	50	0.1200	2.3200	2.6000	0.0050	0.0088	0.0088	528.8080	0.1540	0.0690
Generator-Barge	Generator Sets	4	1	49	37	0.74	1.5	50	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	568.2990	0.0180	0.0081
Emission Subtotals																	

Construction Equipment	Daily Emissions VOC	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N20	Annual Emissions CO2	CH4	N2O	CO2E
	(lb/day)									(MT/yr)			
Crane-LR 1300	0.74	14.31	16.04	0.03	0.54	0.54	3,147.87	0.94	0.42	71.39	0.02	0.01	74.76
Crane-Tadano ATF 220G	0.06	0.26	3.73	0.01	0.01	0.01	518.16	0.16	0.07	11.75	0.00	0.00	12.31
KMAG	0.14	2.78	3.12	0.01	0.01	0.01	634	0.18	0.08	14.38	0.00	0.00	15.05
Generator-Barge	0.01	0.33	0.49	0.00	0.00	0.00	68	0.00	0.00	1.55	0.00	0.00	1.55
Emission Subtotals	**0.96**	**17.68**	**23.37**	**0.04**	**0.56**	**0.56**	**4,368.26**	**1.28**	**0.57**	**99.07**	**0.03**	**0.01**	**103.67**

Notes:

Emission factors are default emission factors from CalEEMod 2016.3.2, which relies on OFFROAD 2011.

Load factor for generator and cranes are defaults from CalEEMod 2016.3.2.

Load factor for KMAG based on average speed over route compared to rated maximum travel speed.

Emission Factors

Equipment Type	Year	Low HP	High HP	VOC	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N2O
				(g/BHP-hr)								
KMAG	Tier 3	300	599	0.1200	2.3200	2.6000	0.0050	0.0088	0.0088	528.8080	0.1540	0.0690
Generator Sets	Tier 4 Final	25	49	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	568.2990	0.0180	0.0081
Crane-LR 1300	Tier 3	600	750	0.1200	2.3200	2.6000	0.0050	0.0880	0.0880	510.3340	0.1520	0.0681
Crane-Tadano ATF 220G	Tier 4 Final	120	174	0.0600	0.2600	3.7000	0.0050	0.0080	0.0080	514.2600	0.1540	0.0690

Off-road mobile equipment exhaust emissions were calculated using the following equation:

$$Emissions_{diesel} = \Sigma\, EF_i \times Pop_i \times AvgHP \times Load_i \times Activity_i$$

Where:

EF	=	*Emission factor in grams per horse-power hour*
Pop	=	*Population, or the number of pieces of equipment*
AvgHP	=	*Maximum rated average horsepower*
Load	=	*Load factor*
Activity	=	*Hours of operation*
i	=	*Equipment type*

Roll-On Roll-Off Emissions Elizabeth C - Santa Barbara County

Source Category	**VOC**	**NO_x**	**CO**	**SO_x**	**PM_{10}**	**$PM_{2.5}$**	**Pb**	**CO2**	**CH4**	**N20**	**CO2e**
	ton/yr							**MT/yr**			
Marine Vessel	3.12	35.00	62.84	0.85	0.76	0.76	0.01	8,149.76	0.11	0.33	8251.14
Off-Road	0.04	0.80	1.10	0.00	0.00	0.00	0.00	169.50	0.03	0.01	174.36
Total	**3.16**	**35.80**	**63.95**	**0.86**	**0.76**	**0.76**	**0.01**	**8,319.26**	**0.14**	**0.34**	**8,425.50**

SpaceX Marine Roll-On Roll-Off Emissions

Marine Emission Estimates - Elizabeth C

Boat Classification	Phase	Engine	Engine Tier	Fuel	# Engines	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)	Emission Factors (g/kW-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
Tugboat	Transit	Propulsion	4	0.1%S	2	1,300	969	1.00	24.00	4176	0.19	1.80	5.00	0.07	0.04	0.04	0.00	715.76	0.01	0.03
Tugboat	Transit	Auxiliary	3	0.1%S	1	99	74	0.31	24.00	4176	0.38	5.02	5.00	0.07	0.12	0.12	0.00	656.00	0.01	0.03
Emission Subtotals																				

Boat Classification	Engine	Maximum Daily Emissions (lb/day) VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
Tugboat	Propulsion	19.49	184.65	512.92	6.98	4.10	4.10	0.06	73,426.05	2.97	1.03
Tugboat	Auxiliary	0.46	6.10	6.07	0.08	0.15	0.15	0.00	796.22	0.04	0.01
Emission Subtotals		**19.95**	**190.75**	**518.99**	**7.06**	**4.25**	**4.25**	**0.06**	**74,222.28**	**3.01**	**1.04**

Boat Classification	Engine	Annual Emissions (ton/year) VOC	NOx	CO	SOx	PM10	PM2.5	Pb	(MT/yr) CO2	CH4	N20	CO2E
Tugboat	Propulsion	1.70	16.06	44.62	0.61	0.36	0.36	0.01	5,795.16	0.08	0.23	5,867.16
Tugboat	Auxiliary	0.04	0.53	0.53	0.01	0.01	0.01	0.00	62.84	0.00	0.00	63.69
Emission Subtotals		**1.74**	**16.60**	**45.15**	**0.61**	**0.37**	**0.37**	**0.01**	**5,858.01**	**0.08**	**0.24**	**5,930.85**

Note:

Marine Emission Estimates - Bernardine C

Boat Classification	Phase	Engine	Engine Tier	Fuel	# Engines	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)	Emission Factors (g/kW-hr) VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
Tugboat	Transit	Propulsion	3	0.1%S	2	500	373	1.00	24.00	4176	0.39	5.21	5.00	0.07	0.11	0.11	0.00	715.76	0.01	0.03
Tugboat	Transit	Auxiliary	3	0.1%S	1	99	74	0.31	24.00	4176	0.38	5.02	5.00	0.07	0.12	0.12	0.00	656.00	0.01	0.03
Emission Subtotals																				

Boat Classification	Engine	Maximum Daily Emissions (lb/day) VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
Tugboat	Propulsion	15.47	205.49	197.28	2.68	4.34	4.34	0.02	28,240.79	1.14	0.39
Tugboat	Auxiliary	0.46	6.10	6.07	0.08	0.15	0.15	0.00	796.22	0.04	0.01
Emission Subtotals		**15.93**	**211.58**	**203.35**	**2.77**	**4.49**	**4.49**	**0.02**	**29,037.01**	**1.18**	**0.41**

Boat Classification	Engine	Annual Emissions (ton/yr) VOC	NOx	CO	SOx	PM10	PM2.5	Pb	(MT/yr) CO2	CH4	N20	CO2E
Tugboat	Propulsion	1.35	17.88	17.16	0.23	0.38	0.38	0.00	2,228.91	0.03	0.09	2,256.60
Tugboat	Auxiliary	0.04	0.53	0.53	0.01	0.01	0.01	0.00	62.84	0.00	0.00	63.69
Emission Subtotals		**1.39**	**18.41**	**17.69**	**0.24**	**0.39**	**0.39**	**0.00**	**2,291.75**	**0.03**	**0.09**	**2,320.29**

Note:

Marine Propulsion

Engine Type	Engine Family	Model	Tier	Fuel	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
					(g/kW-hr)									
Slow Speed Diesel		<=1999	Tier 0	0.1%S	0.600	17.01	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		<=1999	Tier 0	0.1%S	0.500	13.16	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2000-2010	Tier 1	0.1%S	0.600	15.98	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2000-2010	Tier 1	0.1%S	0.500	12.22	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2011-2015	Tier 2	0.1%S	0.600	14.38	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2011-2015	Tier 2	0.1%S	0.500	10.53	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2016+	Tier 3	0.1%S	0.600	3.38	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2016+	Tier 3	0.1%S	0.500	2.63	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
EPA Certification	HCEXN19.0AAA		Tier 3	0.1%S	0.392	5.21	5.0	0.07	0.11	0.11	0.0006067	716		
EPA Certification	D233051MX03		Tier 4	0.1%S	0.190	1.80	5.0	0.07	0.04	0.04	0.0006067	716		

Notes:
Emission factors from Table 2.3 and 2.4 of the 2019 Port of Los Angeles Emission Inventory Methodology Report
EPA certification based on Tier 3 rating for the engine family from Table 1 to CFR §1042.101.
Emission factor for Pb from the Santa Barbara Air Pollution Control District Approved TAC Emission Factors, December 2023.

Marine Auxiliary

Engine Type	Model	Tier	Fuel	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
				(g/kW-hr)									
Aux High Speed Diesel	<=1999	Tier 0	0.1%S	0.600	10.9	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	<=1999	Tier 0	0.1%S	0.600	13.82	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel	2000-2010	Tier 1	0.1%S	0.600	9.78	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	2000-2010	Tier 1	0.1%S	0.600	12.22	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel	2011-2015	Tier 2	0.1%S	0.600	7.71	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	2011-2015	Tier 2	0.1%S	0.600	10.53	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel	2011-2015	Tier 3	0.1%S	0.600	1.97	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel	2011-2015	Tier 3	0.1%S	0.600	2.63	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux Med Speed Diesel Tier 3 Standard	2011-2015	Tier 3	0.1%S	0.378	5.022	5	0.068	0.12	0.12	0.0006067			
				(g/hp-hr)									
Generator Sets		Tier 4 Final	0.1%S	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	-	568.2990	0.0180	0.0081

Notes:
Emission factors from Table 2.9 and 2.10 of the 2019 Port of Los Angeles Emission Inventory Methodology Report
Load factors for auxiliary engines based on Table 3.1 of the of the 2019 Port of Los Angeles Emission Inventory Methodology Report
EPA certification based on Tier 3 rating for the engine family from Table 5 to CFR §1042.101.
Emission factor for Pb from the Santa Barbara Air Pollution Control District Approved TAC Emission Factors, December 2023.

Marine exhaust emissions were calculated using the following equation:

$$Emissions_{diesel} = \Sigma\, EF_i \times Eng_i \times AvgHP \times Load_i \times Activity_i$$

Where:

EF	=	*Emission factor in grams per horse-power hour*
Eng	=	*Number of engines*
AvgHP	=	*Maximum rated average horsepower*
Load	=	*Load factor*
Activity	=	*Hours of operation*
i	=	*Equipment type*

SpaceX Offroad Roll-On Roll-Off Emissions

Off-Road Emission Estimates

Construction Equipment	OFFROAD Model Category	Engine Tier	Quantity	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)
Crane-HTC-3140LB J8	Crane-transport	4	1	550	410	0.29	0.5	75
Crane-HTC-3140LB J8	Crane-lift	4	1	215	160	0.29	2	300
KMAG	NA	3	1	453	338	0.30	8	1125
Generator-Barge	Generator Sets	4	1	49	37	0.74	24.0	3600
Emission Subtotals								

Construction Equipment	Emission Factors (g/BHP-hr) VOC	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N2O
Crane-HTC-3140LB J8	0.0600	0.2600	2.2000	0.0050	0.0080	0.0080	470.5495	0.1522	0.0682
Crane-HTC-3140LB J8	0.0600	0.2600	2.2000	0.0050	0.0080	0.0080	472.9057	0.1529	0.0690
KMAG	0.1200	2.3200	2.6000	0.0050	0.0088	0.0088	528.8080	0.1540	0.0690
Generator-Barge	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	568.2990	0.0180	0.0081
Emission Subtotals									

Construction Equipment	Daily Emissions (lb/day) VOC	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N20
Crane-HTC-3140LB J8	0.01	0.05	0.39	0.00	0.00	0.00	82.73	0.03	0.01
Crane-HTC-3140LB J8	0.02	0.07	0.60	0.00	0.00	0.00	130.01	0.04	0.02
KMAG	0.27	5.21	5.84	0.01	0.02	0.02	1,188.24	0.35	0.16
Generator-Barge	0.23	5.28	7.87	0.01	0.02	0.02	1,090	0.03	0.02
Emission Subtotals	**0.53**	**10.61**	**14.70**	**0.02**	**0.04**	**0.04**	**2,491.27**	**0.45**	**0.20**

Construction Equipment	Annual Emissions (ton/year) VOC	NOx	CO	SOx	PM10	PM2.5	(MT/yr) CO2	CH4	N2O	CO2E
Crane-HTC-3140LB J8	0.00	0.00	0.03	0.00	0.00	0.00	5.63	0.00	0.00	5.92
Crane-HTC-3140LB J8	0.00	0.01	0.05	0.00	0.00	0.00	8.85	0.00	0.00	9.30
KMAG	0.02	0.39	0.44	0.00	0.00	0.00	80.85	0.02	0.01	84.58
Generator-Barge	0.02	0.40	0.59	0.00	0.00	0.00	74.18	0.00	0.00	74.55
Emission Subtotals	**0.04**	**0.80**	**1.10**	**0.00**	**0.00**	**0.00**	**169.50**	**0.03**	**0.01**	**174.36**

Notes:

Emission factors are default emission factors from CalEEMod 2016.3.2, which relies on OFFROAD 2011.

Load factor for generator are defaults from CalEEMod 2016.3.2.

Load factor for KMAG based on average speed over route compared to rated maximum travel speed.

Fugitive dust emissions from paved roads assumes the KMAG is loaded.

Emission Factors

Equipment Type	Year	Low HP	High HP	VOC	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N2O
				(g/BHP-hr)								
KMAG	Tier 3	300	599	0.1200	2.3200	2.6000	0.0050	0.0088	0.0088	528.8080	0.1540	0.0690
Crane-HTC-3140LB J8	Tier 4 Final	175	299	0.0600	0.2600	2.2000	0.0050	0.0080	0.0080	472.9057	0.1529	0.0690
Crane-HTC-3140LB J8	Tier 4 Final	300	599	0.0600	0.2600	2.2000	0.0050	0.0080	0.0080	470.5495	0.1522	0.0682
Generator Sets	Tier 4 Final	25	49	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	568.2990	0.0180	0.0081

Off-road mobile equipment exhaust emissions were calculated using the following equation:

$$Emissions_{diesel} = \Sigma\, EF_i \times Pop_i \times AvgHP \times Load_i \times Activity_i$$

Where:

EF	=	*Emission factor in grams per horse-power hour*
Pop	=	*Population, or the number of pieces of equipment*
AvgHP	=	*Maximum rated average horsepower*
Load	=	*Load factor*
Activity	=	*Hours of operation*
i	=	*Equipment type*

Roll-On Roll-Off Emissions Kelly C - Santa Barbara County

Source Category	VOC	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$	Pb	CO2	CH4	N20	CO2e
	ton/yr							MT/yr			
Marine Vessel	1.56	20.75	19.93	0.27	0.44	0.44	0.00	2,584.02	0.04	0.10	2616.17
Off-Road	0.00	0.05	0.07	0.00	0.00	0.00	0.00	11.30	0.00	0.00	11.62
Total	**1.56**	**20.80**	**20.00**	**0.27**	**0.44**	**0.44**	**0.00**	**2,595.32**	**0.04**	**0.11**	**2,627.80**

SpaceX Marine Roll-On Roll-Off Emissions

Marine Emission Estimates - Kelly C

Boat Classification	Phase	Engine	Engine Tier	Fuel	# Engines	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)
Tugboat	Transit	Propulsion	3	0.1%S	2	1,000	746	1.00	24.00	1584
Tugboat	Transit	Auxiliary	3	0.1%S	1	99	74	0.31	24.00	1584
Emission Subtotals										

	Emission Factors (g/kW-hr)									
Boat Classification / Engine	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
Tugboat – Propulsion	0.39	5.21	5.00	0.07	0.11	0.11	0.00	715.76	0.01	0.03
Tugboat – Auxiliary	0.38	5.02	5.00	0.07	0.12	0.12	0.00	656.00	0.01	0.03
Emission Subtotals										

	Maximum Daily Emissions (lb/day)									
Boat Classification / Engine	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
Tugboat – Propulsion	30.93	410.97	394.56	5.37	8.68	8.68	0.05	56,481.58	2.29	0.79
Tugboat – Auxiliary	0.46	6.10	6.07	0.08	0.15	0.15	0.00	796.22	0.04	0.01
Emission Subtotals	**31.39**	**417.07**	**400.63**	**5.45**	**8.83**	**8.83**	**0.05**	**57,277.80**	**2.32**	**0.80**

	Annual Emissions (ton/year)							(MT/yr)			
Boat Classification / Engine	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20	CO2E
Tugboat – Propulsion	1.02	13.56	13.02	0.18	0.29	0.29	0.00	1,690.90	0.02	0.07	1,711.90
Tugboat – Auxiliary	0.02	0.20	0.20	0.00	0.00	0.00	0.00	23.84	0.00	0.00	24.16
Emission Subtotals	**1.04**	**13.76**	**13.22**	**0.18**	**0.29**	**0.29**	**0.00**	**1,714.73**	**0.02**	**0.07**	**1,736.06**

Note:

Marine Emission Estimates - Bernardine C

Boat Classification	Phase	Engine	Engine Tier	Fuel	# Engines	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)
Tugboat	Transit	Propulsion	3	0.1%S	2	500	373	1.00	24.00	1584
Tugboat	Transit	Auxiliary	3	0.1%S	1	99	74	0.31	24.00	1584
Emission Subtotals										

	Emission Factors (g/kW-hr)									
Boat Classification / Engine	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
Tugboat – Propulsion	0.39	5.21	5.00	0.07	0.11	0.11	0.00	715.76	0.01	0.03
Tugboat – Auxiliary	0.38	5.02	5.00	0.07	0.12	0.12	0.00	656.00	0.01	0.03
Emission Subtotals										

	Maximum Daily Emissions (lb/day)									
Boat Classification / Engine	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
Tugboat – Propulsion	15.47	205.49	197.28	2.68	4.34	4.34	0.02	28,240.79	1.14	0.39
Tugboat – Auxiliary	0.46	6.10	6.07	0.08	0.15	0.15	0.00	796.22	0.04	0.01
Emission Subtotals	**15.93**	**211.58**	**203.35**	**2.77**	**4.49**	**4.49**	**0.02**	**29,037.01**	**1.18**	**0.41**

	Annual Emissions (ton/yr)							(MT/yr)			
Boat Classification / Engine	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20	CO2E
Tugboat – Propulsion	0.51	6.78	6.51	0.09	0.14	0.14	0.00	845.45	0.01	0.03	855.95
Tugboat – Auxiliary	0.02	0.20	0.20	0.00	0.00	0.00	0.00	23.84	0.00	0.00	24.16
Emission Subtotals	**0.53**	**6.98**	**6.71**	**0.09**	**0.15**	**0.15**	**0.00**	**869.28**	**0.01**	**0.04**	**880.11**

Note:

Marine Propulsion

Engine Type	Engine Family	Model	Tier	Fuel	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
					(g/kW-hr)									
Slow Speed Diesel		<=1999	Tier 0	0.1%S	0.600	17.01	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		<=1999	Tier 0	0.1%S	0.500	13.16	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2000-2010	Tier 1	0.1%S	0.600	15.98	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2000-2010	Tier 1	0.1%S	0.500	12.22	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2011-2015	Tier 2	0.1%S	0.600	14.38	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2011-2015	Tier 2	0.1%S	0.500	10.53	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2016+	Tier 3	0.1%S	0.600	3.38	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2016+	Tier 3	0.1%S	0.500	2.63	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
EPA Certification	HCEXN19.0AAA		Tier 3	0.1%S	0.392	5.21	5.0	0.07	0.11	0.11	0.0006067	716		
EPA Certification	D233051MX03		Tier 4	0.1%S	0.190	1.80	5.0	0.07	0.04	0.04	0.0006067	716		

Notes:
Emission factors from Table 2.3 and 2.4 of the 2019 Port of Los Angeles Emission Inventory Methodology Report
EPA certification based on Tier 3 rating for the engine family from Table 1 to CFR §1042.101.
Emission factor for Pb from the Santa Barbara Air Pollution Control District Approved TAC Emission Factors, December 2023.

Marine Auxiliary

Engine Type		Model	Tier	Fuel	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
					(g/kW-hr)									
Aux High Speed Diesel		<=1999	Tier 0	0.1%S	0.600	10.9	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel		<=1999	Tier 0	0.1%S	0.600	13.82	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel		2000-2010	Tier 1	0.1%S	0.600	9.78	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel		2000-2010	Tier 1	0.1%S	0.600	12.22	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel		2011-2015	Tier 2	0.1%S	0.600	7.71	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel		2011-2015	Tier 2	0.1%S	0.600	10.53	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel		2011-2015	Tier 3	0.1%S	0.600	1.97	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel		2011-2015	Tier 3	0.1%S	0.600	2.63	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux Med Speed Diesel	Tier 3 Standard	2011-2015	Tier 3	0.1%S	0.378	5.022	5	0.068	0.12	0.12	0.0006067			
					(g/hp-hr)									
Generator Sets			Tier 4 Final	0.1%S	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	-	568.2990	0.0180	0.0081

Notes:
Emission factors from Table 2.9 and 2.10 of the 2019 Port of Los Angeles Emission Inventory Methodology Report
Load factors for auxiliary engines based on Table 3.1 of the of the 2019 Port of Los Angeles Emission Inventory Methodology Report
EPA certification based on Tier 3 rating for the engine family from Table 5 to CFR §1042.101.
Emission factor for Pb from the Santa Barbara Air Pollution Control District Approved TAC Emission Factors, December 2023.

Marine exhaust emissions were calculated using the following equation:

$$Emissions_{diesel} = \Sigma\, EF_i \times Eng_i \times AvgHP \times Load_i \times Activity_i$$

Where:

EF	=	*Emission factor in grams per horse-power hour*
Eng	=	*Number of engines*
AvgHP	=	*Maximum rated average horsepower*
Load	=	*Load factor*
Activity	=	*Hours of operation*
i	=	*Equipment type*

SpaceX Offroad Roll-On Roll-Off Emissions

Off-Road Emission Estimates

Construction Equipment	OFFROAD Model Category	Engine Tier	Quantity	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)
Crane-HTC-3140LB J8	Crane-transport	4	1	550	410	0.29	0.5	5
Crane-HTC-3140LB J8	Crane-lift	4	1	215	160	0.29	2	20
KMAG	NA	3	1	453	338	0.30	8	75
Generator-Barge	Generator Sets	4	1	49	37	0.74	24.0	240
Emission Subtotals								

Construction Equipment	Emission Factors (g/BHP-hr) VOC	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N2O
Crane-HTC-3140LB J8	0.0600	0.2600	2.2000	0.0050	0.0080	0.0080	470.5495	0.1522	0.0682
Crane-HTC-3140LB J8	0.0600	0.2600	2.2000	0.0050	0.0080	0.0080	472.9057	0.1529	0.0690
KMAG	0.1200	2.3200	2.6000	0.0050	0.0088	0.0088	528.8080	0.1540	0.0690
Generator-Barge	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	568.2990	0.0180	0.0081
Emission Subtotals									

Construction Equipment	Daily Emissions (lb/day) VOC	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N20	Annual Emissions (ton/year) VOC	NOx	CO	SOx	PM10	PM2.5	(MT/yr) CO2	CH4	N2O	CO2E
Crane-HTC-3140LB J8	0.01	0.05	0.39	0.00	0.00	0.00	82.73	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.00	0.39
Crane-HTC-3140LB J8	0.02	0.07	0.60	0.00	0.00	0.00	130.01	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.62
KMAG	0.27	5.21	5.84	0.01	0.02	0.02	1,188.24	0.35	0.16	0.00	0.03	0.03	0.00	0.00	0.00	5.39	0.00	0.00	5.64
Generator-Barge	0.23	5.28	7.87	0.01	0.02	0.02	1,090	0.03	0.02	0.00	0.03	0.04	0.00	0.00	0.00	4.95	0.00	0.00	4.97
Emission Subtotals	**0.53**	**10.61**	**14.70**	**0.02**	**0.04**	**0.04**	**2,491.27**	**0.45**	**0.20**	**0.00**	**0.05**	**0.07**	**0.00**	**0.00**	**0.00**	**11.30**	**0.00**	**0.00**	**11.62**

Notes:

Emission factors are default emission factors from CalEEMod 2016.3.2, which relies on OFFROAD 2011.
Load factor for generator are defaults from CalEEMod 2016.3.2.
Load factor for KMAG based on average speed over route compared to rated maximum travel speed.
Fugitive dust emissions from paved roads assumes the KMAG is loaded.

Emission Factors

Equipment Type	Year	Low HP	High HP	VOC (g/BHP-hr)	NOx	CO	SOx	PM10	PM2.5	CO2	CH4	N2O
KMAG	Tier 3	300	599	0.1200	2.3200	2.6000	0.0050	0.0088	0.0088	528.8080	0.1540	0.0690
Crane-HTC-3140LB J8	Tier 4 Final	175	299	0.0600	0.2600	2.2000	0.0050	0.0080	0.0080	472.9057	0.1529	0.0690
Crane-HTC-3140LB J8	Tier 4 Final	300	599	0.0600	0.2600	2.2000	0.0050	0.0080	0.0080	470.5495	0.1522	0.0682
Generator Sets	Tier 4 Final	25	49	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	568.2990	0.0180	0.0081

Off-road mobile equipment exhaust emissions were calculated using the following equation:

$$Emissions_{diesel} = \Sigma\, EF_i \times Pop_i \times AvgHP \times Load_i \times Activity_i$$

Where:

EF = *Emission factor in grams per horse-power hour*
Pop = *Population, or the number of pieces of equipment*
AvgHP = *Maximum rated average horsepower*
Load = *Load factor*
Activity = *Hours of operation*
i = *Equipment type*

SpaceX Roll-On Roll-Off Ventura County

Marine Emission Estimates - Elizabeth C

Boat Classification	Phase	Engine	Engine Tier	Fuel	# Engines	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)
Tugboat	Transit	Propulsion	4	0.1%S	2	1,300	969	1.00	20.00	3120
Tugboat	Transit	Auxiliary	3	0.1%S	1	99	74	0.31	20.00	3120
Generator-Barge	Transit	Generator Sets	4	0.1%S	1	49	37	0.74	20.00	3120
Emission Subtotals										

Boat Classification	Engine	Emission Factors VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
		(g/kW-hr)									
Tugboat	Propulsion	0.19	1.80	5.00	0.07	0.04	0.04	0.00	715.76	0.01	0.03
Tugboat	Auxiliary	0.38	5.02	5.00	0.07	0.12	0.12	0.00	656.00	0.01	0.03
		(g/hp-hr)									
Generator-Barge	Generator Sets	0.12	2.75	4.10	0.01	0.01	0.01	-	568.30	0.02	0.01

Boat Classification	Engine	Maximum Daily Emissions VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
		(lb/day)									
Tugboat	Propulsion	16.24	153.88	427.44	5.81	3.42	3.42	0.05	61,188.38	2.48	0.85
Tugboat	Auxiliary	0.38	5.08	5.06	0.07	0.12	0.12	0.00	663.52	0.03	0.01
Generator-Barge	Generator Sets	0.19	4.40	6.55	0.01	0.01	0.01	-	908.58	0.01	0.03
Emission Subtotals		**16.82**	**163.35**	**439.05**	**5.89**	**3.55**	**3.55**	**0.05**	**62,760.48**	**2.52**	**0.89**

Boat Classification	Engine	Annual Emissions VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20	CO2E
		(ton/yr)							(MT/yr)			
Tugboat	Propulsion	1.27	12.00	33.34	0.45	0.27	0.27	0.00	4,329.72	0.06	0.18	4,383.51
Tugboat	Auxiliary	0.03	0.40	0.39	0.01	0.01	0.01	0.00	46.95	0.00	0.00	47.59
Generator-Barge	Generator Sets	0.01	0.26	0.39	0.00	0.00	0.00	-	48.55	0.00	0.00	48.79
Emission Subtotals		**1.31**	**12.66**	**34.12**	**0.46**	**0.28**	**0.28**	**0.00**	**4,425.22**	**0.06**	**0.18**	**4,479.89**

Note:

Marine Emission Estimates - Bernardine C

Boat Classification	Phase	Engine	Engine Tier	Fuel	# Engines	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)
Tugboat	Transit	Propulsion	3	0.1%S	2	500	373	1.00	20.00	3120
Tugboat	Transit	Auxiliary	3	0.1%S	1	99	74	0.31	20.00	3120
Emission Subtotals										

Boat Classification	Engine	Emission Factors VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
		(g/kW-hr)									
Tugboat	Propulsion	0.39	5.21	5.00	0.07	0.11	0.11	0.00	715.76	0.01	0.03
Tugboat	Auxiliary	0.38	5.02	5.00	0.07	0.12	0.12	0.00	656.00	0.01	0.03

Boat Classification	Engine	Maximum Daily Emissions VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
		(lb/day)									
Tugboat	Propulsion	12.89	171.24	164.40	2.24	3.62	3.62	0.02	23,533.99	0.95	0.33
Tugboat	Auxiliary	0.38	5.08	5.06	0.07	0.12	0.12	0.00	663.52	0.03	0.01
Emission Subtotals		**13.27**	**176.32**	**169.46**	**2.30**	**3.74**	**3.74**	**0.02**	**24,197.51**	**0.98**	**0.34**

Boat Classification	Engine	Annual Emissions VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20	CO2E
		(ton/yr)							(MT/yr)			
Tugboat	Propulsion	1.01	13.36	12.82	0.17	0.28	0.28	0.00	1,665.28	0.02	0.07	1,685.96
Tugboat	Auxiliary	0.03	0.40	0.39	0.01	0.01	0.01	0.00	46.95	0.00	0.00	47.59
Emission Subtotals		**1.04**	**13.75**	**13.22**	**0.18**	**0.29**	**0.29**	**0.00**	**1,712.23**	**0.02**	**0.07**	**1,733.55**

Note:

Emission Factors

Marine Propulsion

Engine Type	Engine Family	Model	Tier	Fuel	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
					(g/kW-hr)									
Slow Speed Diesel		<=1999	Tier 0	0.1%S	0.600	17.01	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		<=1999	Tier 0	0.1%S	0.500	13.16	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2000-2010	Tier 1	0.1%S	0.600	15.98	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2000-2010	Tier 1	0.1%S	0.500	12.22	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2011-2015	Tier 2	0.1%S	0.600	14.38	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2011-2015	Tier 2	0.1%S	0.500	10.53	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2016+	Tier 3	0.1%S	0.600	3.38	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2016+	Tier 3	0.1%S	0.500	2.63	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
EPA Certification	HCEXN19.0AAA		Tier 3	0.1%S	0.392	5.21	5.0	0.07	0.11	0.11	0.0006067	716		
EPA Certification	D233051MX03		Tier 4	0.1%S	0.190	1.80	5.0	0.07	0.04	0.04	0.0006067	716		

Notes:
Emission factors from Table 2.3 and 2.4 of the 2019 Port of Los Angeles Emission Inventory Methodology Report
EPA certification based on Tier 3 rating for the engine family from Table 1 to CFR §1042.101.
Emission factor for Pb from the Santa Barbara Air Pollution Control District Approved TAC Emission Factors, December 2023.

Marine Auxiliary

Engine Type		Model	Tier	Fuel	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
					(g/kW-hr)									
Aux High Speed Diesel		<=1999	Tier 0	0.1%S	0.600	10.9	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel		<=1999	Tier 0	0.1%S	0.600	13.82	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel		2000-2010	Tier 1	0.1%S	0.600	9.78	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel		2000-2010	Tier 1	0.1%S	0.600	12.22	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel		2011-2015	Tier 2	0.1%S	0.600	7.71	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel		2011-2015	Tier 2	0.1%S	0.600	10.53	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel		2011-2015	Tier 3	0.1%S	0.600	1.97	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel		2011-2015	Tier 3	0.1%S	0.600	2.63	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux Med Speed Diesel	Tier 3 Standard	2011-2015	Tier 3	0.1%S	0.378	5.022	5	0.068	0.12	0.12	0.0006067			
					(g/hp-hr)									
Generator Sets			Tier 4 Final	0.1%S	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	-	568.2990	0.0180	0.0081

Notes:
Emission factors from Table 2.9 and 2.10 of the 2019 Port of Los Angeles Emission Inventory Methodology Report
Load factors for auxiliary engines based on Table 3.1 of the of the 2019 Port of Los Angeles Emission Inventory Methodology Report
EPA certification based on Tier 3 rating for the engine family from Table 5 to CFR §1042.101.
Emission factor for Pb from the Santa Barbara Air Pollution Control District Approved TAC Emission Factors, December 2023.

Marine exhaust emissions were calculated using the following equation:

$$Emissions_{diesel} = \Sigma\, EF_i \times Eng_i \times AvgHP \times Load_i \times Activity_i$$

Where:

EF	=	*Emission factor in grams per horse-power hour*
Eng	=	*Number of engines*
AvgHP	=	*Maximum rated average horsepower*
Load	=	*Load factor*
Activity	=	*Hours of operation*
i	=	*Equipment type*

SpaceX Roll-On Roll-Off Emissions Ventura County

Marine Emission Estimates - Kelly C

Boat Classification	Phase	Engine	Engine Tier	Fuel	# Engines	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)	Emission Factors VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
											(g/kW-hr)									
Tugboat	Transit	Propulsion	3	0.1%S	2	1,000	746	1.00	20.00	1180	0.39	5.21	5.00	0.07	0.11	0.11	0.00	715.76	0.01	0.03
Tugboat	Transit	Auxiliary	3	0.1%S	1	99	74	0.31	20.00	1180	0.38	5.02	5.00	0.07	0.12	0.12	0.00	656.00	0.01	0.03
											(g/hp-hr)									
Generator-Barge	Transit	Generator Sets	4	0.1%S	1	49	37	0.74	20.00	1180	0.12	2.75	4.10	0.01	0.01	0.01	-	568.30	0.02	0.01
Emission Subtotals																				

Boat Classification	Engine	Maximum Daily Emissions VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
		(lb/day)									
Tugboat	Propulsion	25.78	342.48	328.80	4.47	7.23	7.23	0.04	47,067.98	1.91	0.66
Tugboat	Auxiliary	0.38	5.08	5.06	0.07	0.12	0.12	0.00	663.52	0.03	0.01
Generator-Barge	Generator Sets	0.19	4.40	6.55	0.01	0.01	0.01	0	908.58	0.01	0.03
Emission Subtotals		**26.35**	**351.95**	**340.41**	**4.55**	**7.37**	**7.37**	**0.04**	**48,640.08**	**1.95**	**0.70**

Boat Classification	Engine	Annual Emissions VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20	CO2E
		(ton/yr)							(MT/yr)			
Tugboat	Propulsion	0.76	10.10	9.70	0.13	0.21	0.21	0.00	1,259.63	0.02	0.05	1,275.28
Tugboat	Auxiliary	0.01	0.15	0.15	0.00	0.00	0.00	0.00	17.76	0.00	0.00	18.00
Generator-Barge	Generator Sets	0.00	0.10	0.15	0.00	0.00	0.00	-	18.36	0.00	0.00	18.45
Emission Subtotals		**0.78**	**10.35**	**9.99**	**0.13**	**0.22**	**0.22**	**0.00**	**1,295.75**	**0.02**	**0.05**	**1,311.73**

Note:

Marine Emission Estimates - Bernardine C

Boat Classification	Phase	Engine	Engine Tier	Fuel	# Engines	Engine Rating (hp)	Engine Rating (kW)	Load Factor	Operation (hr/day)	Operation (hours/yr)	Emission Factors VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
											(g/kW-hr)									
Tugboat	Transit	Propulsion	3	0.1%S	2	500	373	1.00	20.00	1180	0.39	5.21	5.00	0.07	0.11	0.11	0.00	715.76	0.01	0.03
Tugboat	Transit	Auxiliary	3	0.1%S	1	99	74	0.31	20.00	1180	0.38	5.02	5.00	0.07	0.12	0.12	0.00	656.00	0.01	0.03
Emission Subtotals																				

Boat Classification	Engine	Maximum Daily Emissions VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20
		(lb/day)									
Tugboat	Propulsion	12.89	171.24	164.40	2.24	3.62	3.62	0.02	23,533.99	0.95	0.33
Tugboat	Auxiliary	0.38	5.08	5.06	0.07	0.12	0.12	0.00	663.52	0.03	0.01
Emission Subtotals		**13.27**	**176.32**	**169.46**	**2.30**	**3.74**	**3.74**	**0.02**	**24,197.51**	**0.98**	**0.34**

Boat Classification	Engine	Annual Emissions VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N20	CO2E
		(ton/yr)							(MT/yr)			
Tugboat	Propulsion	0.38	5.05	4.85	0.07	0.11	0.11	0.00	629.82	0.01	0.03	637.64
Tugboat	Auxiliary	0.01	0.15	0.15	0.00	0.00	0.00	0.00	17.76	0.00	0.00	18.00
Emission Subtotals		**0.39**	**5.20**	**5.00**	**0.07**	**0.11**	**0.11**	**0.00**	**647.57**	**0.01**	**0.03**	**655.64**

Note:

Emission Factors

Marine Propulsion

Engine Type	Engine Family	Model	Tier	Fuel	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
					(g/kW-hr)									
Slow Speed Diesel		<=1999	Tier 0	0.1%S	0.600	17.01	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		<=1999	Tier 0	0.1%S	0.500	13.16	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2000-2010	Tier 1	0.1%S	0.600	15.98	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2000-2010	Tier 1	0.1%S	0.500	12.22	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2011-2015	Tier 2	0.1%S	0.600	14.38	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2011-2015	Tier 2	0.1%S	0.500	10.53	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
Slow Speed Diesel		2016+	Tier 3	0.1%S	0.600	3.38	1.4	0.39	0.26	0.24	0.0006067	589	0.012	0.029
Medium Speed Diesel		2016+	Tier 3	0.1%S	0.500	2.63	1.1	0.43	0.26	0.24	0.0006067	649	0.010	0.029
EPA Certification	HCEXN19.0AAA		Tier 3	0.1%S	0.392	5.21	5.0	0.07	0.11	0.11	0.0006067	716		
EPA Certification	D233051MX03		Tier 4	0.1%S	0.190	1.80	5.0	0.07	0.04	0.04	0.0006067	716		

Notes:
Emission factors from Table 2.3 and 2.4 of the 2019 Port of Los Angeles Emission Inventory Methodology Report
EPA certification based on Tier 3 rating for the engine family from Table 1 to CFR §1042.101.
Emission factor for Pb from the Santa Barbara Air Pollution Control District Approved TAC Emission Factors, December 2023.

Marine Auxiliary

Engine Type		Model	Tier	Fuel	VOC	NOx	CO	SOx	PM10	PM2.5	Pb	CO2	CH4	N2O
					(g/kW-hr)									
Aux High Speed Diesel		<=1999	Tier 0	0.1%S	0.600	10.9	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel		<=1999	Tier 0	0.1%S	0.600	13.82	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel		2000-2010	Tier 1	0.1%S	0.600	9.78	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel		2000-2010	Tier 1	0.1%S	0.600	12.22	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel		2011-2015	Tier 2	0.1%S	0.600	7.71	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel		2011-2015	Tier 2	0.1%S	0.600	10.53	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux High Speed Diesel		2011-2015	Tier 3	0.1%S	0.600	1.97	1.1	0.455	0.26	0.24	0.0006067	656	0.010	0.029
Aux Med Speed Diesel		2011-2015	Tier 3	0.1%S	0.600	2.63	1.4	0.455	0.26	0.24	0.0006067	686	0.012	0.029
Aux Med Speed Diesel	Tier 3 Standard	2011-2015	Tier 3	0.1%S	0.378	5.022	5	0.068	0.12	0.12	0.0006067			
					(g/hp-hr)									
Generator Sets			Tier 4 Final	0.1%S	0.1200	2.7500	4.1000	0.0050	0.0080	0.0080	-	568.2990	0.0180	0.0081

Notes:
Emission factors from Table 2.9 and 2.10 of the 2019 Port of Los Angeles Emission Inventory Methodology Report
Load factors for auxiliary engines based on Table 3.1 of the of the 2019 Port of Los Angeles Emission Inventory Methodology Report
EPA certification based on Tier 3 rating for the engine family from Table 5 to CFR §1042.101.
Emission factor for Pb from the Santa Barbara Air Pollution Control District Approved TAC Emission Factors, December 2023.

Marine exhaust emissions were calculated using the following equation:

$$Emissions_{diesel} = \Sigma\, EF_i \times Eng_i \times AvgHP \times Load_i \times Activity_i$$

Where:

EF	=	*Emission factor in grams per horse-power hour*
Eng	=	*Number of engines*
AvgHP	=	*Maximum rated average horsepower*
Load	=	*Load factor*
Activity	=	*Hours of operation*
i	=	*Equipment type*

SpaceX SLC-4 and SLC-6 Operations Detailed Report

Table of Contents

1. Basic Project Information

1.1. Basic Project Information

Data Field	Value
Project Name	SpaceX SLC-4 and SLC-6 Operations
Construction Start Date	1/1/2024
Operational Year	2025
Lead Agency	—
Land Use Scale	Project/site
Analysis Level for Defaults	County
Windspeed (m/s)	3.10
Precipitation (days)	27.8
Location	34.58233161250706, -120.6276097945451
County	Santa Barbara
City	Unincorporated
Air District	Santa Barbara County APCD
Air Basin	South Central Coast
TAZ	3342
EDFZ	6
Electric Utility	Pacific Gas & Electric Company
Gas Utility	Southern California Gas
App Version	2022.1.1.20

1.2. Land Use Types

Land Use Subtype	Size	Unit	Lot Acreage	Building Area (sq ft)	Landscape Area (sq ft)	Special Landscape Area (sq ft)	Population	Description

General Heavy Industry	1.00	1000sqft	0.02	1,000	0.00	—	—	—

1.3. User-Selected Emission Reduction Measures by Emissions Sector

No measures selected

2. Emissions Summary

2.1. Construction Emissions Compared Against Thresholds

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Un/Mit.	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	6.50	5.78	17.7	71.8	0.05	0.19	8.91	9.09	0.18	2.14	2.32	—	14,748	14,748	0.78	1.05	49.4	15,128
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	6.58	5.81	18.5	72.4	0.05	0.19	8.91	9.09	0.18	2.14	2.32	—	14,586	14,586	0.83	1.05	1.28	14,920
Average Daily (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	6.38	5.70	16.3	70.4	0.04	0.17	8.44	8.61	0.16	2.01	2.17	—	13,252	13,252	0.75	0.85	19.9	13,544
Annual (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	1.16	1.04	2.97	12.9	0.01	0.03	1.54	1.57	0.03	0.37	0.40	—	2,194	2,194	0.12	0.14	3.29	2,242

2.2. Construction Emissions by Year, Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e

Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2024	6.50	5.78	17.7	71.8	0.05	0.19	8.91	9.09	0.18	2.14	2.32	—	14,748	14,748	0.78	1.05	49.4	15,128
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2024	6.58	5.81	18.5	72.4	0.05	0.19	8.91	9.09	0.18	2.14	2.32	—	14,586	14,586	0.83	1.05	1.28	14,920
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2024	6.38	5.70	16.3	70.4	0.04	0.17	8.44	8.61	0.16	2.01	2.17	—	13,252	13,252	0.75	0.85	19.9	13,544
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2024	1.16	1.04	2.97	12.9	0.01	0.03	1.54	1.57	0.03	0.37	0.40	—	2,194	2,194	0.12	0.14	3.29	2,242

2.4. Operations Emissions Compared Against Thresholds

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Un/Mit.	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	33.6	30.6	103	77.9	0.15	4.49	0.00	4.49	4.49	0.00	4.49	693	47,019	47,712	70.3	0.84	0.26	49,721
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	33.6	30.6	103	77.9	0.15	4.49	0.00	4.49	4.49	0.00	4.49	693	47,019	47,711	70.3	0.84	0.26	49,721
Average Daily (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	1.74	1.61	5.02	4.05	0.01	0.23	0.00	0.23	0.23	0.00	0.23	693	32,205	32,898	69.8	0.73	0.26	34,858
Annual (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	0.32	0.29	0.92	0.74	< 0.005	0.04	0.00	0.04	0.04	0.00	0.04	115	5,332	5,447	11.5	0.12	0.04	5,771

2.5. Operations Emissions by Sector, Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Sector	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mobile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Area	0.01	0.03	< 0.005	0.04	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	0.18	0.18	< 0.005	< 0.005	—	0.18
Energy	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	31,251	31,251	5.06	0.61	—	31,560
Water	—	—	—	—	—	—	—	—	—	—	—	47.7	146	194	0.19	0.11	—	230
Waste	—	—	—	—	—	—	—	—	—	—	—	645	0.00	645	64.5	0.00	—	2,257
Refrig.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.26	0.26
Stationary	33.6	30.5	103	77.9	0.15	4.49	0.00	4.49	4.49	0.00	4.49	0.00	15,622	15,622	0.63	0.12	0.00	15,674
Total	33.6	30.6	103	77.9	0.15	4.49	0.00	4.49	4.49	0.00	4.49	693	47,019	47,712	70.3	0.84	0.26	49,721
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mobile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Area	—	0.03	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Energy	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	31,251	31,251	5.06	0.61	—	31,560
Water	—	—	—	—	—	—	—	—	—	—	—	47.7	146	194	0.19	0.11	—	230
Waste	—	—	—	—	—	—	—	—	—	—	—	645	0.00	645	64.5	0.00	—	2,257
Refrig.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.26	0.26
Stationary	33.6	30.5	103	77.9	0.15	4.49	0.00	4.49	4.49	0.00	4.49	0.00	15,622	15,622	0.63	0.12	0.00	15,674
Total	33.6	30.6	103	77.9	0.15	4.49	0.00	4.49	4.49	0.00	4.49	693	47,019	47,711	70.3	0.84	0.26	49,721
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Mobile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Area	< 0.005	0.03	< 0.005	0.02	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	0.09	0.09	< 0.005	< 0.005	—	0.09
Energy	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	31,251	31,251	5.06	0.61	—	31,560
Water	—	—	—	—	—	—	—	—	—	—	—	47.7	146	194	0.19	0.11	—	230
Waste	—	—	—	—	—	—	—	—	—	—	—	645	0.00	645	64.5	0.00	—	2,257
Refrig.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.26	0.26
Stationary	1.74	1.58	5.02	4.03	0.01	0.23	0.00	0.23	0.23	0.00	0.23	0.00	808	808	0.03	0.01	0.00	811
Total	1.74	1.61	5.02	4.05	0.01	0.23	0.00	0.23	0.23	0.00	0.23	693	32,205	32,898	69.8	0.73	0.26	34,858
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mobile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Area	< 0.005	0.01	< 0.005	< 0.005	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	0.01	0.01	< 0.005	< 0.005	—	0.01
Energy	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	5,174	5,174	0.84	0.10	—	5,225
Water	—	—	—	—	—	—	—	—	—	—	—	7.90	24.1	32.0	0.03	0.02	—	38.1
Waste	—	—	—	—	—	—	—	—	—	—	—	107	0.00	107	10.7	0.00	—	374
Refrig.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.04	0.04
Stationary	0.32	0.29	0.92	0.74	< 0.005	0.04	0.00	0.04	0.04	0.00	0.04	0.00	134	134	0.01	< 0.005	0.00	134
Total	0.32	0.29	0.92	0.74	< 0.005	0.04	0.00	0.04	0.04	0.00	0.04	115	5,332	5,447	11.5	0.12	0.04	5,771

3. Construction Emissions Details

3.1. Fleet Vehicle Use (2024) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	1.00	0.94	0.68	8.01	0.00	0.00	1.24	1.24	0.00	0.29	0.29	—	1,283	1,283	0.09	0.06	5.99	1,308

Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	1.02	0.95	0.78	8.21	0.00	0.00	1.24	1.24	0.00	0.29	0.29	—	1,256	1,256	0.10	0.06	0.16	1,276
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	1.00	0.94	0.78	8.02	0.00	0.00	1.22	1.22	0.00	0.29	0.29	—	1,261	1,261	0.09	0.06	2.60	1,283
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.18	0.17	0.14	1.46	0.00	0.00	0.22	0.22	0.00	0.05	0.05	—	209	209	0.02	0.01	0.43	212
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.3. Vendor-Contractor Vehicles (2024) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—

Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.49	0.24	7.84	3.83	0.03	0.06	1.19	1.25	0.06	0.33	0.39	—	4,842	4,842	0.22	0.70	12.2	5,068
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.48	0.23	8.06	3.91	0.03	0.06	1.19	1.25	0.06	0.33	0.39	—	4,845	4,845	0.22	0.70	0.32	5,059
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.35	0.17	5.79	2.78	0.02	0.04	0.84	0.89	0.04	0.23	0.28	—	3,477	3,477	0.15	0.50	3.76	3,634
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.06	0.03	1.06	0.51	< 0.005	0.01	0.15	0.16	0.01	0.04	0.05	—	576	576	0.03	0.08	0.62	602
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.5. Equipment (2024) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.62	0.49	5.82	20.3	0.02	0.13	—	0.13	0.12	—	0.12	—	1,985	1,985	0.07	0.01	—	1,991
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.62	0.49	5.82	20.3	0.02	0.13	—	0.13	0.12	—	0.12	—	1,985	1,985	0.07	0.01	—	1,991
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.62	0.49	5.83	20.4	0.02	0.13	—	0.13	0.12	—	0.12	—	1,990	1,990	0.07	0.01	—	1,996
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.11	0.09	1.06	3.72	< 0.005	0.02	—	0.02	0.02	—	0.02	—	329	329	0.01	< 0.005	—	330
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.7. Worker Vehicles (2024) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—

Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dust From Material Movement	—	—	—	—	—	—	0.00	0.00	—	0.00	0.00	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	4.40	4.10	3.37	39.6	0.00	0.00	6.47	6.47	0.00	1.52	1.52	—	6,638	6,638	0.41	0.28	31.2	6,762
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	4.47	4.14	3.89	40.0	0.00	0.00	6.47	6.47	0.00	1.52	1.52	—	6,500	6,500	0.44	0.28	0.81	6,595
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	4.41	4.09	3.86	39.2	0.00	0.00	6.37	6.37	0.00	1.49	1.49	—	6,524	6,524	0.43	0.28	13.5	6,631
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.80	0.75	0.70	7.16	0.00	0.00	1.16	1.16	0.00	0.27	0.27	—	1,080	1,080	0.07	0.05	2.24	1,098
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

4. Operations Emissions Details

4.1. Mobile Emissions by Land Use

4.1.1. Unmitigated

Mobile source emissions results are presented in Sections 2.6. No further detailed breakdown of emissions is available.

4.2. Energy

4.2.1. Electricity Emissions By Land Use - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e

Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	—	—	—	—	—	—	—	—	—	—	—	—	31,251	31,251	5.06	0.61	—	31,560
Total	—	—	—	—	—	—	—	—	—	—	—	—	31,251	31,251	5.06	0.61	—	31,560
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	—	—	—	—	—	—	—	—	—	—	—	—	31,251	31,251	5.06	0.61	—	31,560
Total	—	—	—	—	—	—	—	—	—	—	—	—	31,251	31,251	5.06	0.61	—	31,560
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	—	—	—	—	—	—	—	—	—	—	—	—	5,174	5,174	0.84	0.10	—	5,225
Total	—	—	—	—	—	—	—	—	—	—	—	—	5,174	5,174	0.84	0.10	—	5,225

4.2.3. Natural Gas Emissions By Land Use - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00
Total	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

General Heavy Industry	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00
Total	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00
Total	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	—	0.00

4.3. Area Emissions by Source

4.3.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Source	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Consumer Products	—	0.02	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Architectural Coatings	—	0.01	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Landscape Equipment	0.01	0.01	< 0.005	0.04	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	0.18	0.18	< 0.005	< 0.005	—	0.18
Total	0.01	0.03	< 0.005	0.04	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	0.18	0.18	< 0.005	< 0.005	—	0.18
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Consumer	—	0.02	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Architectural Coatings	—	0.01	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	0.03	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Consumer Products	—	< 0.005	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Architectural Coatings	—	< 0.005	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Landscape Equipment	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	0.01	0.01	< 0.005	< 0.005	—	0.01
Total	< 0.005	0.01	< 0.005	< 0.005	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	0.01	0.01	< 0.005	< 0.005	—	0.01

4.4. Water Emissions by Land Use

4.4.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	—	—	—	—	—	—	—	—	—	—	—	47.7	146	194	0.19	0.11	—	230
Total	—	—	—	—	—	—	—	—	—	—	—	47.7	146	194	0.19	0.11	—	230

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	—	—	—	—	—	—	—	—	—	—	—	47.7	146	194	0.19	0.11	—	230
Total	—	—	—	—	—	—	—	—	—	—	—	47.7	146	194	0.19	0.11	—	230
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	—	—	—	—	—	—	—	—	—	—	—	7.90	24.1	32.0	0.03	0.02	—	38.1
Total	—	—	—	—	—	—	—	—	—	—	—	7.90	24.1	32.0	0.03	0.02	—	38.1

4.5. Waste Emissions by Land Use

4.5.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	—	—	—	—	—	—	—	—	—	—	—	645	0.00	645	64.5	0.00	—	2,257
Total	—	—	—	—	—	—	—	—	—	—	—	645	0.00	645	64.5	0.00	—	2,257
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	—	—	—	—	—	—	—	—	—	—	—	645	0.00	645	64.5	0.00	—	2,257
Total	—	—	—	—	—	—	—	—	—	—	—	645	0.00	645	64.5	0.00	—	2,257

Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	—	—	—	—	—	—	—	—	—	—	—	107	0.00	107	10.7	0.00	—	374
Total	—	—	—	—	—	—	—	—	—	—	—	107	0.00	107	10.7	0.00	—	374

4.6. Refrigerant Emissions by Land Use

4.6.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.26	0.26
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.26	0.26
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.26	0.26
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.26	0.26
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Heavy Industry	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.04	0.04
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.04	0.04

4.7. Offroad Emissions By Equipment Type

4.7.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Equipment Type	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.8. Stationary Emissions By Equipment Type

4.8.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Equipment Type	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Emergency Generator	33.6	30.5	103	77.9	0.15	4.49	0.00	4.49	4.49	0.00	4.49	0.00	15,622	15,622	0.63	0.12	0.00	15,674

Total	33.6	30.5	103	77.9	0.15	4.49	0.00	4.49	4.49	0.00	4.49	0.00	15,622	15,622	0.63	0.12	0.00	15,674
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Emergency Generator	33.6	30.5	103	77.9	0.15	4.49	0.00	4.49	4.49	0.00	4.49	0.00	15,622	15,622	0.63	0.12	0.00	15,674
Total	33.6	30.5	103	77.9	0.15	4.49	0.00	4.49	4.49	0.00	4.49	0.00	15,622	15,622	0.63	0.12	0.00	15,674
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Emergency Generator	0.32	0.29	0.92	0.74	< 0.005	0.04	0.00	0.04	0.04	0.00	0.04	0.00	134	134	0.01	< 0.005	0.00	134
Total	0.32	0.29	0.92	0.74	< 0.005	0.04	0.00	0.04	0.04	0.00	0.04	0.00	134	134	0.01	< 0.005	0.00	134

4.9. User Defined Emissions By Equipment Type

4.9.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Equipment Type	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10. Soil Carbon Accumulation By Vegetation Type

4.10.1. Soil Carbon Accumulation By Vegetation Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Vegetation	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.2. Above and Belowground Carbon Accumulation by Land Use Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.3. Avoided and Sequestered Emissions by Species - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Species	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Sequest	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

5. Activity Data

5.1. Construction Schedule

Phase Name	Phase Type	Start Date	End Date	Days Per Week	Work Days per Phase	Phase Description
Fleet Vehicle Use	Site Preparation	1/1/2024	12/31/2024	7.00	366	—
Vendor-Contractor Vehicles	Site Preparation	1/1/2024	12/31/2024	5.00	262	—
Equipment	Grading	1/1/2024	12/31/2024	7.00	366	—
Worker Vehicles	Grading	1/1/2024	12/31/2024	7.00	366	—

5.2. Off-Road Equipment

5.2.1. Unmitigated

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Equipment	Aerial Lifts	Diesel	Average	8.00	1.00	84.0	0.37
Equipment	Forklifts	CNG	Average	10.0	1.00	70.0	0.30
Equipment	Off-Highway Trucks	Diesel	Average	6.00	1.00	367	0.40
Equipment	Rough Terrain Forklifts	Diesel	Average	8.00	1.00	96.0	0.40

5.3. Construction Vehicles

5.3.1. Unmitigated

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Fleet Vehicle Use	—	—	—	—
Fleet Vehicle Use	Worker	200	8.80	LDA,LDT1,LDT2
Fleet Vehicle Use	Vendor	—	5.30	HHDT,MHDT
Fleet Vehicle Use	Hauling	0.00	20.0	HHDT
Fleet Vehicle Use	Onsite truck	—	—	HHDT
Vendor-Contractor Vehicles	—	—	—	—
Vendor-Contractor Vehicles	Worker	0.00	8.80	LDA,LDT1,LDT2
Vendor-Contractor Vehicles	Vendor	268	5.30	HHDT,MHDT
Vendor-Contractor Vehicles	Hauling	0.00	20.0	HHDT
Vendor-Contractor Vehicles	Onsite truck	—	—	HHDT
Equipment	—	—	—	—
Equipment	Worker	0.00	8.80	LDA,LDT1,LDT2
Equipment	Vendor	—	5.30	HHDT,MHDT
Equipment	Hauling	0.00	20.0	HHDT
Equipment	Onsite truck	—	—	HHDT
Worker Vehicles	—	—	—	—
Worker Vehicles	Worker	848	10.8	LDA,LDT1,LDT2
Worker Vehicles	Vendor	—	5.30	HHDT,MHDT
Worker Vehicles	Hauling	0.00	20.0	HHDT
Worker Vehicles	Onsite truck	—	—	HHDT

5.4. Vehicles

5.4.1. Construction Vehicle Control Strategies

Non-applicable. No control strategies activated by user.

5.5. Architectural Coatings

Phase Name	Residential Interior Area Coated (sq ft)	Residential Exterior Area Coated (sq ft)	Non-Residential Interior Area Coated (sq ft)	Non-Residential Exterior Area Coated (sq ft)	Parking Area Coated (sq ft)

5.6. Dust Mitigation

5.6.1. Construction Earthmoving Activities

Phase Name	Material Imported (cy)	Material Exported (cy)	Acres Graded (acres)	Material Demolished (sq. ft.)	Acres Paved (acres)
Fleet Vehicle Use	—	—	0.00	0.00	—
Vendor-Contractor Vehicles	—	—	0.00	0.00	—
Equipment	—	—	0.00	0.00	—
Worker Vehicles	—	—	0.00	0.00	—

5.6.2. Construction Earthmoving Control Strategies

Non-applicable. No control strategies activated by user.

5.7. Construction Paving

Land Use	Area Paved (acres)	% Asphalt
General Heavy Industry	0.00	0%

5.8. Construction Electricity Consumption and Emissions Factors

kWh per Year and Emission Factor (lb/MWh)

Year	kWh per Year	CO2	CH4	N2O
2024	0.00	204	0.03	< 0.005

5.9. Operational Mobile Sources

5.9.1. Unmitigated

Land Use Type	Trips/Weekday	Trips/Saturday	Trips/Sunday	Trips/Year	VMT/Weekday	VMT/Saturday	VMT/Sunday	VMT/Year
Total all Land Uses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

5.10. Operational Area Sources

5.10.1. Hearths

5.10.1.1. Unmitigated

5.10.2. Architectural Coatings

Residential Interior Area Coated (sq ft)	Residential Exterior Area Coated (sq ft)	Non-Residential Interior Area Coated (sq ft)	Non-Residential Exterior Area Coated (sq ft)	Parking Area Coated (sq ft)
0	0.00	1,500	500	—

5.10.3. Landscape Equipment

Season	Unit	Value
Snow Days	day/yr	0.00
Summer Days	day/yr	180

5.11. Operational Energy Consumption

5.11.1. Unmitigated

Electricity (kWh/yr) and CO2 and CH4 and N2O and Natural Gas (kBTU/yr)

Land Use	Electricity (kWh/yr)	CO2	CH4	N2O	Natural Gas (kBTU/yr)
General Heavy Industry	55,919,136	204	0.0330	0.0040	0.00

5.12. Operational Water and Wastewater Consumption

5.12.1. Unmitigated

Land Use	Indoor Water (gal/year)	Outdoor Water (gal/year)
General Heavy Industry	22,330,980	36,220,000

5.13. Operational Waste Generation

5.13.1. Unmitigated

Land Use	Waste (ton/year)	Cogeneration (kWh/year)
General Heavy Industry	1,197	—

5.14. Operational Refrigeration and Air Conditioning Equipment

5.14.1. Unmitigated

Land Use Type	Equipment Type	Refrigerant	GWP	Quantity (kg)	Operations Leak Rate	Service Leak Rate	Times Serviced
General Heavy Industry	Other commercial A/C and heat pumps	R-410A	2,088	0.30	4.00	4.00	18.0

5.15. Operational Off-Road Equipment

5.15.1. Unmitigated

Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor

5.16. Stationary Sources

5.16.1. Emergency Generators and Fire Pumps

Equipment Type	Fuel Type	Number per Day	Hours per Day	Hours per Year	Horsepower	Load Factor
Emergency Generator	Diesel	3.00	2.00	25.0	779	1.00
Emergency Generator	Diesel	1.00	2.00	25.0	367	1.00
Emergency Generator	Diesel	1.00	2.00	25.0	320	1.00
Emergency Generator	Diesel	1.00	24.0	576	314	1.00

5.16.2. Process Boilers

Equipment Type	Fuel Type	Number	Boiler Rating (MMBtu/hr)	Daily Heat Input (MMBtu/day)	Annual Heat Input (MMBtu/yr)

5.17. User Defined

Equipment Type	Fuel Type

5.18. Vegetation

5.18.1. Land Use Change

5.18.1.1. Unmitigated

Vegetation Land Use Type	Vegetation Soil Type	Initial Acres	Final Acres

5.18.1. Biomass Cover Type

5.18.1.1. Unmitigated

Biomass Cover Type	Initial Acres	Final Acres

5.18.2. Sequestration

5.18.2.1. Unmitigated

Tree Type	Number	Electricity Saved (kWh/year)	Natural Gas Saved (btu/year)

6. Climate Risk Detailed Report

6.1. Climate Risk Summary

Cal-Adapt midcentury 2040–2059 average projections for four hazards are reported below for your project location. These are under Representation Concentration Pathway (RCP) 8.5 which assumes GHG emissions will continue to rise strongly through 2050 and then plateau around 2100.

Climate Hazard	Result for Project Location	Unit
Temperature and Extreme Heat	6.60	annual days of extreme heat
Extreme Precipitation	4.10	annual days with precipitation above 20 mm
Sea Level Rise	0.00	meters of inundation depth
Wildfire	9.82	annual hectares burned

Temperature and Extreme Heat data are for grid cell in which your project are located. The projection is based on the 98th historical percentile of daily maximum/minimum temperatures from observed historical data (32 climate model ensemble from Cal-Adapt, 2040–2059 average under RCP 8.5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Extreme Precipitation data are for the grid cell in which your project are located. The threshold of 20 mm is equivalent to about ¾ an inch of rain, which would be light to moderate rainfall if received over a full day or heavy rain if received over a period of 2 to 4 hours. Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Sea Level Rise data are for the grid cell in which your project are located. The projections are from Radke et al. (2017), as reported in Cal-Adapt (Radke et al., 2017, CEC-500-2017-008), and consider inundation location and depth for the San Francisco Bay, the Sacramento-San Joaquin River Delta and California coast resulting different increments of sea level rise coupled with extreme storm events. Users may select from four scenarios to view the range in potential inundation depth for the grid cell. The four scenarios are: No rise, 0.5 meter, 1.0 meter, 1.41 meters
Wildfire data are for the grid cell in which your project are located. The projections are from UC Davis, as reported in Cal-Adapt (2040–2059 average under RCP 8.5), and consider historical data of climate, vegetation, population density, and large (> 400 ha) fire history. Users may select from four model simulations to view the range in potential wildfire probabilities for the grid cell. The four simulations make different assumptions about expected rainfall and temperature are: Warmer/drier (HadGEM2-ES), Cooler/wetter (CNRM-CM5), Average conditions (CanESM2), Range of different rainfall and temperature possibilities (MIROC5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.

6.2. Initial Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	N/A	N/A	N/A	N/A
Wildfire	N/A	N/A	N/A	N/A
Flooding	N/A	N/A	N/A	N/A

Drought	N/A	N/A	N/A	N/A
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.
The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.
The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores do not include implementation of climate risk reduction measures.

6.3. Adjusted Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	N/A	N/A	N/A	N/A
Wildfire	N/A	N/A	N/A	N/A
Flooding	N/A	N/A	N/A	N/A
Drought	N/A	N/A	N/A	N/A
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.
The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.
The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores include implementation of climate risk reduction measures.

6.4. Climate Risk Reduction Measures

7. Health and Equity Details

7.1. CalEnviroScreen 4.0 Scores

The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Exposure Indicators	—
AQ-Ozone	6.40
AQ-PM	8.33
AQ-DPM	1.94
Drinking Water	69.5
Lead Risk Housing	39.5
Pesticides	69.9
Toxic Releases	4.78
Traffic	30.0
Effect Indicators	—
CleanUp Sites	87.5
Groundwater	99.1
Haz Waste Facilities/Generators	99.3
Impaired Water Bodies	51.2
Solid Waste	83.3
Sensitive Population	—
Asthma	22.0
Cardio-vascular	38.5
Low Birth Weights	7.06
Socioeconomic Factor Indicators	—
Education	7.40
Housing	81.9
Linguistic	0.00
Poverty	44.9
Unemployment	67.5

7.2. Healthy Places Index Scores

The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Economic	—
Above Poverty	51.63608366
Employed	0.230976517
Median HI	47.9019633
Education	—
Bachelor's or higher	52.66264596
High school enrollment	100
Preschool enrollment	20.94187091
Transportation	—
Auto Access	92.6344155
Active commuting	57.93660978
Social	—
2-parent households	92.39060695
Voting	25.18927242
Neighborhood	—
Alcohol availability	97.0101373
Park access	4.722186578
Retail density	7.404080585
Supermarket access	2.399589375
Tree canopy	53.80469652
Housing	—
Homeownership	0.436288977
Housing habitability	62.00436289
Low-inc homeowner severe housing cost burden	99.12742205

Low-inc renter severe housing cost burden	76.40189914
Uncrowded housing	77.4541255
Health Outcomes	—
Insured adults	99.2429103
Arthritis	0.0
Asthma ER Admissions	72.7
High Blood Pressure	0.0
Cancer (excluding skin)	0.0
Asthma	0.0
Coronary Heart Disease	0.0
Chronic Obstructive Pulmonary Disease	0.0
Diagnosed Diabetes	0.0
Life Expectancy at Birth	78.6
Cognitively Disabled	87.2
Physically Disabled	99.2
Heart Attack ER Admissions	56.4
Mental Health Not Good	0.0
Chronic Kidney Disease	0.0
Obesity	0.0
Pedestrian Injuries	19.6
Physical Health Not Good	0.0
Stroke	0.0
Health Risk Behaviors	—
Binge Drinking	0.0
Current Smoker	0.0
No Leisure Time for Physical Activity	0.0
Environment	—

Wildfire Risk	0.0
SLR Inundation Area	0.0
Children	0.1
Elderly	99.5
English Speaking	94.4
Foreign-born	2.8
Outdoor Workers	87.6
Adaptive Capacity	—
Impervious Surface Cover	90.1
Traffic Density	15.0
Traffic Access	0.0
Other Indices	—
Hardship	41.2
Other Decision Support	—
2016 Voting	26.1

7.3. Overall Health & Equity Scores

Metric	Result for Project Census Tract
CalEnviroScreen 4.0 Score for Project Location (a)	35.0
Healthy Places Index Score for Project Location (b)	28.0
Project Located in a Designated Disadvantaged Community (Senate Bill 535)	No
Project Located in a Low-Income Community (Assembly Bill 1550)	Yes
Project Located in a Community Air Protection Program Community (Assembly Bill 617)	No

a: The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.
b: The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

7.4. Health & Equity Measures

No Health & Equity Measures selected.

7.5. Evaluation Scorecard

Health & Equity Evaluation Scorecard not completed.

7.6. Health & Equity Custom Measures

No Health & Equity Custom Measures created.

8. User Changes to Default Data

Screen	Justification
Construction: Construction Phases	Operational vehicle and equipment use modeled here.
Construction: Off-Road Equipment	Based on applicant provided information.
Construction: Trips and VMT	Based on applicant provided information.
Operations: Energy Use	Based on applicant provided information. All electric.
Operations: Water and Waste Water	Based on applicant provided information. Outdoor water use for launch support.
Operations: Solid Waste	Based on applicant provided information.
Operations: Refrigerants	etwer
Operations: Emergency Generators and Fire Pumps	Existing permitted generators for GHG emissions.

Appendix G

Sound – Background & Regulatory Requirements

G.1 Definition of Sound and Characteristics

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air or water, and are sensed by the human ear. Noise is defined as unwanted or annoying sound that interferes with or disrupts normal human activities. Although continuous and extended exposure to high noise levels (e.g., through occupational exposure) can cause hearing loss, the principal human response to noise is annoyance. The response of different individuals to similar noise events is diverse and is influenced by the type of noise, perceived importance of the noise, its appropriateness in the setting, time of day, type of activity during which the noise occurs, and sensitivity of the individual.

The perception and evaluation of sound involves three basic physical characteristics:

- Intensity – the acoustic energy, which is expressed in terms of sound pressure, in decibels (dB)
- Frequency – the number of cycles per second the air vibrates, in Hertz (Hz)
- Duration – the length of time the sound can be detected

Noise is defined as unwanted or annoying sound that interferes with or disrupts normal human activities. The primary human response to noise is annoyance, which is defined by the United States (U.S.) Environmental Protection Agency (EPA) as any negative subjective reaction on the part of an individual or group (U.S. Environmental Protection Agency 1974). The response of different individuals to similar noise events is diverse and is influenced by the type of noise, perceived importance of the noise, its appropriateness in the setting, time of day, type of activity during which the noise occurs, and sensitivity of the individual. While aircraft are not the only sources of noise in an urban or suburban environment, they are readily identified by their noise output.

G.2 Sound Intensity and Weighting

The loudest sounds that can be detected comfortably by the human ear have intensities that are a trillion times higher than those of sounds that can barely be heard. Because of this vast range, it is unwieldy to use a linear scale to represent the intensity of sound. As a result, a logarithmic unit known as the decibel represents the intensity or amplitude of a sound, also referred to as the sound level. The dB scale simplifies the broad range of encountered sound pressures detected by the human ear and allows the measurement of sound to be more easily understood. A sound level of 0 dB is approximately the threshold of human hearing and is barely audible under extremely quiet listening conditions. Normal speech has a sound level of approximately 60 dB. Sound levels above 120 dB begin to be felt inside the human ear as discomfort. Sound levels between 130 and 140 dB are felt as pain (Berglund 1995).

All sounds have a spectral content, which means their magnitude or level changes with frequency, where frequency is measured in cycles per second or Hz. To mimic the human ear's non-linear sensitivity and perception of different frequencies of sound, the spectral content is weighted. For example, environmental noise measurements are usually on an "A-weighted" scale, which places less weight on very low and very high frequencies in order to replicate human hearing sensitivity. The general range of human hearing is from 20 to 20,000 cycles per second, or Hz; humans hear best in the range of 1,000–4,000 Hz. A-weighting is a frequency-dependent adjustment of sound level used to approximate the natural range and sensitivity of the human auditory system. Table G-1 provides a comparison of how the human ear perceives changes in loudness on the logarithmic scale.

Table G-1: Subjective Responses to Changes in A-Weighted Decibels

Change	Change in Perceived Loudness
3 dB	Barely perceptible
5 dB	Quite noticeable
10 dB	Dramatic – twice or half as loud
20 dB	Striking – fourfold change

Note: dB = decibel(s)

Figure G-1 provides a chart of A-weighted sound levels from typical noise sources (Cowan 1994; Harris 1979). Some noise sources (e.g., air conditioner, vacuum cleaner) are continuous sounds that maintain a constant sound level for some period of time. Other sources are time-varying events and reach a maximum sound level during an event, such as a vehicle passing by. Sounds can also be part of the ambient environment (e.g., urban daytime, urban nighttime) and are described by averages taken over extended periods. A variety of noise metrics has been developed to describe noise, particularly aircraft noise, in different contexts and over different time periods.

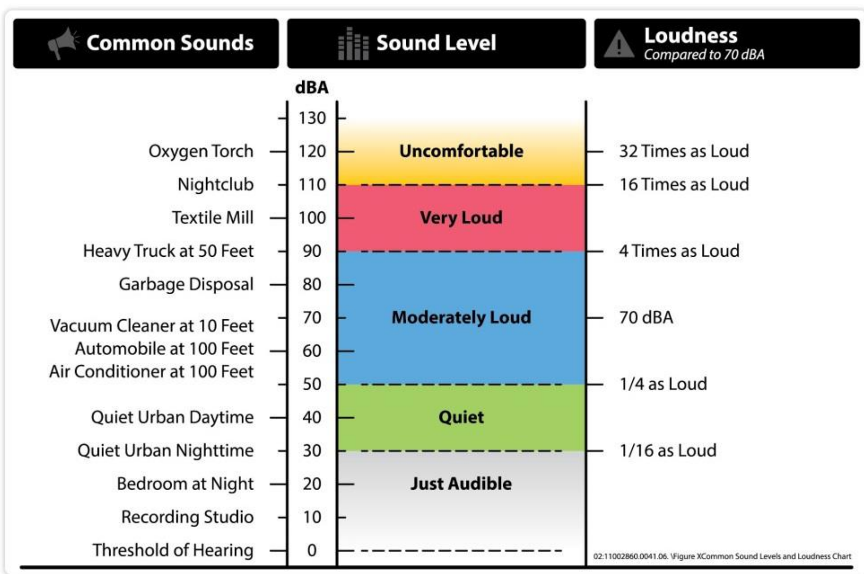

Figure G-1: A-Weighted Sound Levels from Typical Sources

G.3 Sound Metrics

A "metric" is a system for measuring or quantifying a particular characteristic of a subject. Since noise is a complex physical phenomenon, different noise metrics help to quantify the noise environment. The Day-Night Average Sound Level (DNL) metric is the energy-averaged sound level measured over a 24-hour period, with a 10 dB nighttime adjustment to account for heightened human sensitivity to noise when ambient sound levels are low, such as when sleep disturbance could occur. DNL does not represent a sound level heard at any given time but instead represents long-term exposure. Scientific studies have found good correlation between the percentages of groups of people highly annoyed and the level of their average noise exposure measured in DNL (U.S. Department of the Navy et al. 1978; U.S. Environmental Protection Agency 1999). While DNL is the primary metric used to determine noise impacts by the U.S. Department of Housing and Urban Development, Federal Aviation Administration (FAA), and EPA, California has adopted the use of the Community Noise Equivalent Level (CNEL). While CNEL, like DNL, is an energy-averaged sound level measured over a 24-hour period. However, CNEL adds a ten times weighting (equivalent to a 10 dBA [A-weighted decibel] "penalty") to each operation between 10:00 p.m. and 7:00 a.m., CNEL also adds a three times weighting (equivalent to a 4.77 dBA penalty) for each operation during evening hours (7:00 p.m. to 10:00 p.m.). As such, DNL and CNEL have been determined to be a reliable measure of long-term community annoyance.

CNEL values are average quantities, mathematically representing the continuous sound level (L_{eq1H}) that would be present if all of the variations in sound level that occur over a 24-hour period were averaged to have the same total sound energy. The CNEL metric quantifies the total sound energy received and is therefore a cumulative measure, but it does not provide specific information on the number of noise events or the individual sound levels that occur during the 24-hour day.

Of note is that methods for quantifying noise depend on the potential impacts in question and on the type of noise. Another useful noise measurement in determining the effects of noise is the 1-hour average sound level, abbreviated L_{eq1H}. The L_{eq1H} can be thought of in terms of equivalent sound; that is, if a L_{eq1H} is 45.3 dB, this is what would be measured if a sound measurement device were placed in a sound field of 45.3 dB for 1 hour. The L_{eq1H} is usually A weighted unless specified otherwise (dBA). A weighting is a standard filter used in acoustics that approximates human hearing and in some cases is the most appropriate weighting filter when investigating the impacts of noise on wildlife as well as humans.

G.4 Sound Propagation

In an ideal setting in which sound propagates away from a point source without any outside influence (e.g., a barrier reflecting or attenuating the sound), sound energy radiates uniformly outward in all directions from the source in a pattern referred to as spherical spreading. As sound energy propagates away from the sound source, both the sound level and frequency change. For each doubling of distance from the source, the sound level attenuates (or drops off) at a rate of 6 dBA.

In a real-world setting, a number of factors can influence how sound propagates in the environment; the ideal case of spherical spreading is at best only an approximation of attenuation with distance. Wind has been shown to be the single most important meteorological factor within approximately 500 feet (152 meters) of the sound source, while vertical air temperature gradients are more important in sound propagation over longer distances. Other atmospheric conditions such as air temperature, humidity, and turbulence also can have a major effect on received sound levels.

Whether natural or manmade, a large object or barrier in the path between a sound source and a receptor can attenuate sound levels substantially. The impact of this shielding depends on the size and material of the object as well as the frequency content of the sound source. Natural terrain, buildings, and walls can serve as noise barriers in which attenuation of 5–10 dB is often not noticeable.

G.5 Noise Control Act

The Noise Control Act (NCA) (42 United States Code 4901 et seq.) sought to limit the exposure and disturbance that individuals and communities experience from noise. It focuses on surface transportation and construction sources, particularly near airport environments. The NCA also specifies that performance standards for transportation equipment be established with the assistance of the

U.S. Department of Transportation. Section 7 of the NCA regulates sonic booms and gave the FAA regulatory authority after consultation with the EPA. Furthermore, the 1987 Quiet Community amendment gave state and local authorities greater involvement in controlling noise.

G.6 Ambient Sound Guidance Documents

Ambient sound standards regulate ambient sound levels through time-averaged sound limits. Sound standards for land use compatibility established by DoD and civilian jurisdictions are expressed in terms of the DNL.

G.7 Federal Interagency Committee on Urban Noise Criteria

The federal government has established suggested land use compatibility criteria for different noise zones. However, land use compatibility with differing noise levels is regulated at the local level (Federal Interagency Committee on Urban Noise 1980). Residential areas and schools are considered compatible where the DNL is less than or equal to 65 dBA, and outdoor recreational activities are compatible with noise levels less than or equal to 70 dBA. Furthermore, parks are compatible with noise levels less than or equal to 75 dBA based on Land Use Guidelines.

G.8 U.S. Environmental Protection Agency Noise Standards

The level of environmental noise at which no measurable hearing loss would be expected to occur over a lifetime, as identified by the EPA, is a 24-hour exposure level of 70 dB (U.S. Environmental Protection Agency 1974).

G.9 Bibliography

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FALCON 9 and FALCON HEAVY NOISE ASSESSMENT FOR FLIGHT AND TEST OPERATIONS AT VANDENBERG SPACE FORCE BASE

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***Prepared for*:**

Space Exploration Technologies Corporation (SpaceX)
1 Rocket Road
Hawthorne, CA 90250

SPACEX

***Prepared by*:**

KBR

Kevin A. Bradley
Clifton B. Wilmer

Environment and Energy

15020 Conference Center Drive, Suite 100
Chantilly, VA 20151
828.318.5878

Cover Image By Space Exploration Technologies Corp. - https://www.spacex.com/vehicles/falcon-heavy/

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Executive Summary

Space Exploration Technologies Corporation (SpaceX) is planning to conduct flight operations and testing of the Falcon 9 and Falcon Heavy vehicles at Space Launch Complex (SLC)-4 and SLC-6 at Vandenberg Space Force Base (VSFB). To support environmental studies for Department of Air Force (DAF) and Federal Aviation Administration (FAA) actions, KBR, Inc. conducted this noise modeling study to estimate the single event and cumulative noise levels in the vicinity of VSFB from future Falcon 9 and Falcon Heavy launches, booster landings, and static fire tests at SLC-4 and SLC-6.

The RNOISE model, which computes far field noise levels in the community, was used to estimate rocket noise from Falcon 9 and Falcon Heavy flight and test operations at SLC-4 and SLC-6. Sonic boom exposure levels were estimated for the flight operations of these vehicles using the PCBoom model; PCBoom computes single-event sonic boom footprints, including contours of peak overpressure and signatures from any supersonic vehicle executing arbitrary maneuvers in a three-dimensional atmosphere. SpaceX provided the operations data required to conduct the noise modeling, including orbital launch and booster landing trajectories, engine operating data, static fire test parameters, and the projected annual number of daytime and nighttime launch, landing, and static fire test operations at SLC-4 and SLC-6.

Conclusions are that rocket noise from individual launch, landing, and static fire test events is expected to be heard by people in the communities surrounding SLC-4 and SLC-6, primarily Lompoc to the east, Narlon and Orcutt to the north, and Conception to the south. However, due to the levels and expected frequency of events, these individual noise events are not expected to cause general annoyance or pose health concerns, though noise complaints may occur. Projected annual operations at SLC-4 and SLC-6, with an approximate 50% daytime and 50% nighttime operations split, are expected to generate cumulative noise levels in residential areas that are below levels associated with adverse noise exposure (i.e., below the California Noise Equivalent Level (CNEL) 65 dBA threshold). Also, the CNEL 65 dBA contour would remain on VSFB property. The potential for structural damage assessment indicates that damage claims can be expected at 1 in 1,000 residences located within the maximum unweighted 111 dB noise contour for certain launch events; the 111 dB contour extends to the west side of Lompoc for Falcon 9 launches from SLC-4 and this noise contour extends to the east side of Lompoc for Falcon Heavy launches from SLC-6.

Falcon 9 launch events at SLC-4 and SLC-6 are expected to generate sonic booms over the Pacific Ocean with levels ranging from 0.1 to 0.5 pounds per square foot (psf) in most areas with the possibility that a limited number of small focal regions could experience levels up to 5.0 psf. Falcon Heavy launches from SLC-6 are expected to generate similar sonic boom exposure levels over the Pacific Ocean, including the Northern Channel Islands. Areas of mainland California could experience a sonic boom during ascent depending on the launch trajectory, inclination, and atmospheric conditions. For booster landing events at both sites, SLC-4 and SLC-6, boom levels in the vicinity of the landing pads are expected to range from about 5.0 psf to 8.0 psf and in the surrounding communities from 0.2 to 2.0 psf, and vary depending on the descent/landing trajectory and atmospheric conditions. Cumulative sonic boom levels from all landing operations together would be below the FAA's CDNL 60 dB significance threshold for compatible land use. In general, a 0.2 psf boom could be heard by someone who is expecting it, 0.5 psf booms are more likely to be noticed, and booms of 1.0 psf and higher are certain to be noticed and may cause people to be startled or annoyed. Boom levels over land, which are less than 2.0 psf in most areas, are unlikely to cause structural damage.

1 Introduction

Space Exploration Technologies Corporation (SpaceX) plans to increase the number of annual Falcon 9 Block 5 and Falcon Heavy Block 5 flight and test operations at Vandenberg Space Force Base (VSFB), California. The Falcon 9 Block 5, hereafter referred to as the Falcon 9, is a two-stage vehicle comprised of a booster and second stage (vehicle with payload); the vehicle has a total height of 229 ft and includes nine Merlin 1D engines that each provide sea-level thrust of 190,000 lbf, with a maximum thrust of 1.71 MM lbf during launch. The Falcon Heavy Block 5, hereafter referred to as the Falcon Heavy, is comprised of a center core on which two Falcon 9 boosters are attached, and a second stage on top of the center core which carries the payload. The Falcon Heavy has 27 Merlin 1D engines that provide a maximum thrust of 5.13 MM lbf during launch. Both vehicles have vertical take-off and landing (VTOL) capability and are reusable. KBR, Inc. conducted this study to estimate the single event and cumulative noise levels in the vicinity of VSFB from future Falcon 9 and Falcon Heavy launches, booster landings, and static fire tests at Vandenberg's Space Launch Complex 4 (SLC-4) and Space Launch Complex 6 (SLC-6).

SpaceX provided the following data for noise modeling:

- Orbital launch trajectories for the Falcon 9 and Falcon Heavy vehicles from liftoff to stage separation.
- Merlin 1D engine operating data and nominal ascent thrust profiles.
- Falcon 9 and Falcon Heavy booster reentry and descent/landing trajectories from separation to landing with descent thrust profiles.
- Static fire test parameters for the Falcon 9 and Falcon Heavy boosters.
- Projected annual launch, landing, and static fire test operations at SLC-4 and SLC-6.

This study estimates rocket noise exposure levels for flight events (launches and landings) and static test events and sonic boom exposure levels for flight events. Rocket noise levels were estimated for Falcon 9 and Falcon Heavy flight and static test operations at SLC-4 and SLC-6 using the RNOISE model. RNOISE[1,2], a far-field (distances beyond several hundred feet) community noise model for launch noise assessment is described further in Section 2. Sonic boom levels were estimated for Falcon 9 and Falcon Heavy flight operations at SLC-4 and SLC-6 using the PCBoom model[13,14]; PCBoom computes single-event sonic boom footprints, including contours of peak overpressure and signatures from any supersonic vehicle executing arbitrary maneuvers in a three-dimensional atmosphere (described further in Section 7).

In the following sections of this report, a description of rocket noise fundamentals is provided in Section 2 followed by estimated single event noise levels for Falcon 9 and Falcon Heavy orbital launches (Section 3), Falcon 9 and Falcon Heavy booster landings (Section 4), and static fire tests for both vehicles (Section 5). Section 6 presents cumulative noise level estimates for future projected launches, landings, and static fire tests at SLC-4 and SLC-6; cumulative noise is assessed for all projected operations combined. Sonic boom fundamentals, including metrics and assessment criteria, are presented in Section 7 followed by Falcon 9 and Falcon Heavy launch and landing sonic boom exposure levels in Sections 8 and 9, respectively.

2 Rocket Noise Background and Metrics

2.1 Background

Rockets generate significant noise from the combustion process and turbulent mixing of the exhaust flow with the surrounding air. Figure 1 is a sketch of rocket noise. There is a supersonic potential core of exhaust flow, surrounded by a mixing region. Noise is generated in this flow. It is directional, with the highest noise levels at an angle of 40 to 50 degrees from the direction of the exhaust flow. The fundamentals of predicting rocket noise were established by Wilhold et al.[3] for moving rockets and by Eldred et al.[4] for static firing. Sutherland[5] refined modeling of rocket source noise, improving its consistency relative to jet noise theory. Based on those fundamentals, Wyle has developed the PAD model for near field rocket noise[6] and the RNOISE model for far field noise in the community. RNOISE was used for the current analysis.

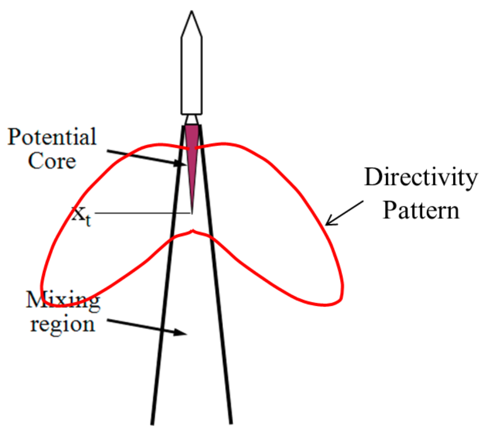

Figure 1. Rocket Noise Source

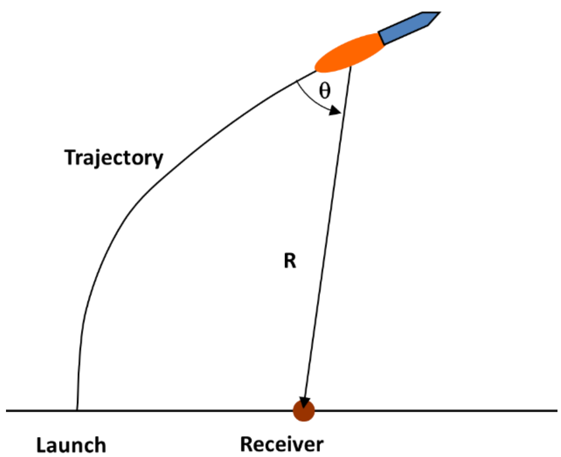

Figure 2. Modeling Rocket Noise at the Ground

Figure 2 is a sketch of far field rocket noise as treated by RNOISE. The vehicle's position and attitude are known from the trajectory. Rocket noise source characteristics are known from the engine properties, with thrust and exhaust velocity being the most important parameters. The emission angle and distance to the receiver are known from the flight path and receiver position. Noise at the ground is computed accounting for distance, ground impedance,[7] atmospheric absorption of sound,[8] and uniform ground elevation. RNOISE propagates the full spectrum to the ground, accounting for Doppler shift from vehicle motion. It is a time simulation model, computing the noise at individual points or on a regular grid for every time point in the trajectory. Propagation time from the vehicle to the receiver is accounted for, yielding a spectral time history at the ground (including a range of frequencies from 1 Hz to 16 kHz). A variety of noise metrics can be computed from the full calculated noise field and the metrics commonly used to assess rocket noise are described in the following section.

2.2 Rocket Noise Metrics and Assessment Criteria

2.2.1 Noise Metrics

FAA Order 1050.1F[9] specifies Day-Night Average Sound Level (DNL) as the standard metric for community noise impact analysis, but also specifies that other supplemental metrics may be used as appropriate for the circumstances. DNL is appropriate for continuous noise sources, such as airport noise and road traffic noise. Community Noise Equivalent Level (CNEL) is a variation of DNL specified by law in California (California Code of Regulations Title 21, Public Works) (Wyle Laboratories, 1970)[10]. CNEL has the 10-dB nighttime penalty for events between 10:00 p.m. and 7:00 a.m. but also includes a 4.8-dB penalty for events during the evening period of 7:00 p.m. to 10:00 p.m. The penalties account for the added intrusiveness of sounds during these periods. For airports DNL and CNEL represent the average sound level for annual average daily aircraft events. The noise metrics used for rocket noise analysis are:

- DNL, as defined by FAA Order 1050.1F, and CNEL;
- SEL, the Sound Exposure Level, for individual events;
- L_{Amax}, the maximum A-weighted overall sound pressure level (OASPL), for individual events;
- L_{max}, the maximum unweighted OASPL, for individual events; and
- One third octave spectra at certain sensitive receptors.

As mentioned, DNL and CNEL are necessary for policy. The next three metrics provide a measure of the impact of individual events; SEL and L_{Amax} are A-weighted and L_{max} is un-weighted. Loud individual events can pose a hearing damage hazard to people, and can also cause adverse reactions by animals. Adverse animal reactions can include flight, nest abandonment, and interference with reproductive activities. L_{max} along with spectra, may be needed to assess potential damage to structures and adverse reaction of species whose hearing response is not like that of humans.

L_{Amax} is appropriate for community noise assessment of a single event, such as a rocket launch or static fire test. This metric represents the highest A-weighted integrated sound level for the event in which the sound level changes value with time. Slowly varying or steady sounds are generally integrated over a period of one second. L_{Amax} is important in judging the interference caused by a noise event with conversation, TV listening, sleep, or other common activities. Similarly, L_{max} is the highest unweighted integrated sound level for the event, used to assess the potential for structural damage. Although A-weighted maximum sound level provides some measure of the intrusiveness of the event, it does not completely describe the total event, because it does not include the duration that the sound is heard.

SEL is a composite metric that represents both the level of a sound and its duration. Individual time-varying noise events (e.g., aircraft overflights) have two main characteristics: a sound level that changes throughout the event and a period during which the event is heard. SEL provides a measure of the total acoustic energy transmitted to the listener during the event, but it does not directly represent the sound level heard at any given time. For example, during an aircraft flyover, SEL would include both the maximum noise level and the lower noise levels produced during the entire overflight. Mathematically, it represents the sound level of a constant sound that would, in one second, generate the same acoustic energy as the actual time-varying noise event. For a rocket launch, SEL is expected to be greater than L_{Amax}.

2.2.2 Noise Assessment Guidelines

Land Use Compatibility Guidelines for Cumulative Noise Exposure

As previously mentioned, DNL and CNEL (used in California) represent the average sound level for annual average daily aircraft events which are used to assess cumulative noise exposure; both metrics are similar except CNEL includes an additional noise penalty for evening operations. FAA's published 14 Code of Federal Regulations (CFR) Part 150 defines land use compatibility guidelines for aviation noise exposure that are also applicable to rocket noise exposure. These guidelines consider land use compatibility for different uses over a range of DNL (or CNEL) noise exposure levels, including the adoption of DNL 65 dBA (or CNEL 65 dBA as specified by California law) as the limit for residential land use compatibility.

Hearing Conservation

Occupational Safety and Health Administration (OSHA)[11] guidelines are to protect human hearing from long-term, continuous exposures to high noise levels and aid in the prevention of noise-induced hearing loss (NIHL). OSHA's permissible daily noise exposure limits include a L_{Amax} of 115 dBA (slow response) for a duration of 0.25 hours or less. This is the criteria used in this study to evaluate areas around launch, landing, and static fire test sites that would require implementing a hearing conservation program, i.e., areas within the L_{Amax} 115 dBA contour. This level was chosen as a conservative indicator of when a hearing conservation program should be implemented since all proposed flight and test operations, individually or together, are not expected to exceed 0.25 hours in duration on any given day.

Structural Damage Potential

The potential for structural damage due to Falcon 9 and Falcon Heavy rocket engine noise events is assessed using two different criteria for structural damage. The first is based on an applicable study of structural damage claims from rocket static firing tests which indicates that, based on Maximum Unweighted Sound Level (L_{max}), approximately one damage claim will result per 100 households exposed at 120 dB and one damage claim will result per 1,000 households exposed at 111 dB[12]. The second method of assessment uses the conclusions from a recent, applicable study to ascertain whether range activities (i.e., test, evaluation, demilitarization, and training activities of items such as weapons systems, ordinance, and munitions would cause structural damage. The study concluded that structural damage becomes improbable below 140 dB [Maximum Un-weighted or linear Sound Level (L_{max})]. No glass or plaster damage is expected below 140 dB and no damage is expected below 134 dB[13].

Estimated rocket noise results for Falcon 9 and Falcon Heavy launch, landing, and static fire test events are presented in the following sections. These results include L_{Amax}, SEL, and L_{max} contours for single event noise assessment over the study area (Sections 3 through 5) and CNEL contours to assess the cumulative noise from all projected annual flight and test events at SLC-4 and SLC-6 (Section 6).

3 Orbital Launch Noise Levels

3.1 Falcon 9 Launch Noise at SLC-4 and SLC-6

RNOISE was used to estimate the L_{Amax}, SEL, and L_{max} contours for Falcon 9 orbital launches at VSFB SLC-4 and SLC-6 using trajectory data, from liftoff to stage separation, provided by SpaceX in files 'EROS_C_ASCENT_80_12_RNOISE2.TXT' and 'TRANSPORTER8_SLC6E_SLC6LANDING_ASCENT_80_12.ASC'. The L_{Amax} contours indicate the maximum sound level at each location over the duration of the launch where engine thrust varies according to the ascent thrust profile provided.

RNOISE computations were done using a radial grid consisting of 128 azimuths, from 0 to 360 degrees, and 100 intervals out to 500,000 feet from the launch point. Land areas were modeled using a single ground impedance value estimated from the most common ground cover type in the vicinity of Vandenberg SFB, and water areas modeled as acoustically hard. Ground effect was based on a weighted average over the propagation path. As will be shown in the resulting noise contour maps (Figures 3 through 14), the shape of the innermost contours is approximately circular. The shape of the outermost contours is due to rocket noise directivity and the difference between the ground impedance values used for water areas and land areas. The launch pad locations at SLC-4 and SLC-6 are indicated in the map legends as is the Vandenberg SFB property line and nearby cities including Lompoc, CA.

The L_{Amax} 90 dB through 130 dB contours shown in Figures 3 and 4 represent the maximum levels estimated for each Falcon 9 orbital launch at SLC-4; Figure 4 shows these contours using a zoomed in map scale to better show the extent of the noise exposure relative to cities located around SLC-4. The higher L_{Amax} contours (100 – 130 dB) are located within about 4 miles of SLC-4. Only the 90 dB contour extends beyond the Vandenberg SFB property line as far as the western side of Lompoc, CA. If a Falcon 9 orbital launch occurs during the day, when background levels are in the 50 dB to 60 dB range, residents of Lompoc may notice launch noise levels above 70 dB and up to 90 dB. If the same launch occurs during the night, when background levels are lower than during the day (e.g., below 40 dB to 50 dB range), Lompoc residents and the residents of Orcutt, CA to the north and Conception, CA to the south may notice launch noise levels that exceed 60 dB. A prevailing on-shore or off-shore breeze may also strongly influence noise levels in these communities.

Estimated SEL contour levels of 90 dB through 140 dB, in 10 dB increments, are shown in Figures 5 and 6 for each Falcon 9 orbital launch at SLC-4 with Figure 6 showing a zoomed in map scale. As mentioned previously, SEL is an integrated metric and is expected to be greater than the L_{Amax} because the launch event is up to several minutes in duration whereas the maximum sound level (L_{Amax}) occurs instantaneously. In Figure 6, the 100 dB SEL contour is expected to extend to the west side of Lompoc and the 90 dB SEL contour to extend further, beyond the eastern side of Lompoc.

Orbital launch events are the loudest single events of all the flight and test operations assessed in this modeling study. Accordingly, Falcon 9 orbital launch single event noise levels are related to guidelines for hearing conservation and potential for structural damage as follows.

An estimate of the areas in the vicinity of Falcon 9 orbital launches at SLC-4, where a hearing conservation program should apply was made using OSHA's permissible daily noise exposure limit of 115 dBA (slow response) for a duration of 0.25 hours or less. Figure 4 shows that noise levels (L_{Amax}) are less than OSHA's 115 dBA upper noise limit guideline at distances greater than approximately 1.5 miles from the launch pad (i.e., hearing conservation should apply within 1.5 miles from the launch pad). Falcon 9 orbital launch noise events will last a few minutes at most, at a specific location, with the highest noise levels occurring for less than a minute such that OSHA's 115 dBA daily noise exposure limit is not expected to be exceeded.

The potential for structural damage due to Falcon 9 orbital launch events is assessed using the criteria described in Section 2.2.2 which indicates that, based on Maximum Unweighted Sound Level (L_{max}), approximately one damage claim will result per 100 households exposed at 120 dB and one damage claim will result per 1,000 households exposed at 111 dB[12]. The L_{max} contours estimated for Falcon 9 orbital launch events are shown on Figures 7 and 8 (zoomed in) including the L_{max} 111 dB and 120 dB contours used for damage claim assessment. The L_{max} 120 dB contour extends approximately 4 miles from the launch pad (Figure 8) and remains entirely on VSFB property except to the west it extends beyond the coastline. The 111 dB contour extends approximately 8 miles east of the launch pad to the west side of Lompoc, CA, where residential development exists. There are a limited number of houses within the 111 dB contour, however the potential for damage can be estimated using one damage claim per 1,000 households. Using the second less conservative criteria in Section 2.2.2, indicates that no damage is expected from Falcon 9 launches or any of the other Falcon 9 operations that generate lower noise levels than launches. The 134 dB Maximum Unweighted Sound Level (L_{max}) contour for all Falcon 9 flight and test operations is well within VSFB property, such that no off-base impacts are expected. The L_{max} 110 dB through 140 dB contours estimated for Falcon 9 orbital launch events at SLC-4 are shown in Figures 7 and 8 (zoomed in). Falcon 9 orbital launch events are estimated to generate L_{max} of 134 dB approximately 0.5 miles from the launch pad (Figure 8).

Falcon 9 orbital launches from SLC-6 are estimated to generate L_{Amax}, SEL, and L_{max} contours of comparable size (extents from the launch pad) compared with the same Falcon 9 orbital launch contours at SLC-4. Much of the preceding discussion about launch noise exposure at SLC-4 applies as well to SLC-6 with the notable difference that SLC-6 is located about 3.5 miles south/southwest of SLC-4. Accordingly, the L_{Amax}, SEL, and L_{max} contours shown in Figures 9 – 14 reflect the shift in noise exposures to the southwest, centered on SLC-6. For this reason, noise exposure in Lompoc is estimated to be less from Falcon 9 launches at SLC-6, compared with Falcon 9 launches at SLC-4 (compare L_{Amax} contours in Figures 4 and 10, for example). Figure 14 shows the L_{max} 111 dB and 120 dB contours used to assess the potential for structural damage; neither contour extends far enough east into residential areas, such that the probability of damage is low (less than one damage claim would be expected per 1,000 households). The L_{max} 134 dB and 140 dB contours, and in between the 134 dB contour (not shown), also used to assess the potential for structural damage, are well within VSFB property such that no damage to off base residences would be expected.

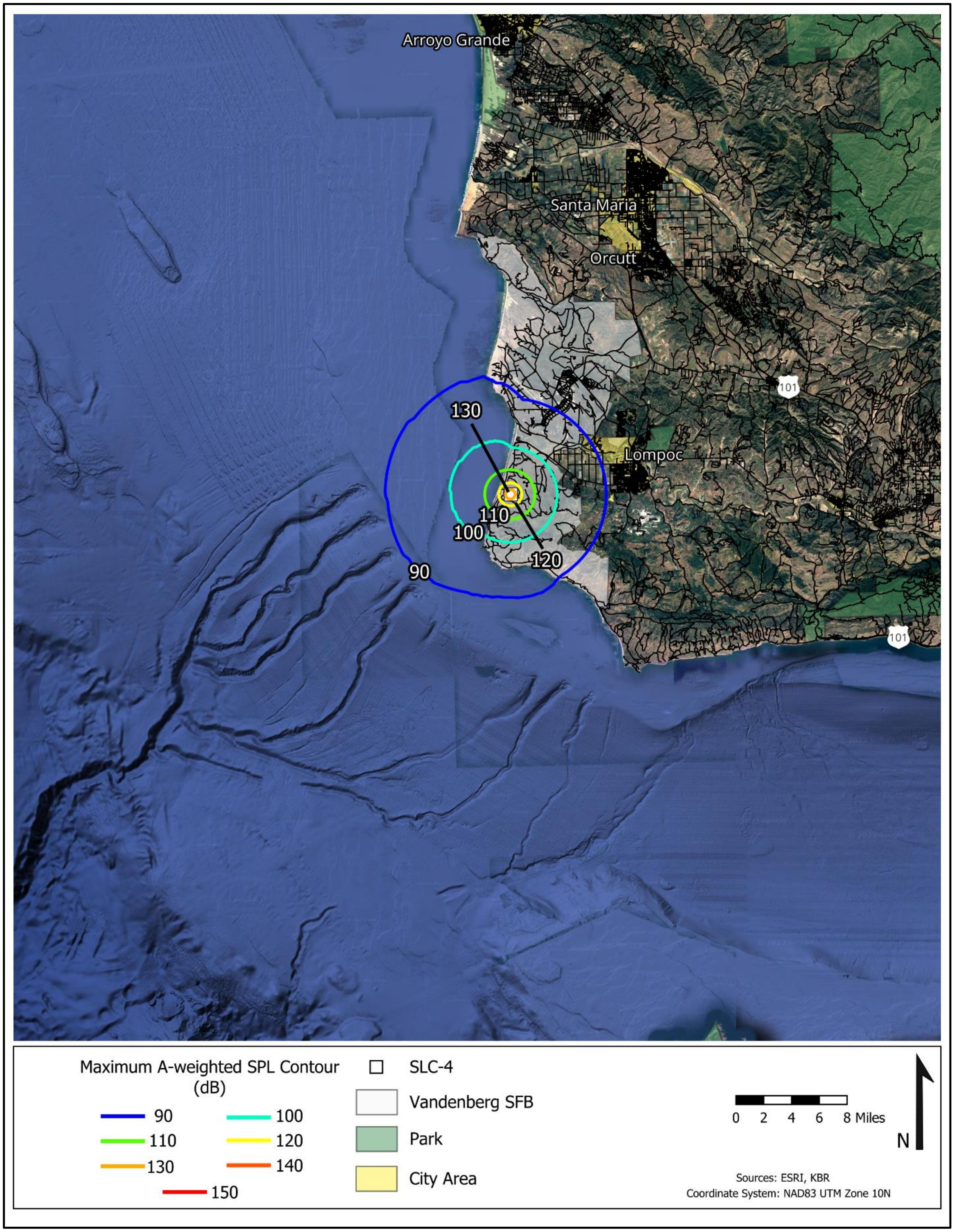

Figure 3. Falcon 9 Orbital Launch from SLC-4: Maximum A-Weighted Sound Levels

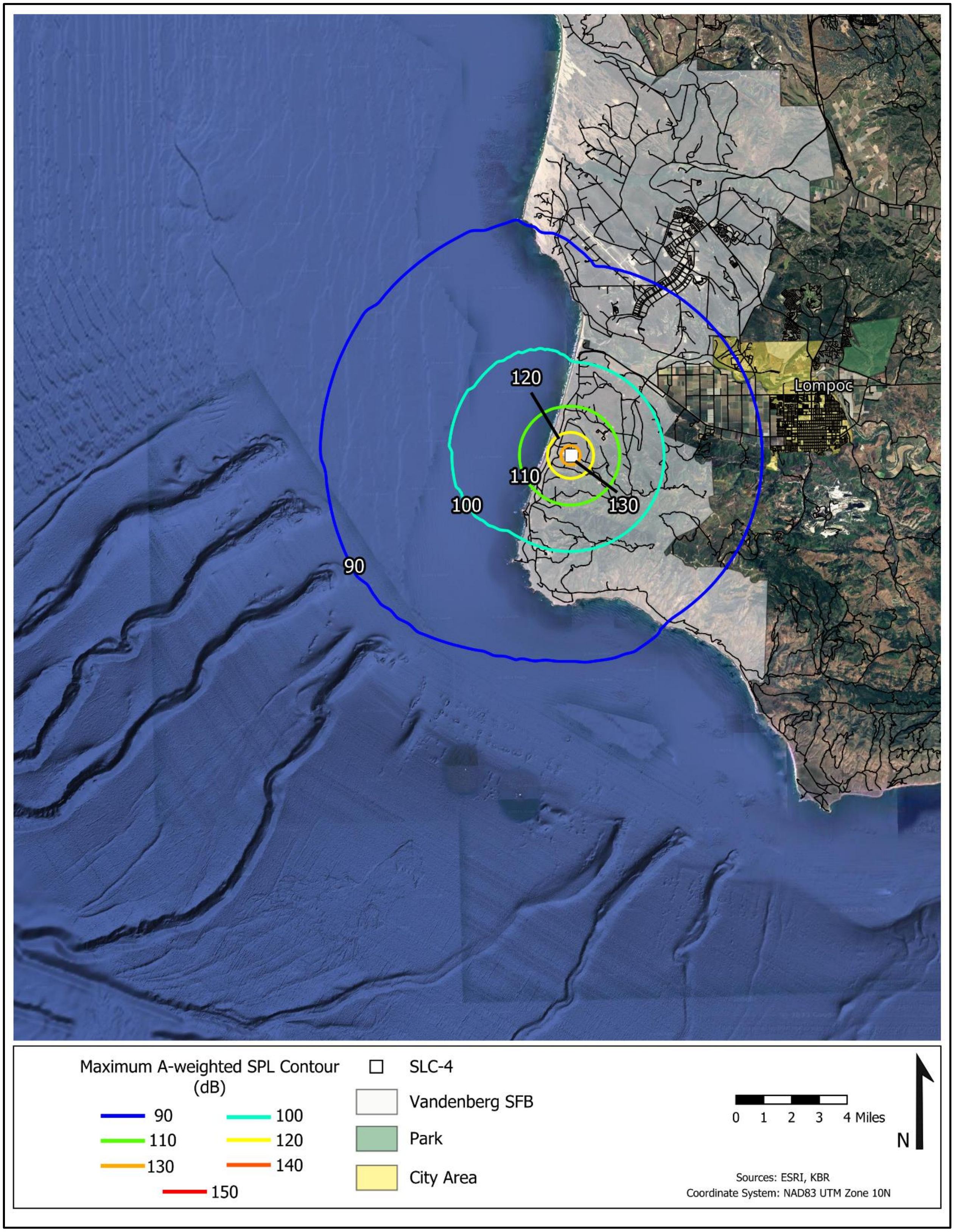

Figure 4. Falcon 9 Orbital Launch from SLC-4: Maximum A-Weighted Sound Levels (Zoom In)

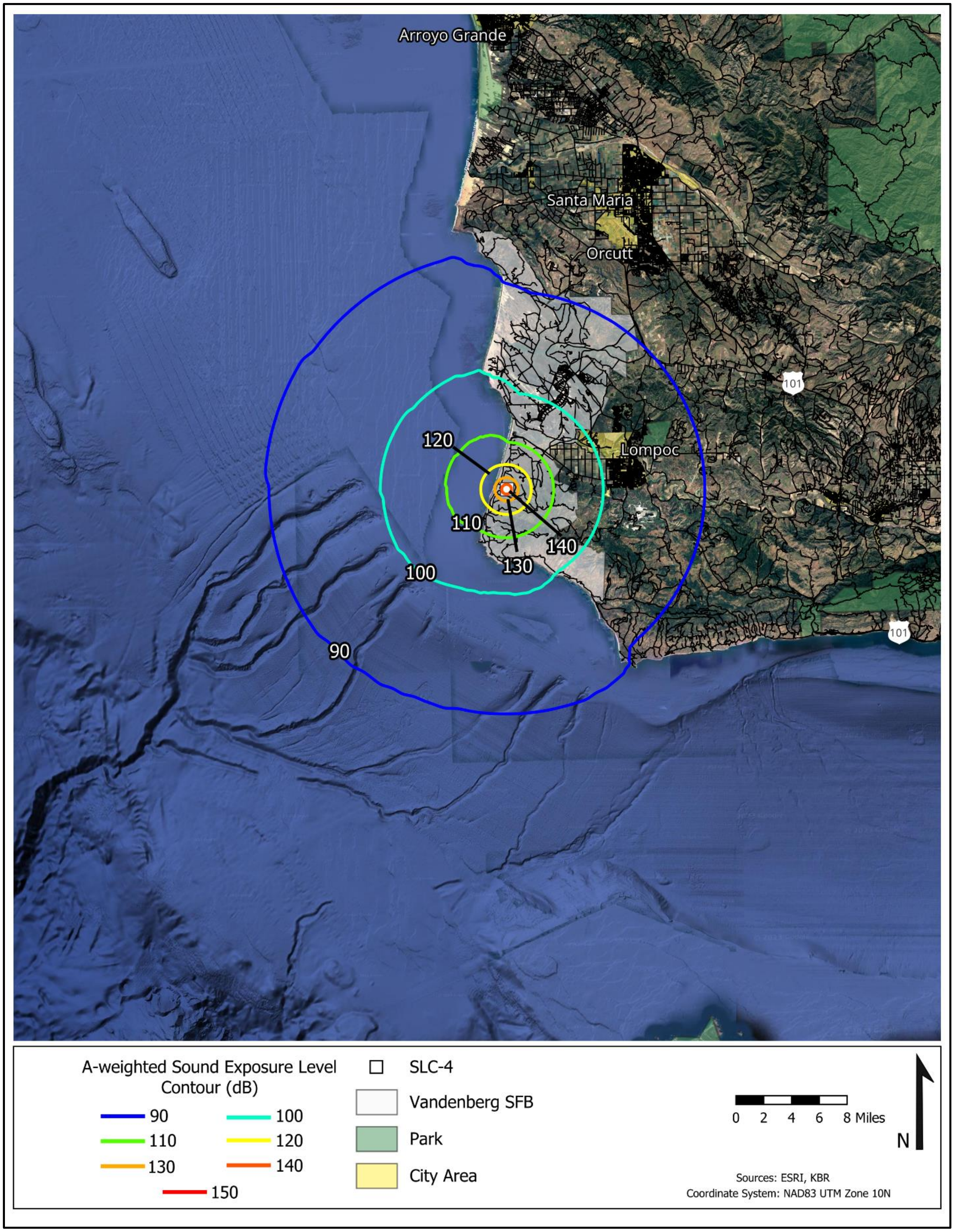

Figure 5. Falcon 9 Orbital Launch from SLC-4: Sound Exposure Levels

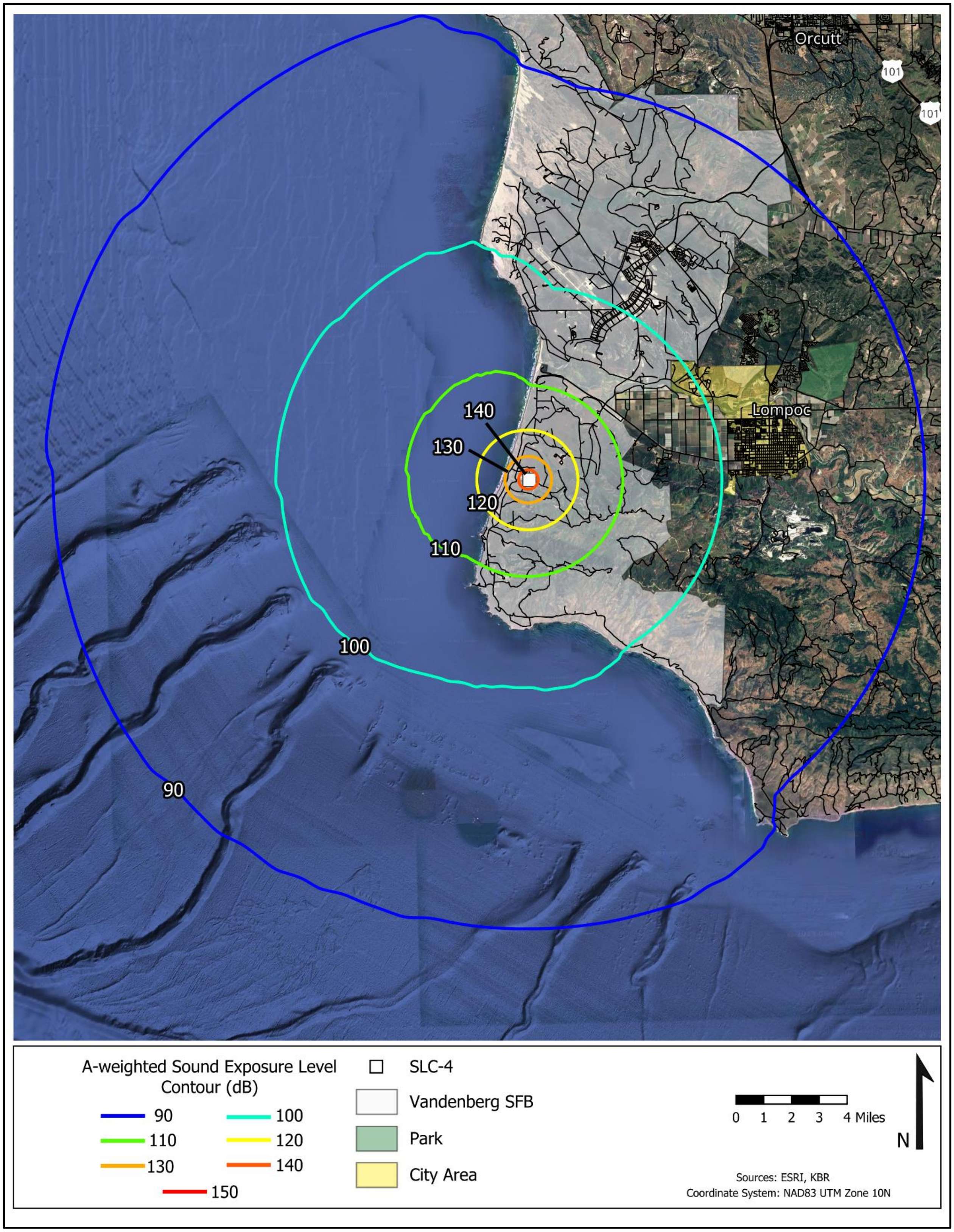

Figure 6. Falcon 9 Orbital Launch from SLC-4: Sound Exposure Levels (Zoom in)

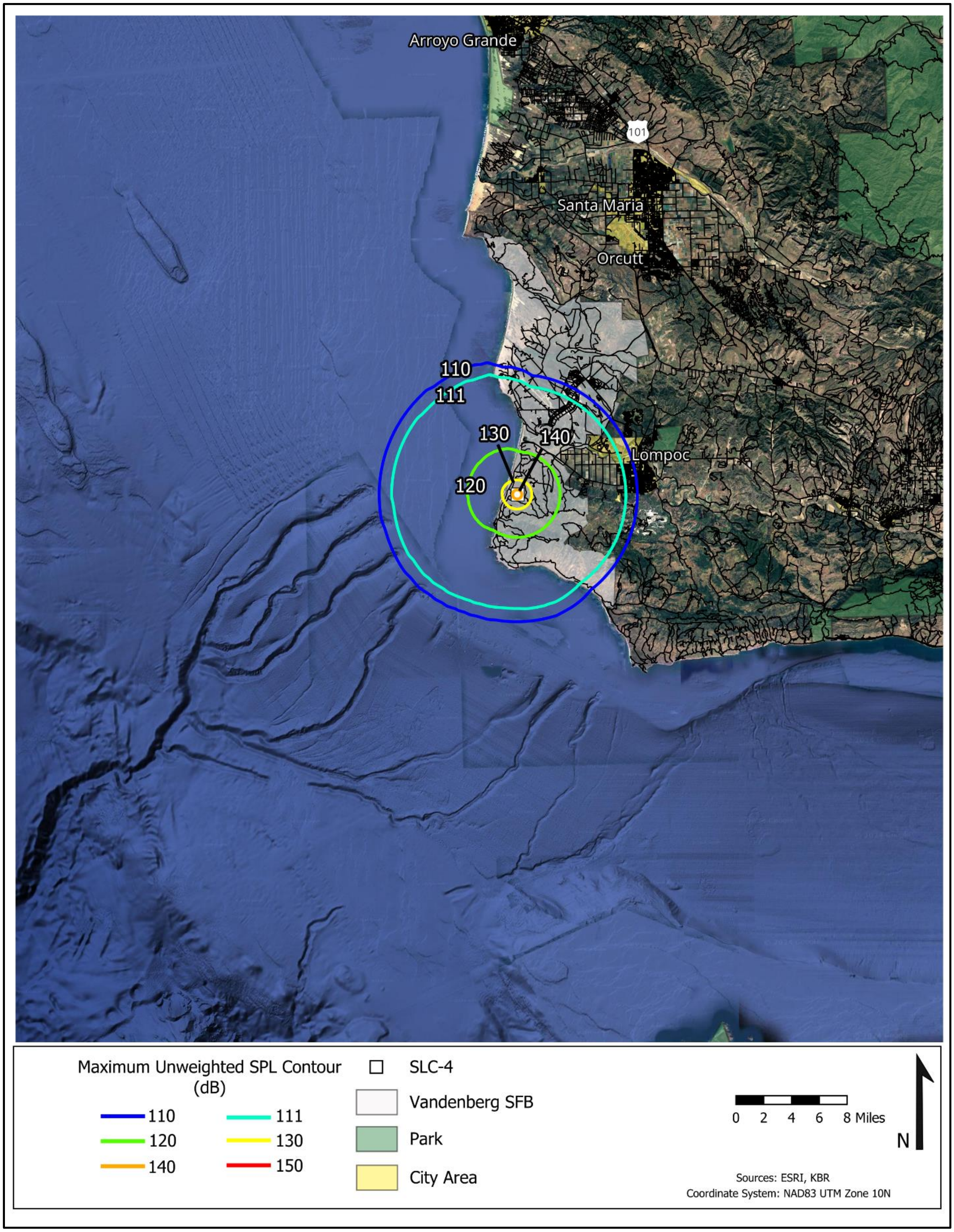

Figure 7. Falcon 9 Orbital Launch from SLC-4: Maximum Un-Weighted Sound Levels

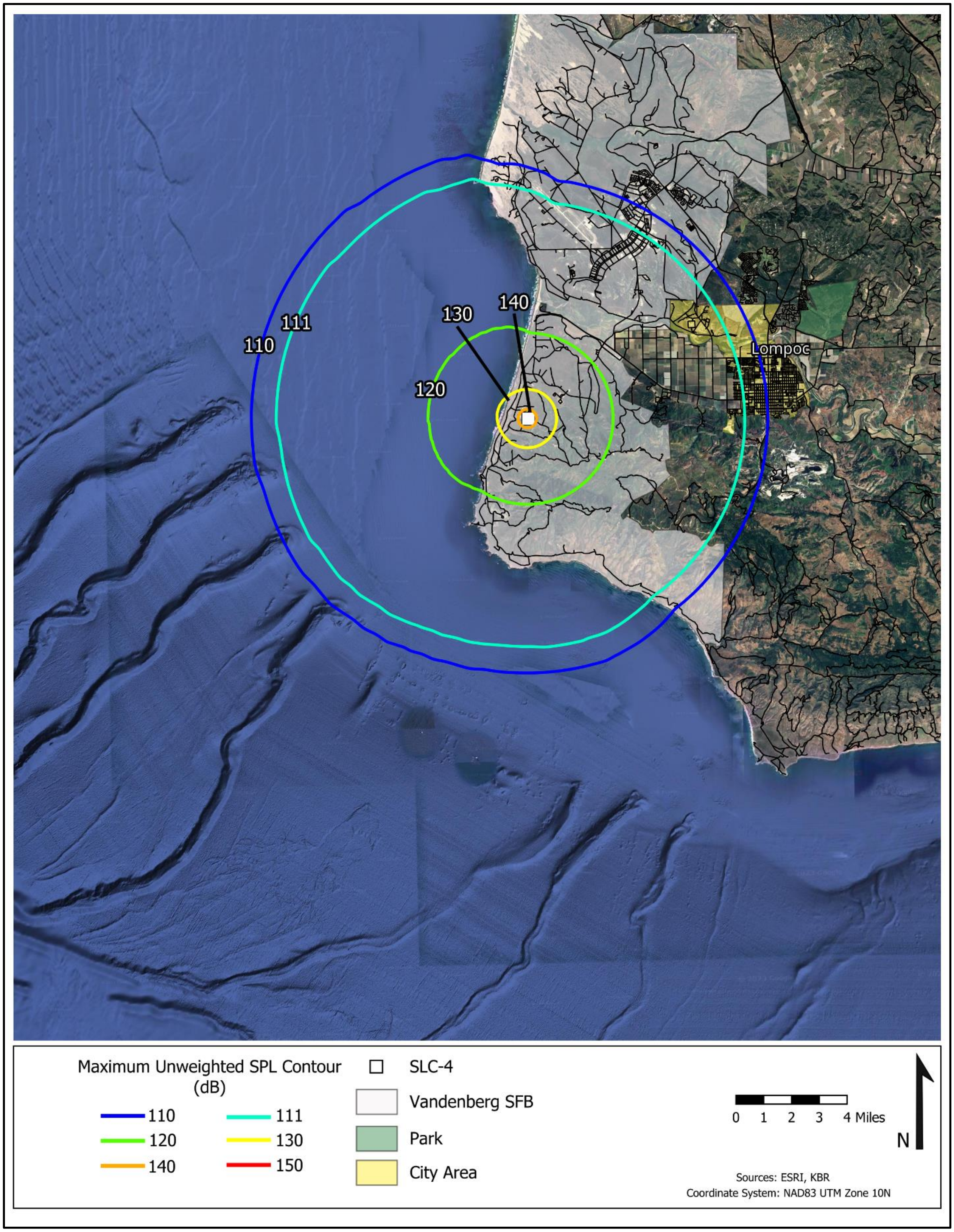

Figure 8. Falcon 9 Orbital Launch from SLC-4: Maximum Un-Weighted Sound Levels (Zoom In)

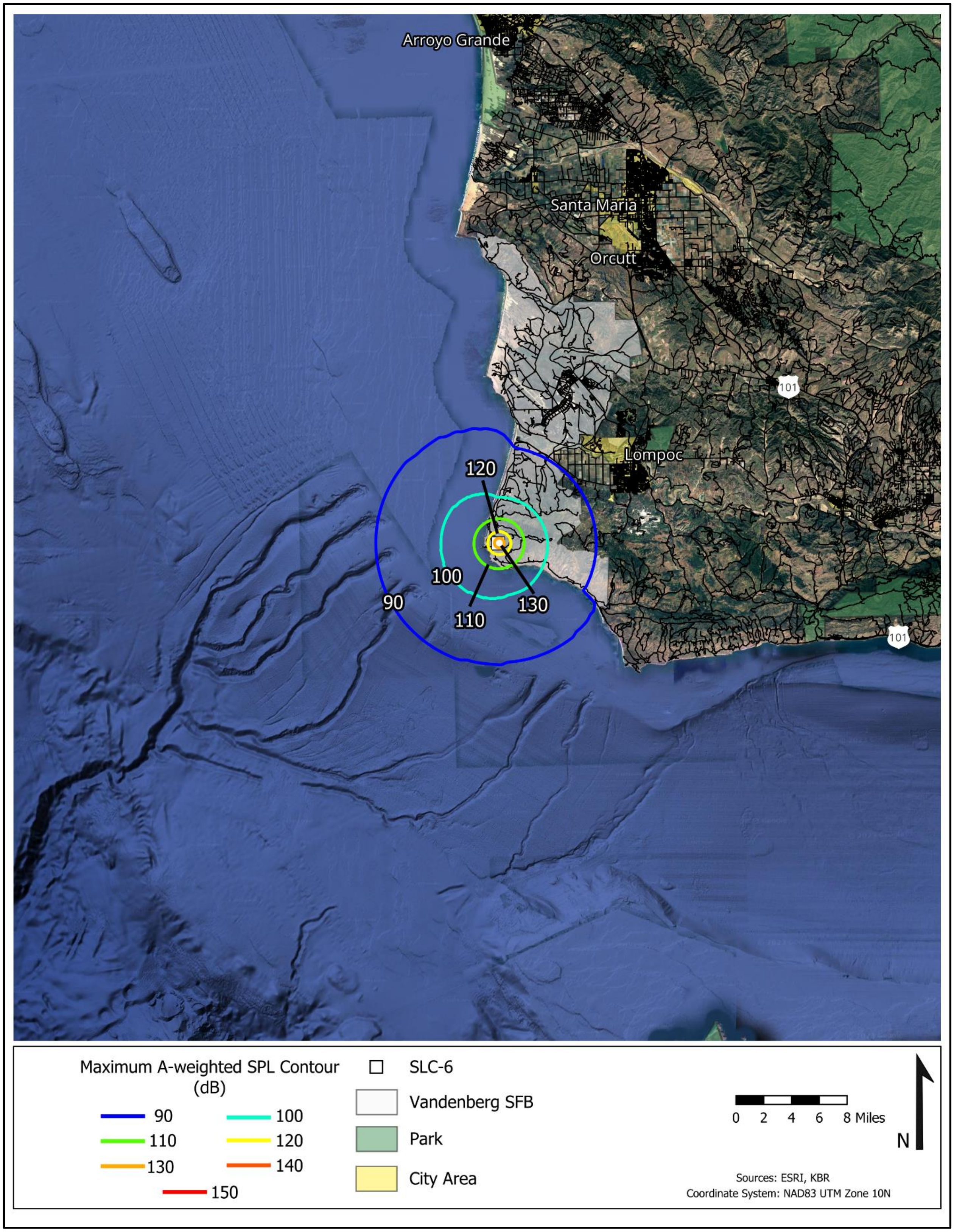

Figure 9. Falcon 9 Orbital Launch from SLC-6: Maximum A-Weighted Sound Levels

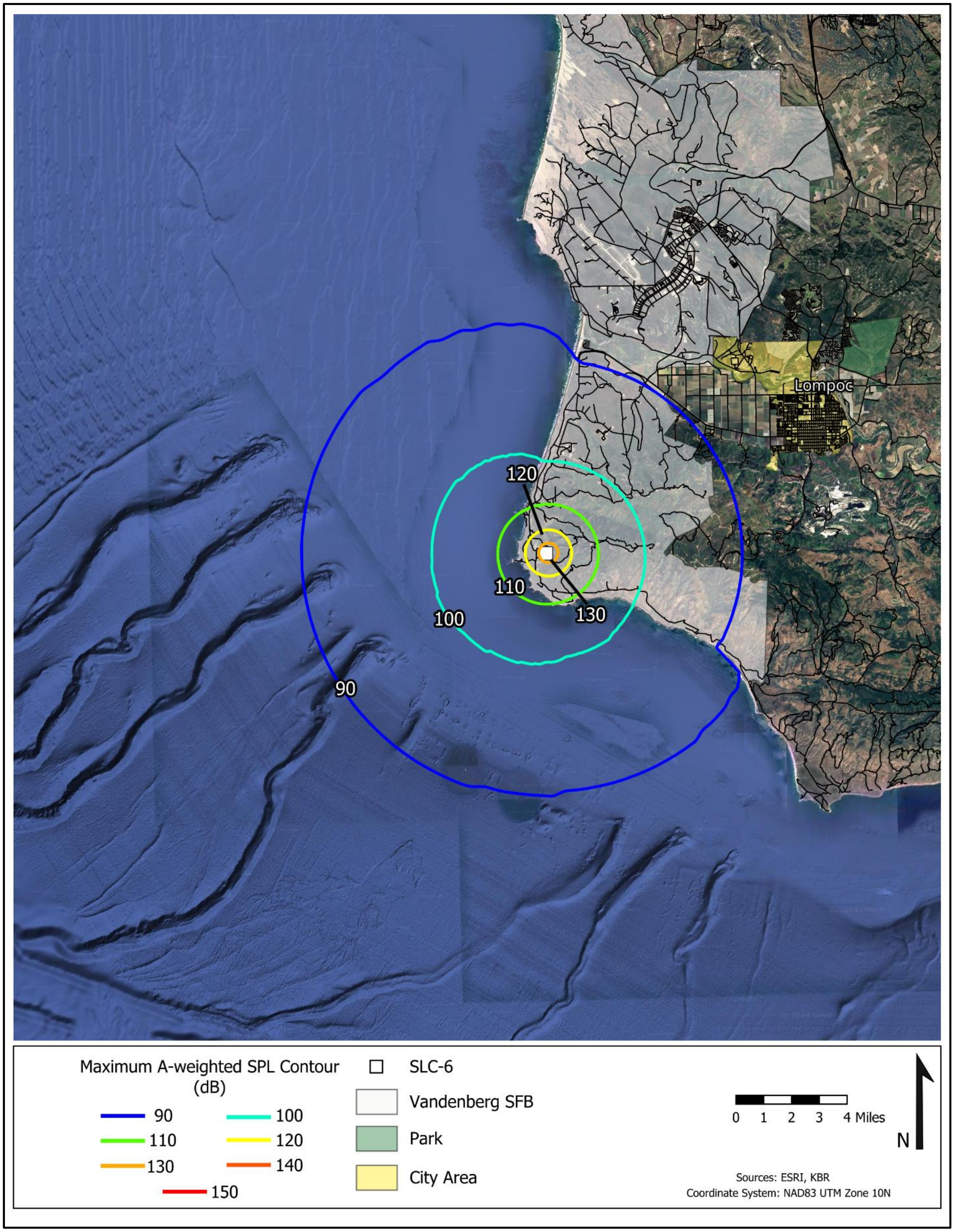

Figure 10. Falcon 9 Orbital Launch from SLC-6: Maximum A-Weighted Sound Levels (Zoom In)

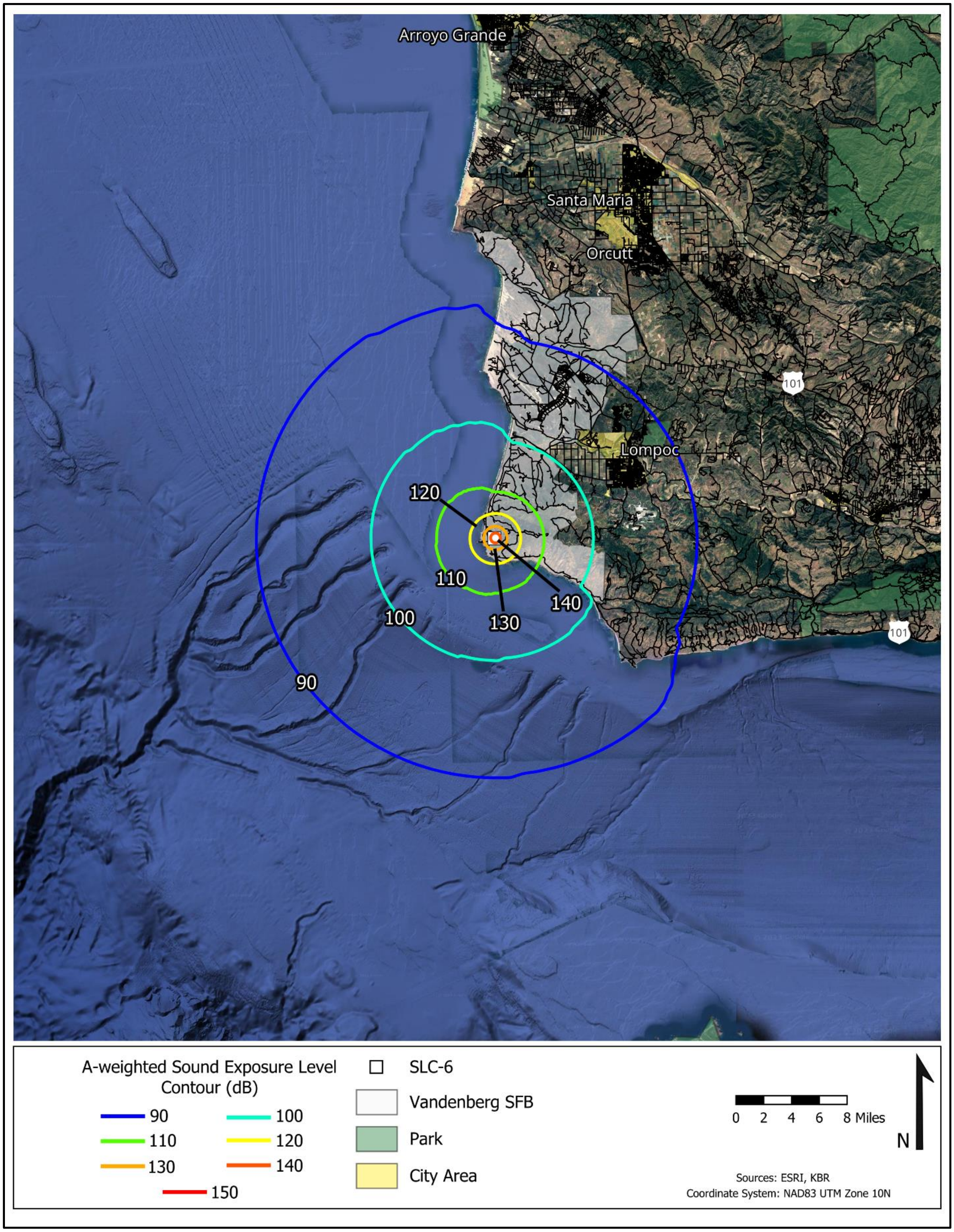

Figure 11. Falcon 9 Orbital Launch From SLC-6: Sound Exposure Levels

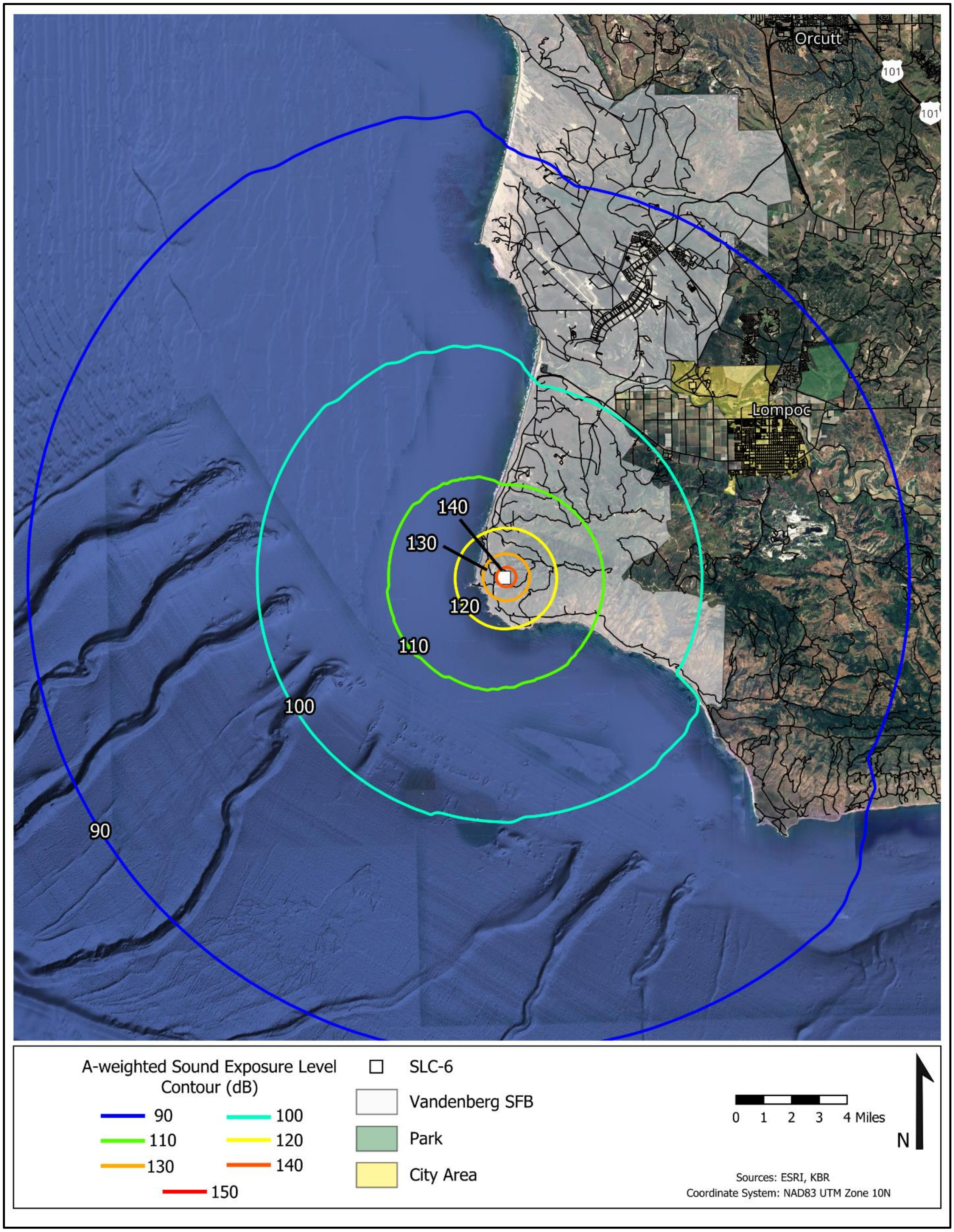

Figure 12. Falcon 9 Orbital Launch from SLC-6: Sound Exposure Levels (Zoom In)

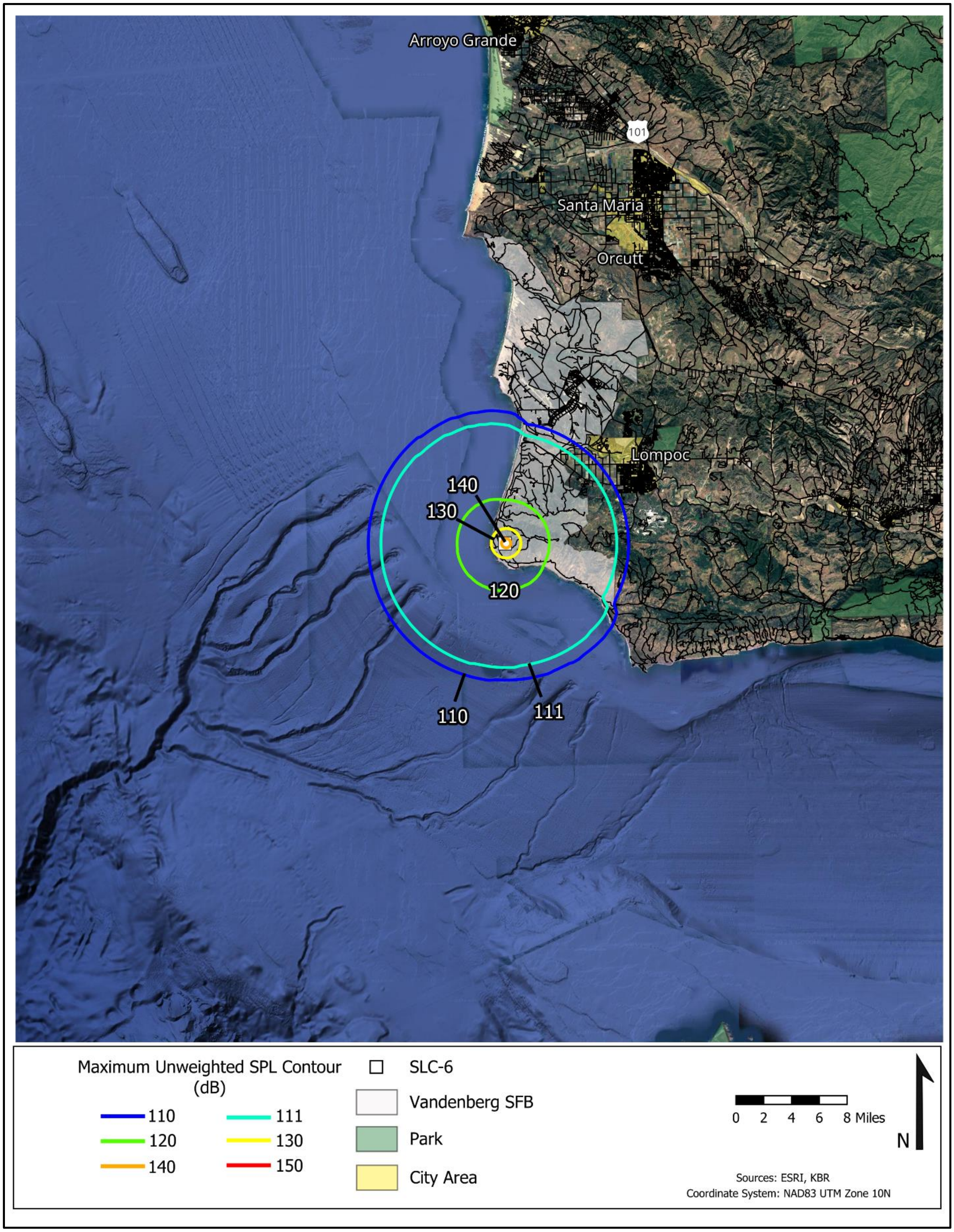

Figure 13. Falcon 9 Orbital Launch from SLC-6: Maximum Un-Weighted Sound Levels

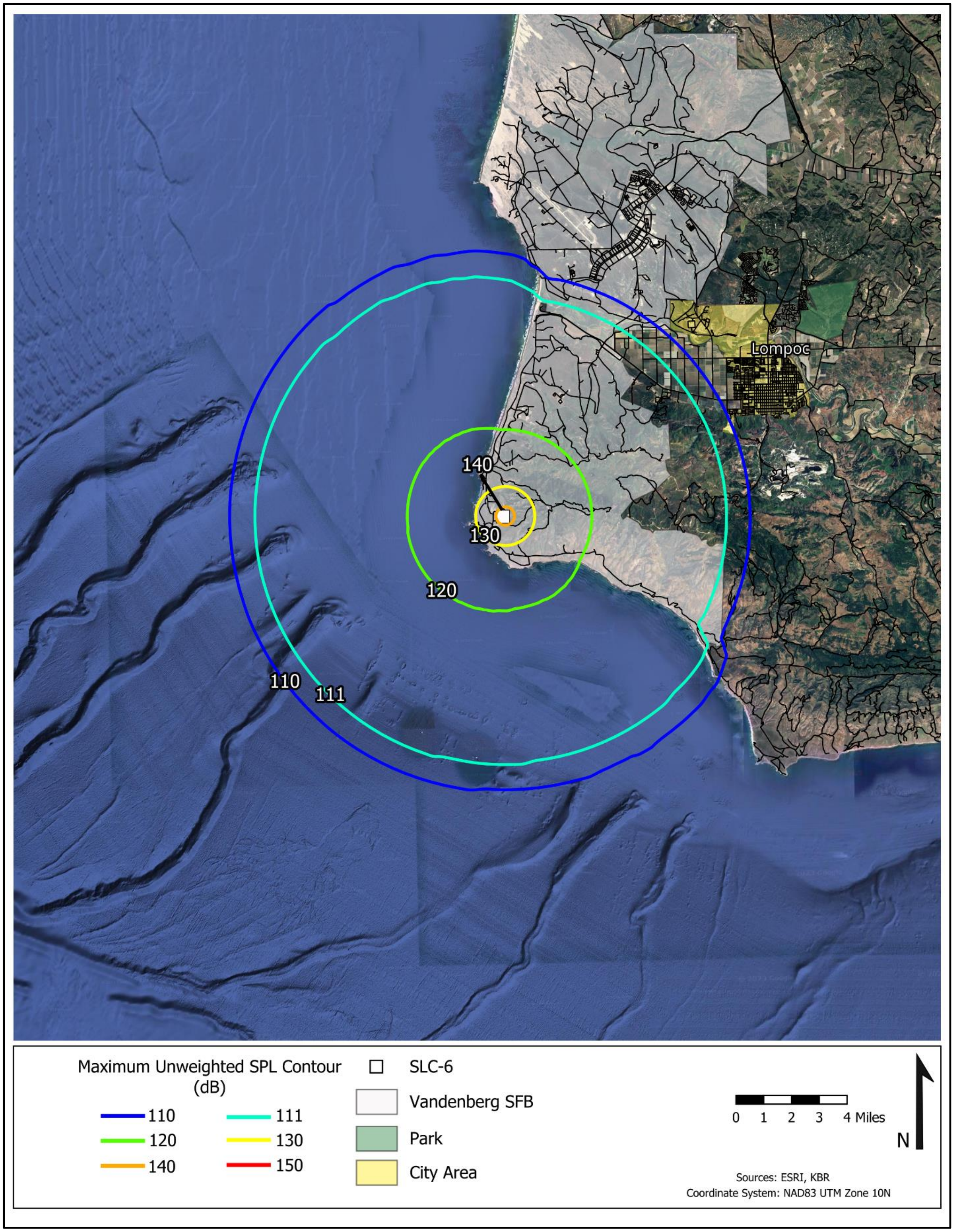

Figure 14. Falcon 9 Orbital Launch from SLC-6: Maximum Un-Weighted Sound Levels (Zoom In)

3.2 Falcon Heavy Launch Noise at SLC-6

RNOISE was used to estimate the L_{Amax}, SEL, and L_{max} contours for Falcon Heavy orbital launches at Vandenberg SFB SLC-6 using trajectory data, from liftoff to stage separation, provided by SpaceX in file 'NSSL23_MOLNIYA_SLC6E_SLC6LANDING_ASCENT_80_12.ASC'. RNOISE computations were done using the same methodology as described in Section 3.1. As will be shown in the resulting noise contour maps (Figures 15 through 20), the shape of the innermost contours is approximately circular. The shape of the outermost contours is due to rocket noise directivity and the difference between the ground impedance values used for water areas and land areas. The launch pad location at SLC-6 is indicated in the map legends as is the Vandenberg SFB property line and nearby cities including Lompoc, CA.

The L_{Amax} contours indicate the maximum sound level at each location over the duration of the launch where engine thrust varies according to the ascent thrust profile provided. The L_{Amax} 90 dB through 140 dB contours shown in Figures 15 and 16 represent the maximum levels estimated for each Falcon Heavy orbital launch at SLC-6; Figure 16 shows these contours using a zoomed in map scale to better show the extent of the noise exposure relative to cities located around SLC-6. The higher L_{Amax} contours (100 – 140 dB) are located within about 5 miles of SLC-6; the 100 dB contour remains mostly within the Vandenberg SFB property line. Only the 90 dB contour extends well beyond the Vandenberg SFB property line as far as the western side of Lompoc, CA. If a Falcon Heavy orbital launch occurs during the day, when background levels are in the 50 dB to 60 dB range, residents of Lompoc may notice launch noise levels above 70 dB and up to 90 dB. If the same launch occurs during the night, when background levels are lower than during the day (e.g., below 40 dB to 50 dB range), Lompoc residents and the residents of Orcutt, CA to the north and Conception, CA to the south may notice launch noise levels that exceed 60 dB. A prevailing on-shore or off-shore breeze may also strongly influence noise levels in these communities.

Estimated SEL contour levels of 90 dB through 140 dB, in 10 dB increments, are shown in Figures 17 and 18 for each Falcon Heavy orbital launch at SLC-6 with Figure 18 showing a zoomed in map scale. As mentioned previously, SEL is an integrated metric and is expected to be greater than the L_{Amax} because the launch event is up to several minutes in duration whereas the maximum sound level (L_{Amax}) occurs instantaneously. In Figure 18, the 100 dB SEL contour is expected to extend to the west side of Lompoc and the 90 dB SEL contour to extend further, beyond the eastern side of Lompoc.

The Falcon Heavy orbital launch event is the loudest single event of all the flight and test operations assessed in this modeling study. Like the analysis done for the Falcon 9 (Section 3.1), Falcon Heavy orbital launch single event noise levels are related to guidelines for hearing conservation and potential for structural damage as follows.

Falcon Heavy orbital launches at SLC-6 noise events will last a few minutes at most, with the highest noise levels occurring for less than a minute. OSHA's L_{Amax} 115 dB guideline[11] can be used as a conservative limit for hearing conservation. Figure 16 shows that noise levels (L_{Amax}) are less than OSHA's 115 dBA upper noise limit guideline at distances greater than approximately 3.0 miles from the launch pad (i.e., hearing conservation should apply within 3 miles from the launch pad).

The L_{max} contours estimated for Falcon Heavy orbital launch events at SLC-6 are shown in Figures 19 and 20 (zoomed in). These include the L_{max} 111 dB and 120 dB contours used to assess the potential for damage (Section 2.2.2) which indicates that, based on Maximum Unweighted Sound Level (L_{max}), approximately one damage claim will result per 100 households exposed at 120 dB and one damage claim will result per 1,000 households exposed at 111 dB[12]. The L_{max} 120 dB contour extends approximately 6 miles from the launch pad (Figure 8) and remains entirely on VSFB property except to the west it extends beyond the coastline. The 111 dB contour extends approximately 13 miles east of the launch pad to the east side of Lompoc, CA (on the eastern side of the residential development). Most of the residences in Lompoc are estimated to be within the 111 dB contour during a Falcon Heavy launch. Therefore the potential for structural damage resulting from a Falcon Heavy launch, would be higher than for a Falcon 9 launch since more residences are exposed to higher noise levels (above L_{max} 111 dB, for example). No off-base damage is expected from the other Falcon Heavy flight and test operations which generate lower noise levels than launches. The L_{max} 130 dB and 140 dB contours, and in between the 134 dB contour (not shown), is also used to assess the potential for damage (Section 2.2.2). The 134 dB L_{max} contour for Falcon Heavy launches at SLC-6 is approximately 1 mile from the pad and located well within VSFB property, such that no off-base damage is expected to occur from this assessment. Similarly, no off-base damage is expected from the other Falcon Heavy flight and test operations which generate lower noise levels than launches.

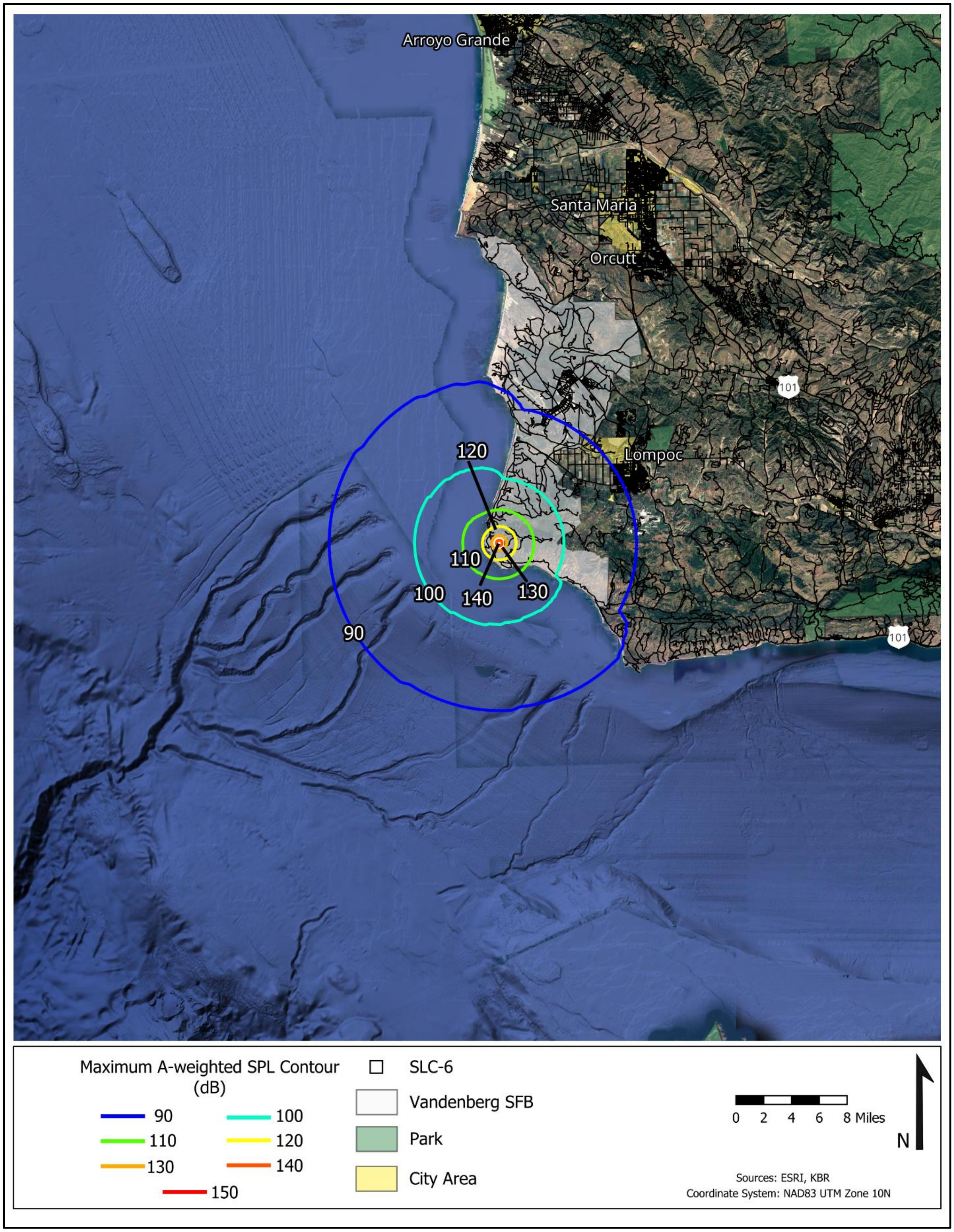

Figure 15. Falcon Heavy Orbital Launch from SLC-6: Maximum A-Weighted Sound Levels

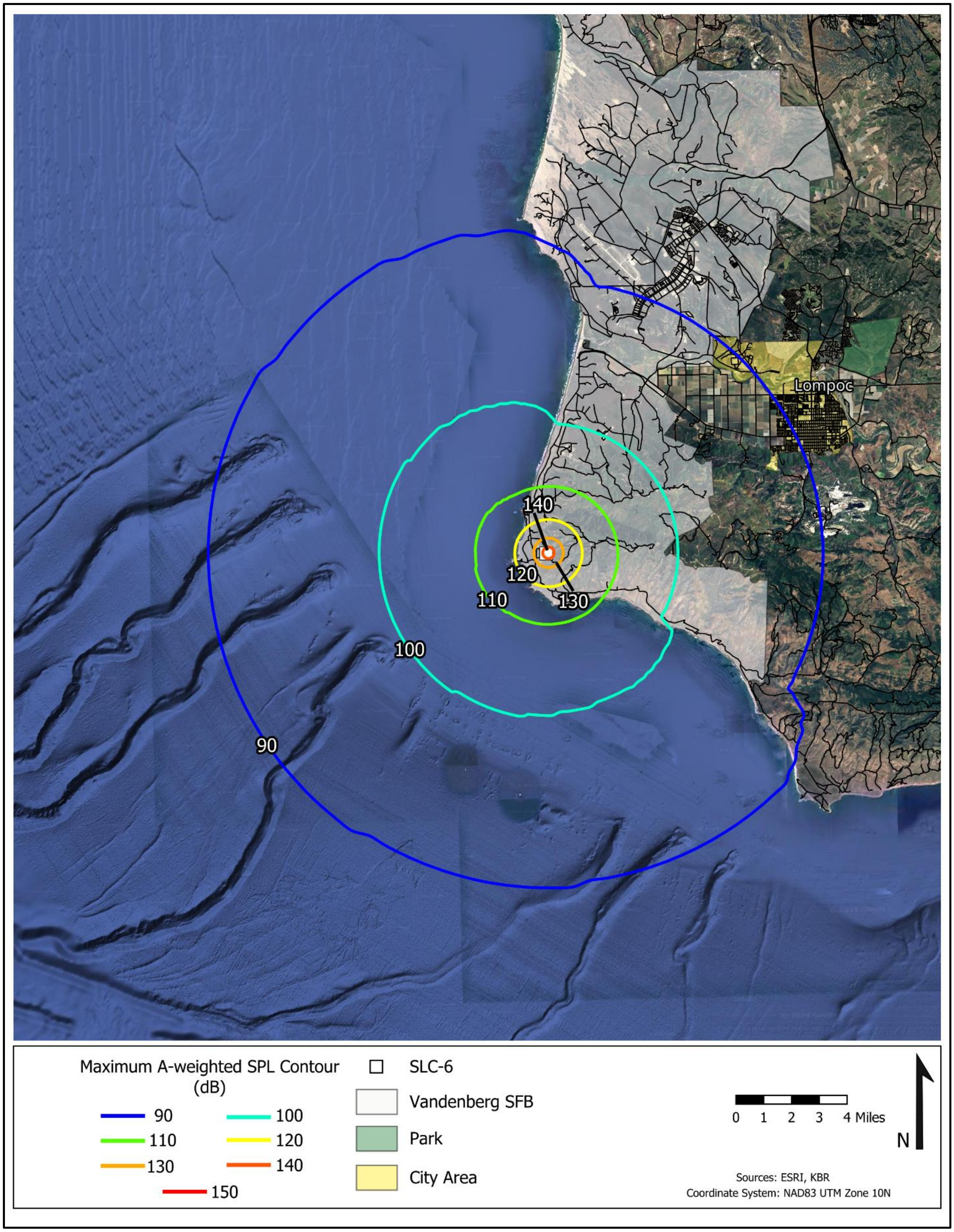

Figure 16. Falcon Heavy Orbital Launch from SLC-6: Maximum A-Weighted Sound Levels (Zoom In)

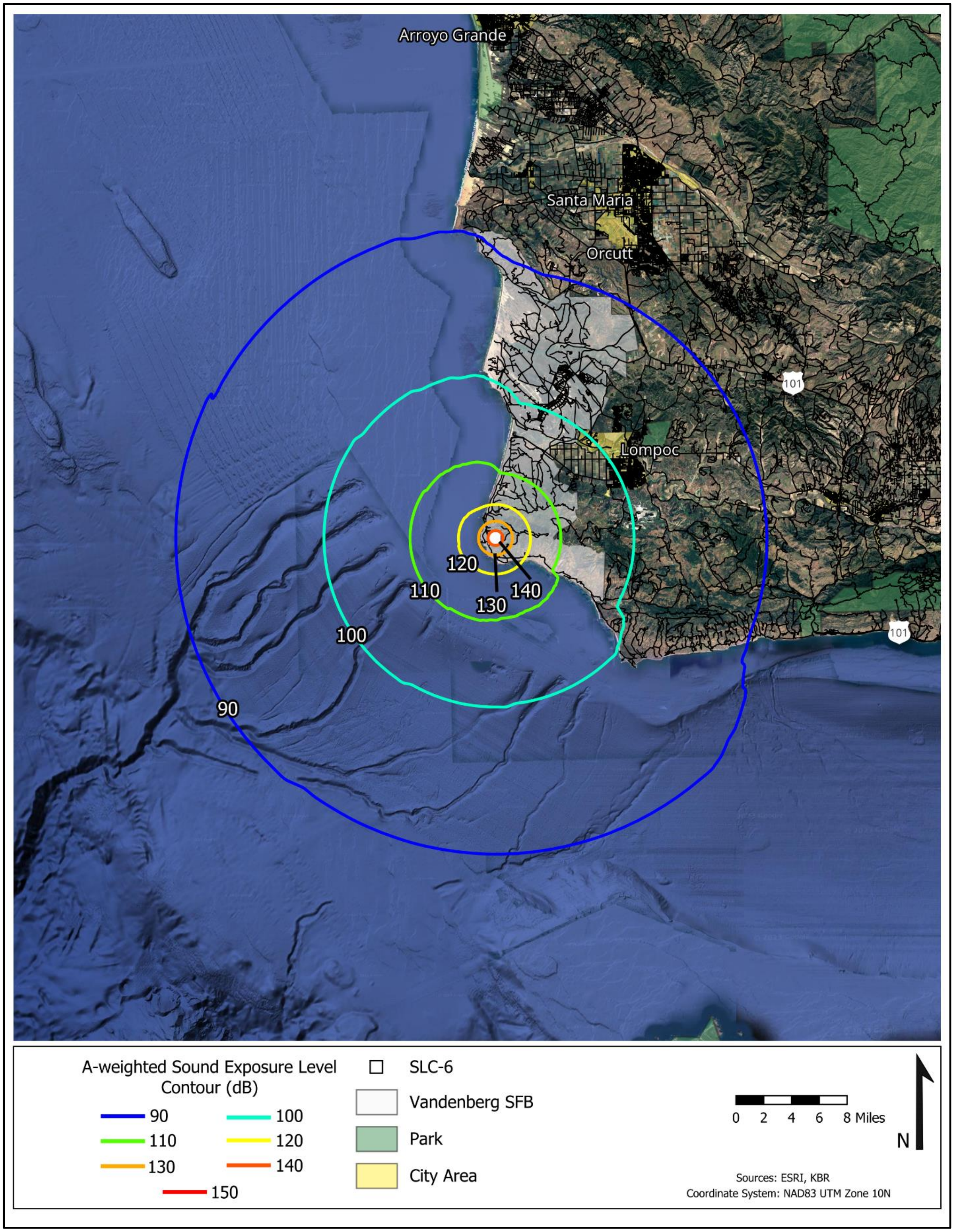

Figure 17. Falcon Heavy Orbital Launch from SLC-6: Sound Exposure Levels

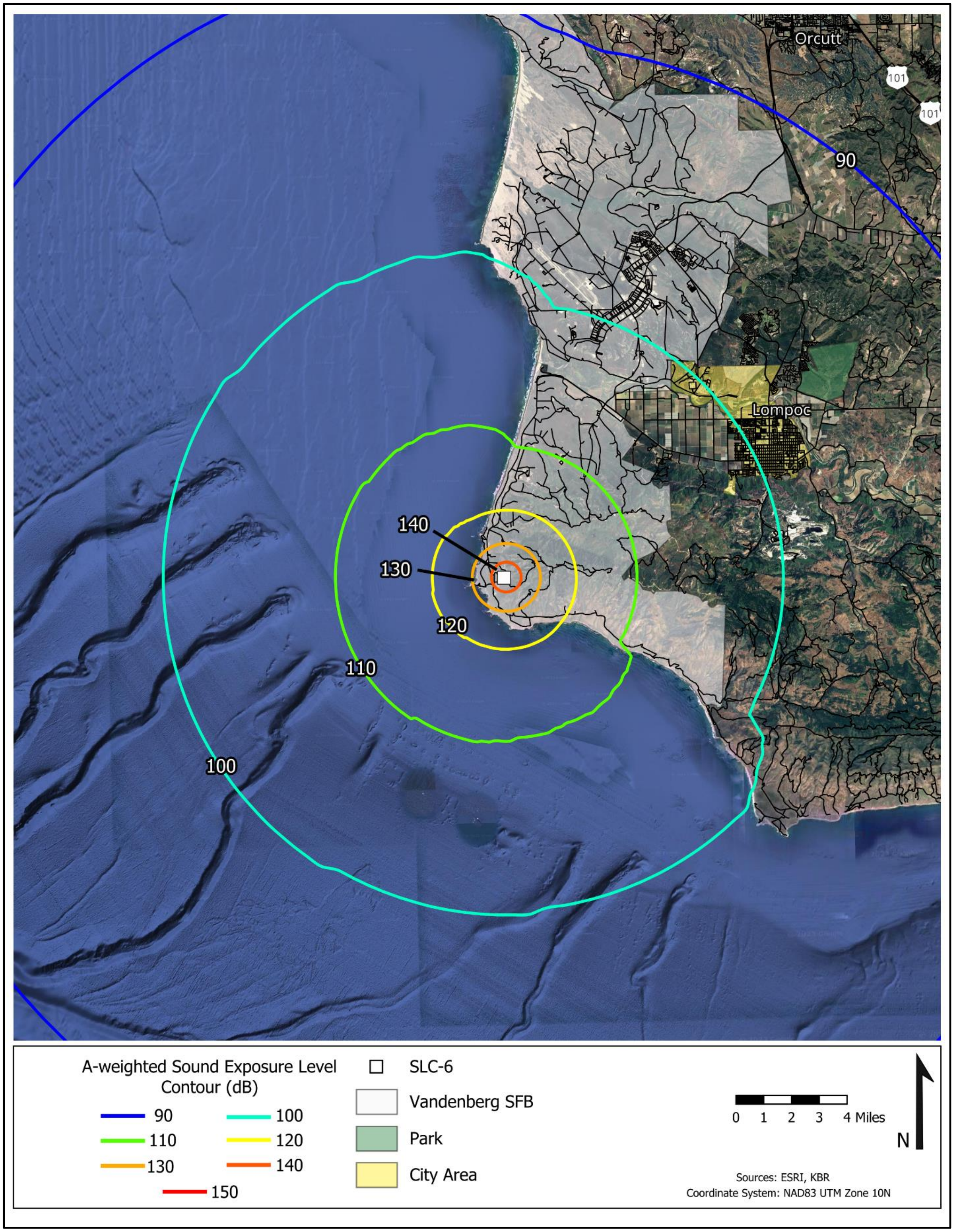

Figure 18. Falcon Heavy Orbital Launch from SLC-6: Sound Exposure Levels (Zoom In)

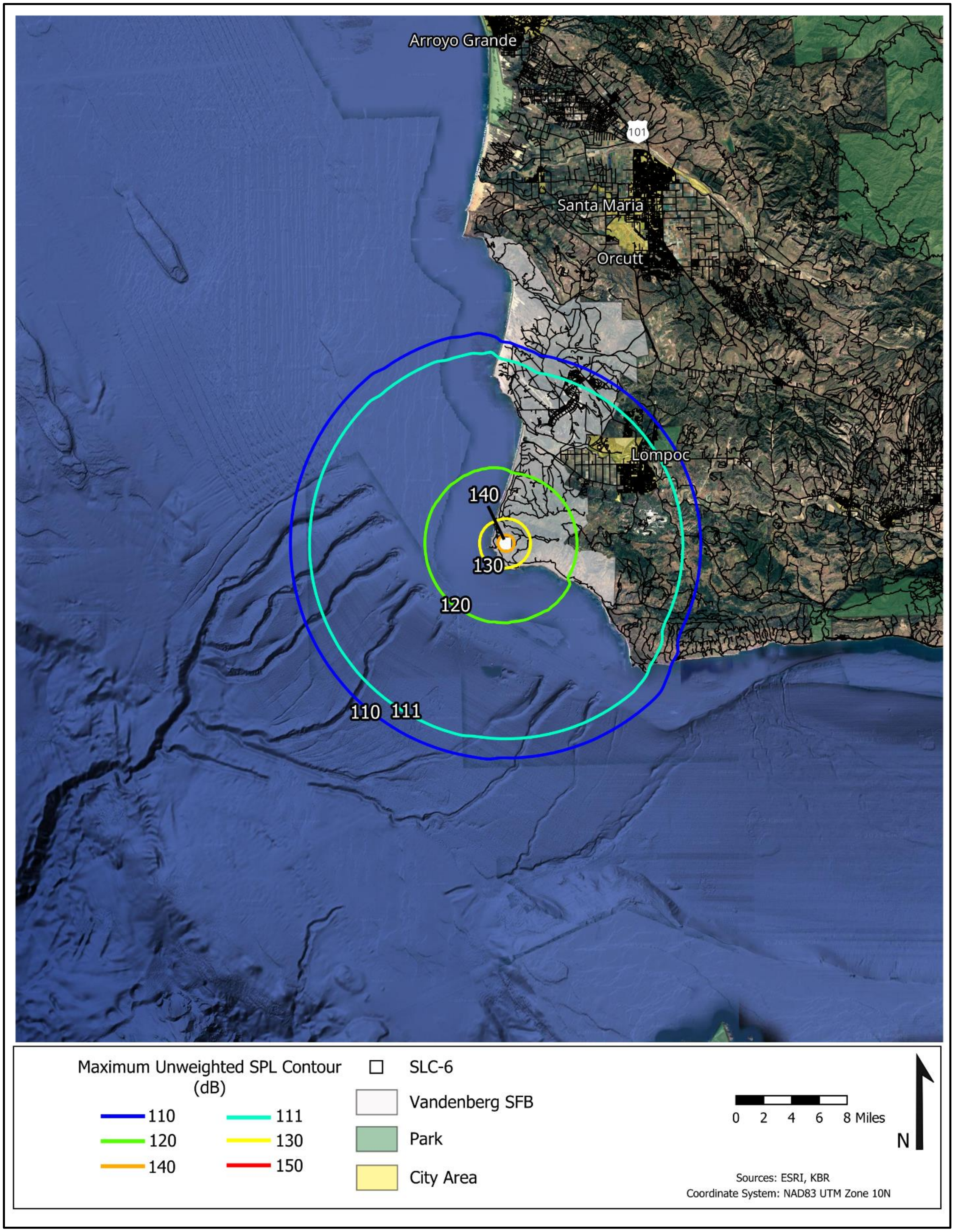

Figure 19. Falcon Heavy Orbital Launch from SLC-6: Un-Weighted Sound Levels

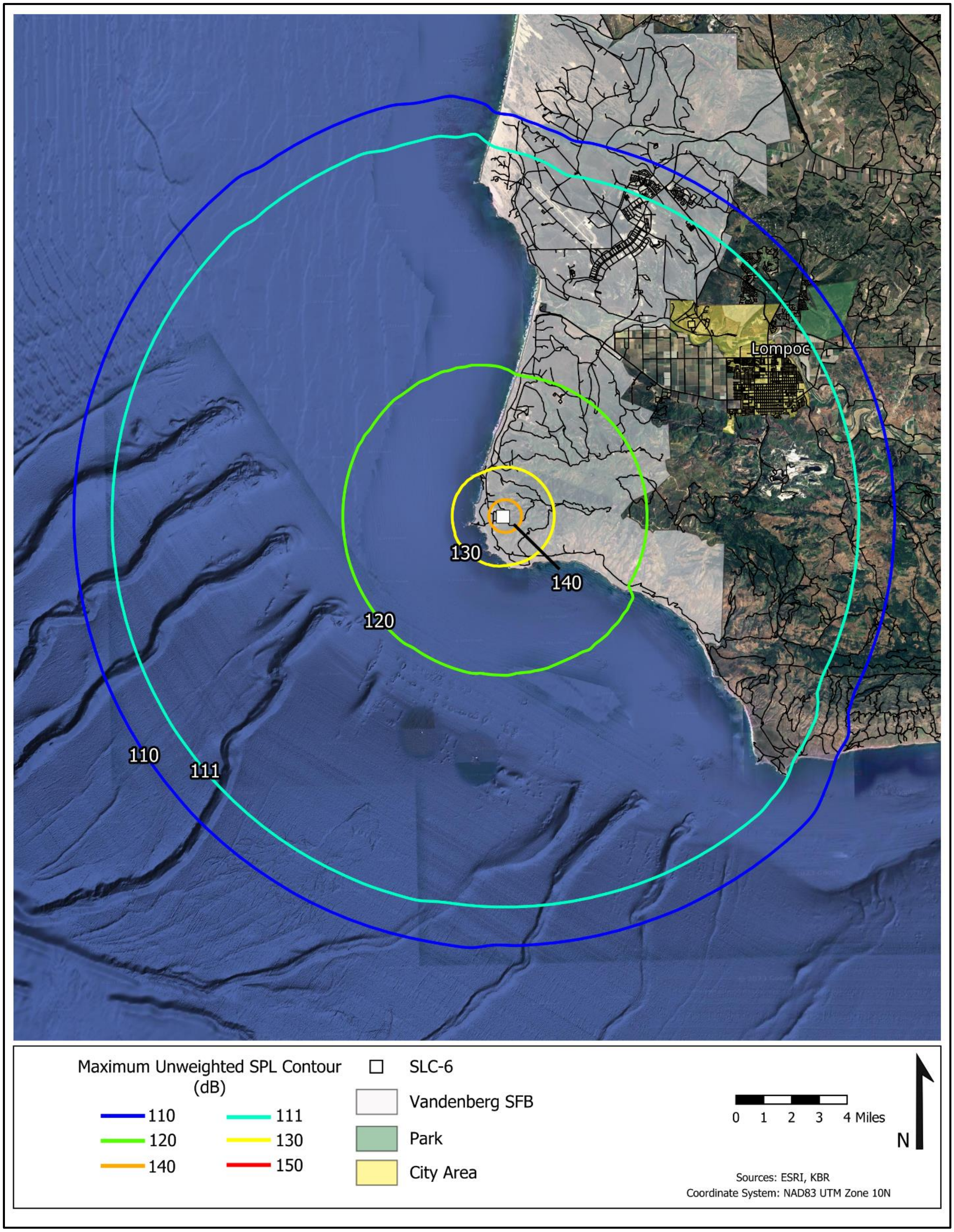

Figure 20. Falcon Heavy Orbital Launch from SLC-6: Un-Weighted Sound Levels (Zoom In)

4 Descent/Landing Noise Levels

4.1 Falcon 9 Booster Landings at SLC-4 and SLC-6

RNOISE was used to estimate the L_{Amax}, SEL and L_{max} contours for Falcon 9 booster landings at SLC-4 and SLC-6. The Falcon 9 booster reentry and landing trajectories were provided by SpaceX in files 'EROS_C_SLC6E_SLC4LANDING_STAGE1_80_12.ASC' and 'TRANSPORTER8_SLC6E_SLC6LANDING_STAGE1_80_12.ASC'. L_{Amax} contours indicate the maximum sound level at each location over the duration of the landing where booster engine thrust varies according to the reentry/descent thrust schedule provided.

RNOISE computations were done using a radial grid consisting of 128 azimuths and 100 intervals out to 500,000 feet from the launch point. Land areas were modeled using a single ground impedance value estimated from the most common ground cover type in the vicinity of Vandenberg SFB, and water areas modeled as acoustically hard. Ground effect was based on a weighted average over the propagation path. As will be shown in the resulting noise contour maps (Figures 21 through 26), the shape of the innermost contours is approximately circular. The shape of the outermost contours is due to rocket noise directivity and the difference between the ground impedance values used for water areas and land areas. The landing pad locations at SLC-4 and SLC-6 are indicated in the map legends as is the Vandenberg SFB property line and nearby cities including Lompoc, CA. Figures 21 through 23 display the L_{Amax}, SEL, and L_{max} contours, respectively, for a Falcon 9 landing at SLC-4 and Figures 24 through 26 display the L_{Amax}, SEL, and L_{max} contours, respectively, for a Falcon 9 landing at SLC-6.

In Figure 21 the 90 dB L_{Amax} contour is entirely within the Vandenberg SFB property line. Residents of Lompoc, CA may notice Falcon 9 landing event levels above 60 dB L_{Amax} especially for nighttime events. Compared with the Falcon 9 orbital launch noise levels reported in Section 3, Falcon 9 descent/landing noise levels at SLC-4 are considerably lower due to the much lower total engine thrust and limited firing schedule used for landing operations.

Figures 22 and 23 show the SEL and L_{max} contours, respectively, estimated for Falcon 9 landings at SLC-4. The 90 dB SEL contour is expected to extend near the west side of Lompoc though levels are considerably less than those from a Falcon 9 launch at SLC-4. In Figure 23, the L_{max} 111 dB contour, used to assess the potential for structural damage, is entirely within VSFB property. Similarly, the L_{max} 130 dB contour is entirely within VSFB property, such that structural damage is not expected to occur at off base residences using either damage criteria.

Estimated noise levels from a Falcon 9 landing at SLC-6 are shown in Figures 24 through 26 which display the L_{Amax}, SEL, and L_{max} contours, respectively. Each of these noise results can be assessed similarly to results for the same metric described above for a Falcon 9 landing at SLC-4. The main difference is that SLC-6 is located about 3.5 miles south/southwest of SLC-4, such that noise exposure from landings at SLC-6 occurs further south/southwest. For this reason, noise exposure in Lompoc is estimated to be less from Falcon 9 landings at SLC-6, compared with Falcon 9 landings at SLC-4 (compare L_{Amax} contours in Figures 21 and 24, for example).

The next section presents single event noise levels for a Falcon Heavy booster landing at SLC-6.

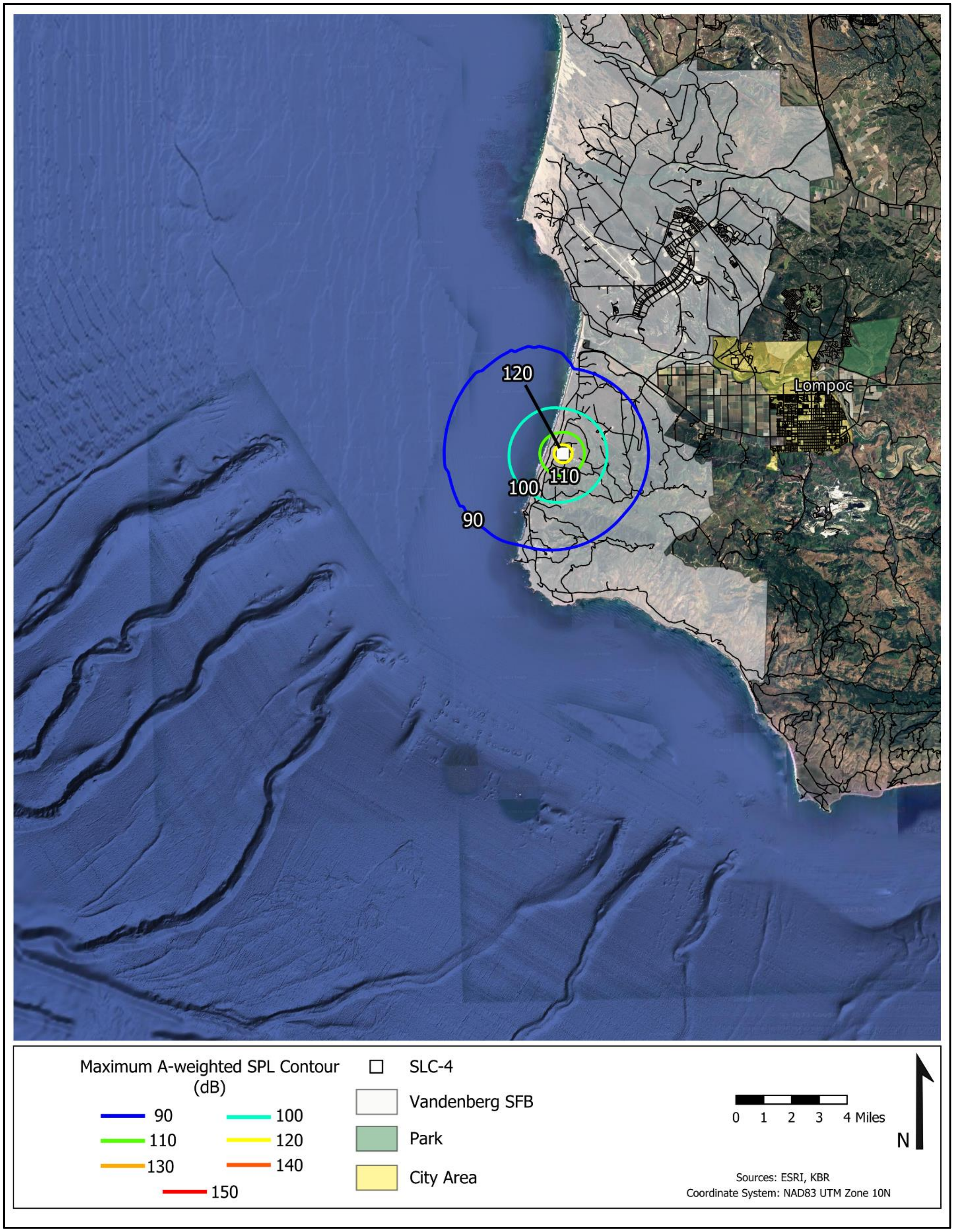

Figure 21. Falcon 9 Landing at SLC-4: Maximum A-Weighted Sound Levels (Zoom In)

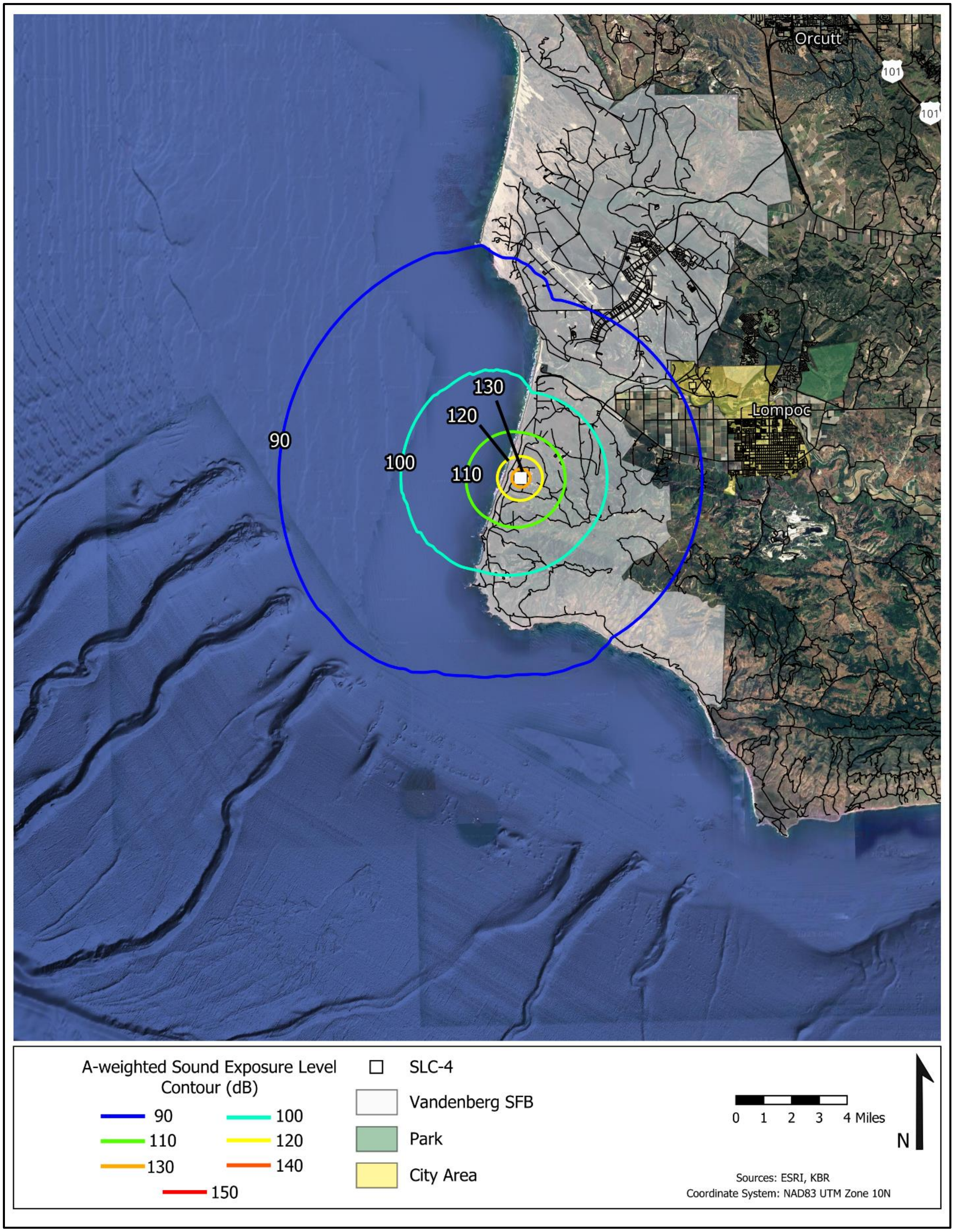

Figure 22. Falcon 9 Landing at SLC-4: Sound Exposure Levels (Zoom In)

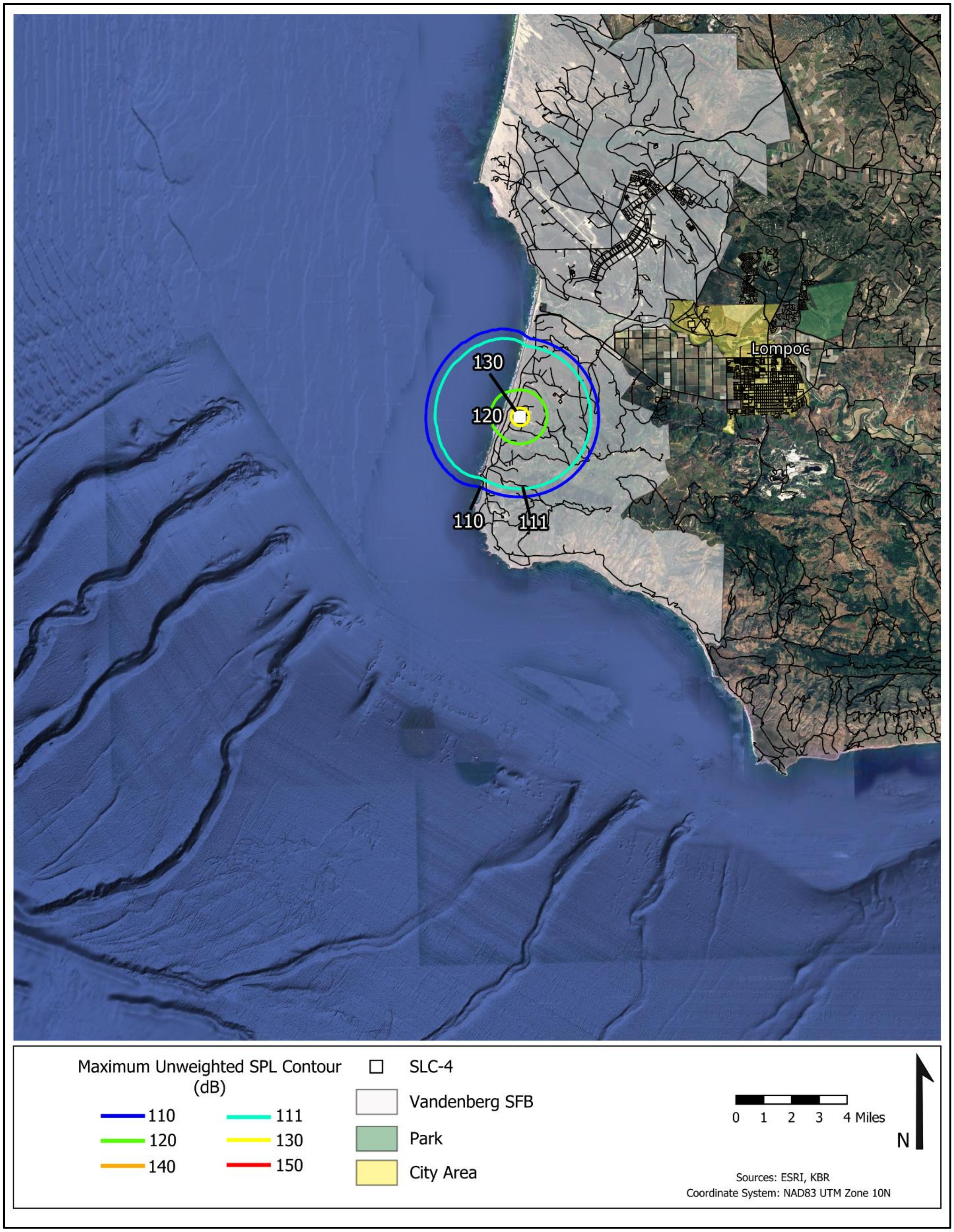

Figure 23. Falcon 9 Landing at SLC-4: Maximum Un-Weighted Sound Levels (Zoom in)

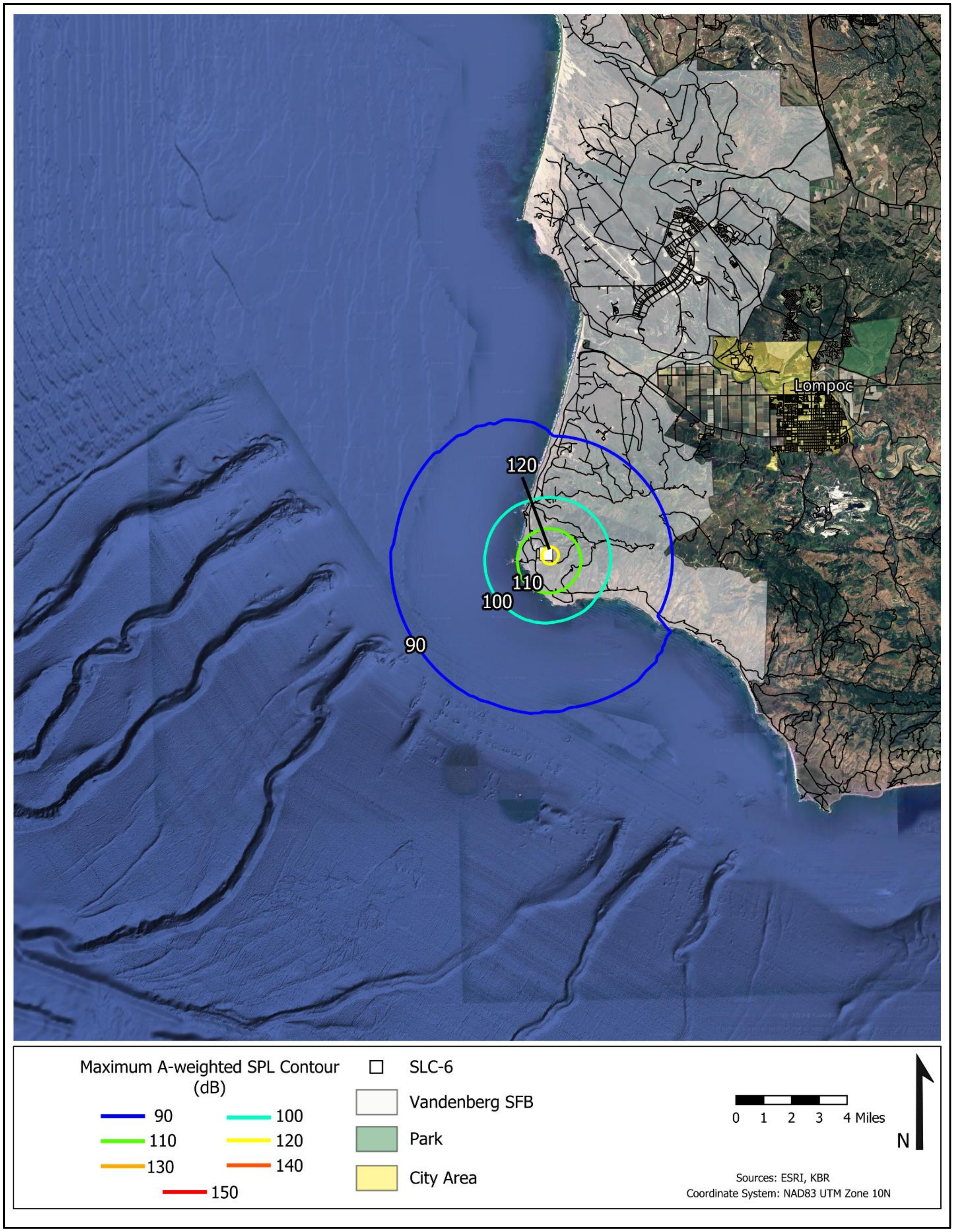

Figure 24. Falcon 9 Landing at SLC-6: Maximum A-Weighted Sound Levels (Zoom In)

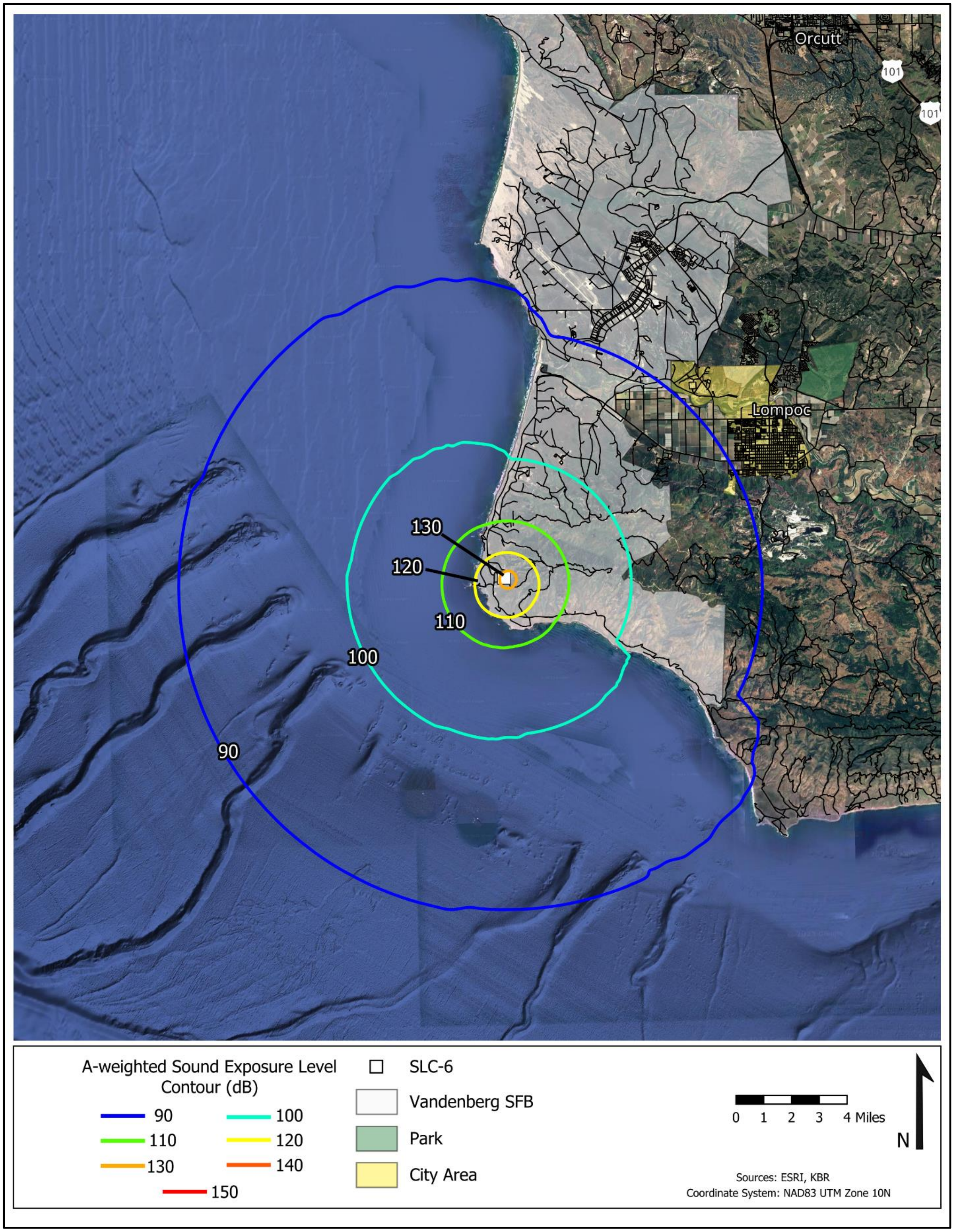

Figure 25. Falcon 9 Landing at SLC-6: Sound Exposure Levels (Zoom In)

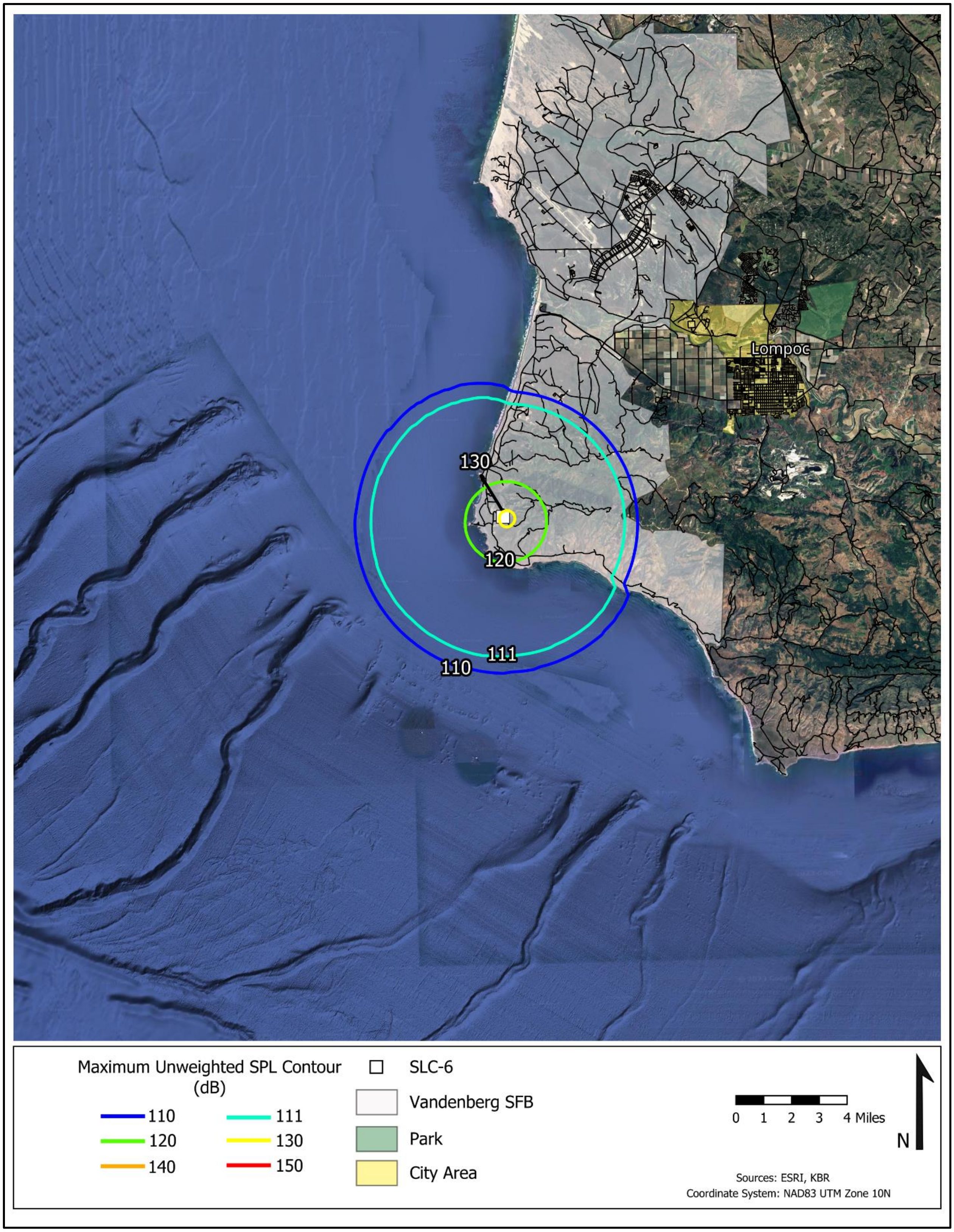

Figure 26. Falcon 9 Landing at SLC-6: Un-Weighted Sound Levels (Zoom in)

4.2 Falcon Heavy Stage 1 Landings at SLC-6

RNOISE was used to estimate the L_{Amax}, SEL and L_{max} contours for Falcon Heavy booster landings at SLC-6. The Falcon Heavy booster descent and landing trajectory was provided by SpaceX in file 'NSSL23_MOLNIYA_SLC6E_SLC6LANDING_STAGE1_80_12.ASC'. L_{Amax} contours indicate the maximum sound level at each location over the duration of the landing where booster engine thrust varies according to the descent/landing thrust schedule provided. Each Falcon Heavy landing event includes 2 booster landings.

RNOISE computations were done using the same methodology as described in Section 4.1. As will be shown in the resulting noise contour maps (Figures 27 through 30), the shape of the innermost contours is approximately circular. The shape of the outermost contours is due to rocket noise directivity and the difference between the ground impedance values used for water areas and land areas. The landing pad location at SLC-6 is indicated in the map legends as is the Vandenberg SFB property line and nearby cities including Lompoc, CA. Figures 27 through 30 display the L_{Amax}, SEL, and L_{max} contours, respectively, for a Falcon Heavy landing at SLC-6.

In Figure 27 and 28 (Zoomed In version) the 90 dB L_{Amax} contour is almost entirely within the Vandenberg SFB property line. Residents of Lompoc, CA may notice Falcon Heavy landing event levels above 60 dB L_{Amax} especially for nighttime events. Compared with the Falcon Heavy orbital launch noise levels reported in Section 3, Falcon Heavy descent/landing noise levels at SLC-6 are considerably lower due to the much lower total engine thrust and limited firing schedule used for landing operations.

Figures 29 and 30 show the SEL and L_{max} contours, respectively, estimated for Falcon Heavy landings at SLC-6. The 90 dB SEL contour is expected to extend to the east side of Lompoc though levels are considerably less than those from a Falcon Heavy launch at SLC-6. In Figure 30, the 111 dB L_{max} contour, used to assess the potential for structural damage, is entirely within VSFB property (except for the extension to the west over water). Similarly, the L_{max} 130 dB contour is entirely within VSFB property, such that structural damage is not expected to occur at off base residences using either damage criteria.

The next section, Section 5, presents single event noise levels for Falcon 9 static fire tests at SLC-4 and SLC-6 and a Falcon Heavy static fire test at SLC-6. Following that, in Section 6, is an estimate of the cumulative noise generated by all projected annual Falcon 9 and Falcon Heavy flight and test events at SLC-4 and SLC-6.

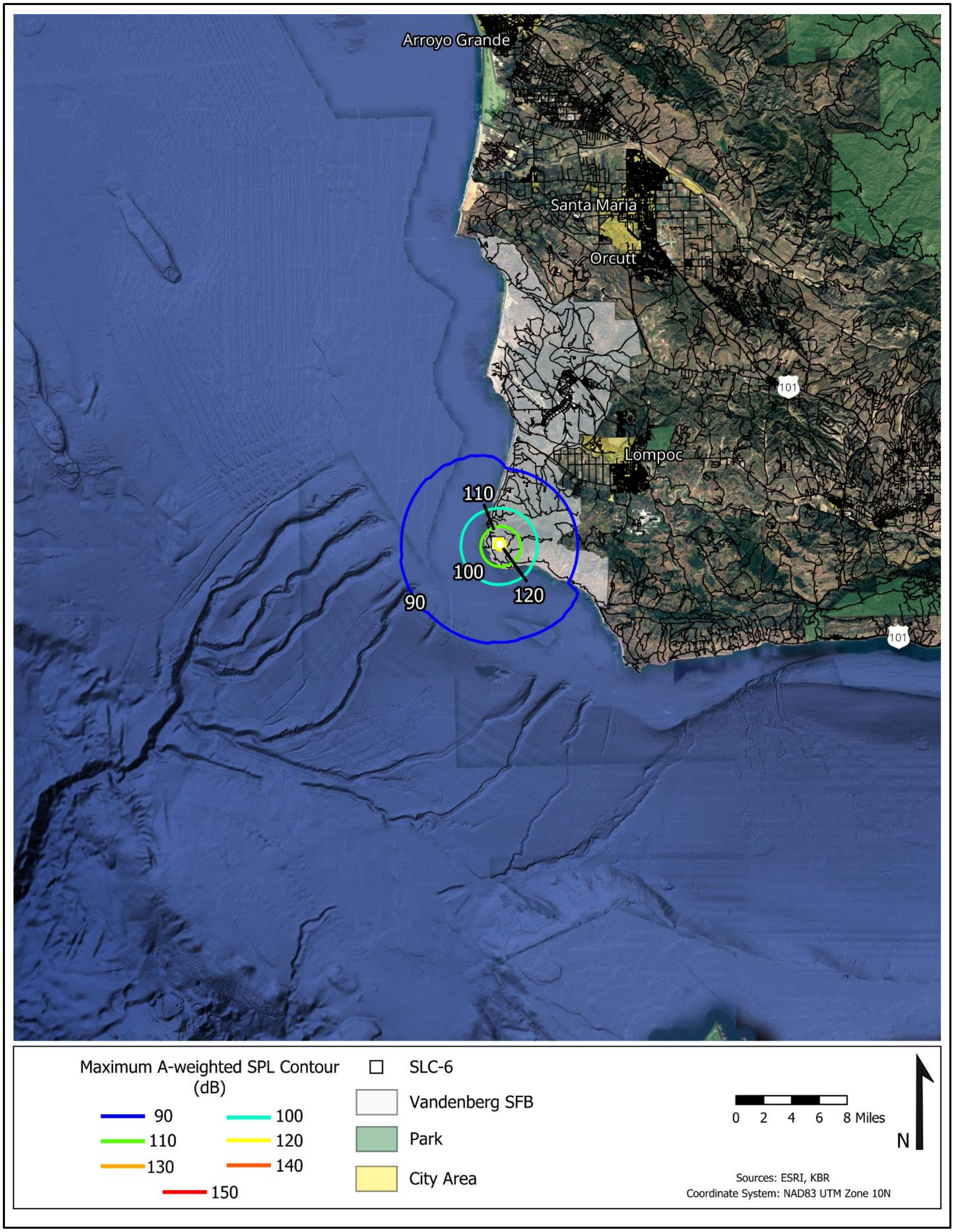

Figure 27. Falcon Heavy Landing at SLC-6: Maximum A-Weighted Sound Levels

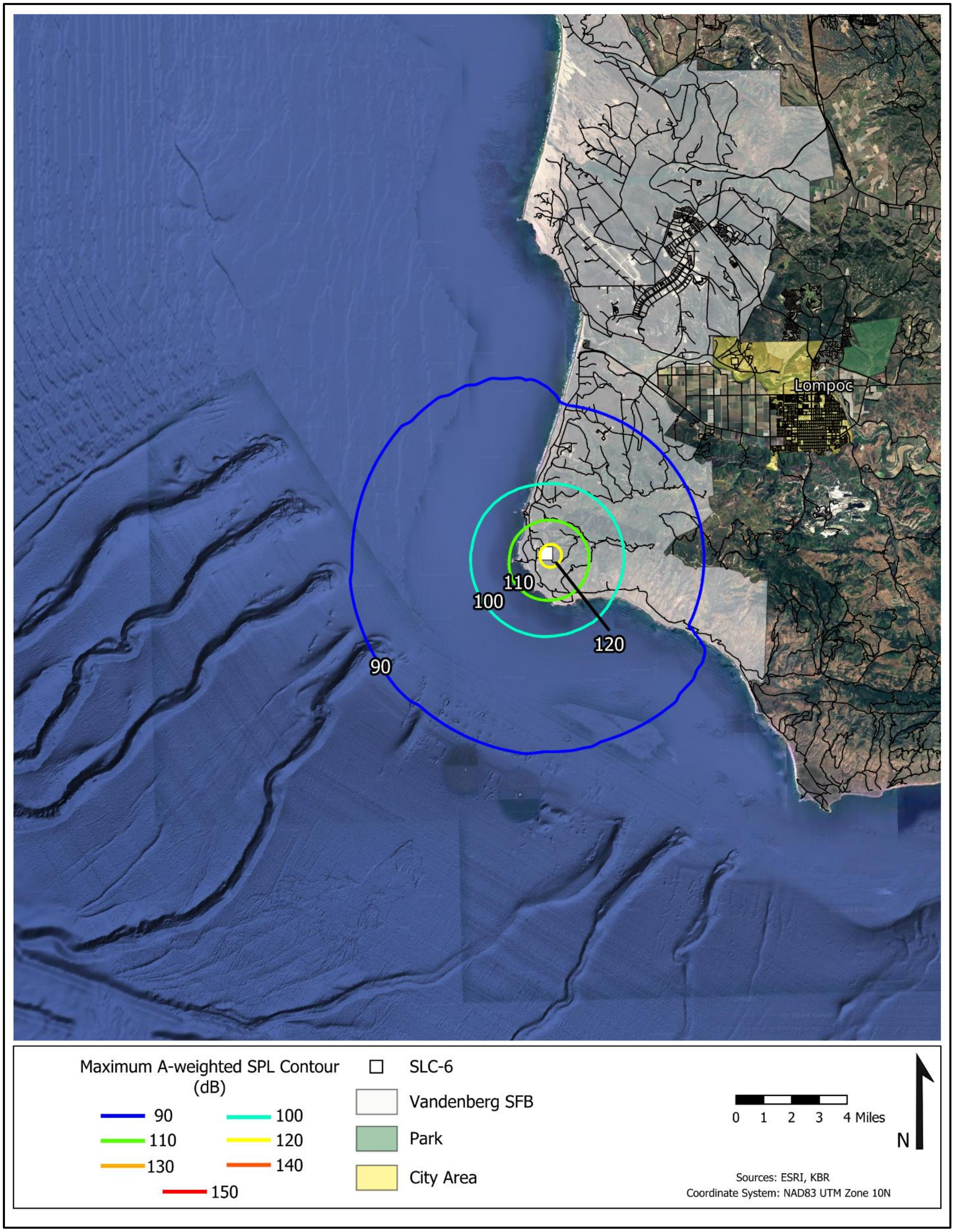

Figure 28. Falcon Heavy Landing at SLC-6: Maximum A-Weighted Sound Levels (Zoom In)

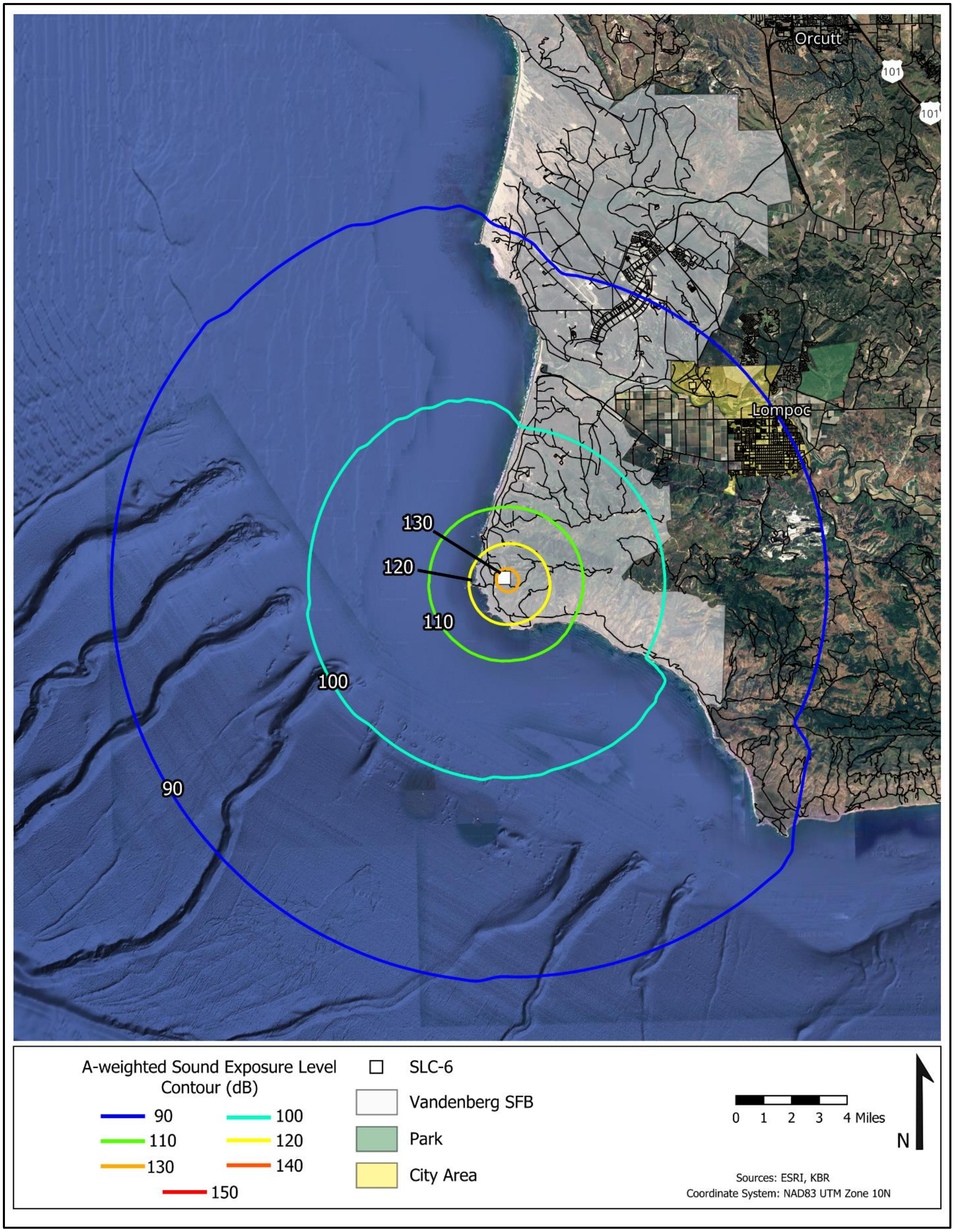

Figure 29. Falcon Heavy Landing at SLC-6: Sound Exposure Levels (Zoom In)

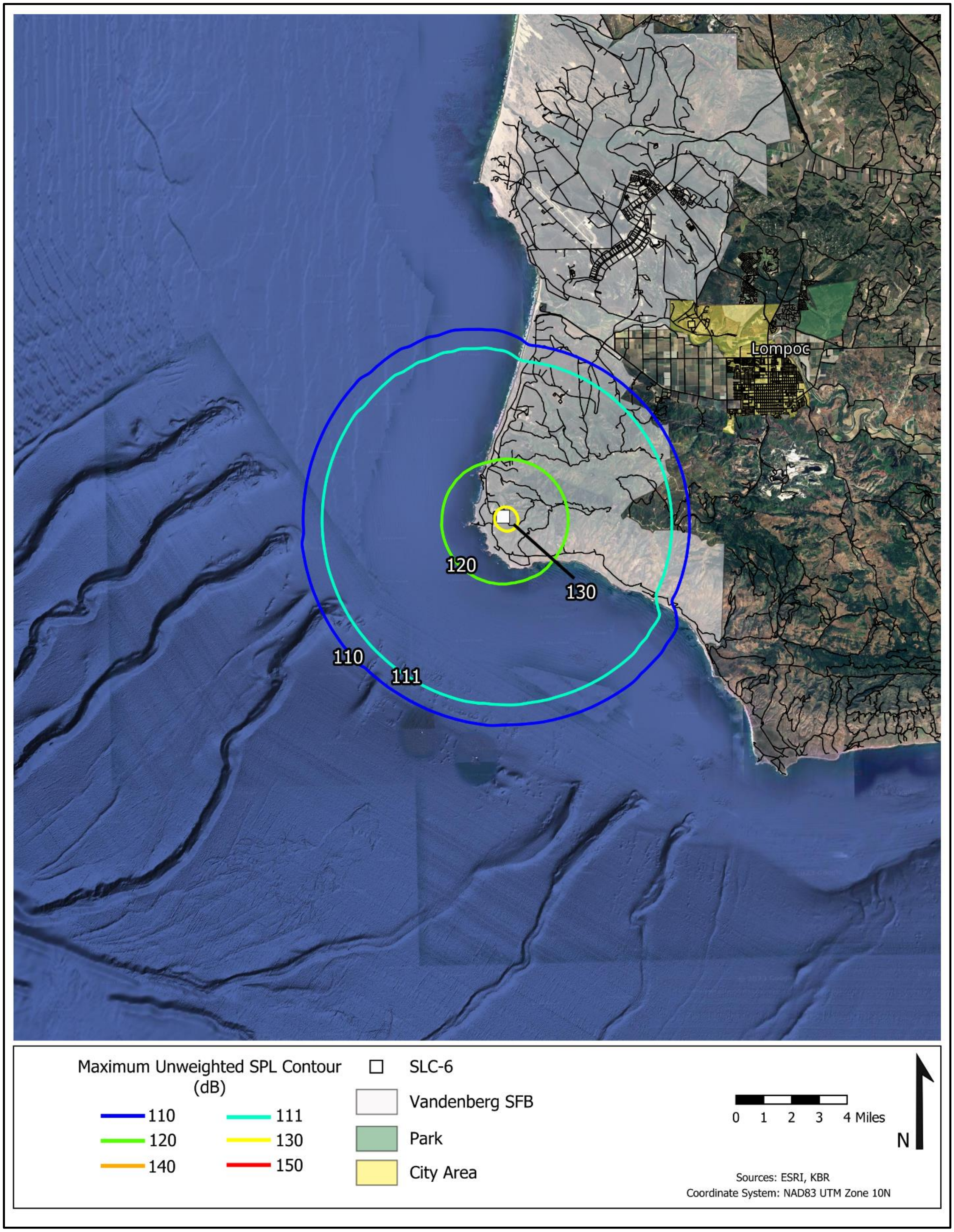

Figure 30. Falcon Heavy Landing at SLC-6: Maximum Un-Weighted Sound Levels (Zoom In)

5 Static Fire Test Noise Levels

5.1 Falcon 9 Static Fire Test Noise at SLC-4 and SLC-6

Falcon 9 static fire tests are planned to occur at SLC-4 and SLC-6 where 9 engines, that each generate 190 Klbs of thrust at sea level, will be fired for 7 seconds. Figures 31 through 33 show the estimated L_{Amax}, SEL, and L_{max} contours, respectively, for a static fire test at SLC-4. The L_{Amax} 90 dB contour (Figure 31) and SEL 90 dB contour (Figure 32) do not extend off Vandenberg SFB property. The L_{max} 111 dB contour, in Figure 33, which is used to assess the potential for structural damage, is located almost entirely within VSFB property with limited extension off property to the northeast; though no residences exist there, so the probability of damage due to static fire tests is low. To the west of SLC-4, these contours extend much farther out due to modeling sound propagation over water compared with propagation over land to the east. Residents of Lompoc, CA may hear Falcon 9 static test events above 60 dB, and particularly at night and if onshore wind conditions favor sound propagation to the east (historically, winds are most often from the west for 3.9 months per year, from May 11 to September 9, with a peak percentage of 60% on July 16).

Similarly, Figures 34 through 36 show the estimated L_{Amax}, SEL, and L_{max} contours, respectively, for a Falcon 9 static fire test at SLC-6. The location of SLC-6 is about 3.5 miles south/southwest of SLC-4 such that the L_{Amax} 90 dB contour (Figure 34) and SEL 90 dB contour (Figure 35) do not extend off VSFB property and the L_{max} 111 dB contour (Figure 36) is also almost entirely within VSFB property. Using the less conservative structural damage criteria[13], the L_{max} 130 dB and 140 dB contours in Figure 36, and the 134 dB contour in between (not shown), are entirely within VSFB property, such that structural damage is not expected to occur to off base residences using either criteria. Like static fire tests at SLC-4, residents of Lompoc, CA may hear Falcon 9 static test events at SLC-6 that generate levels above 60 dB in the community, and particularly at night and if onshore wind conditions favor sound propagation to the east.

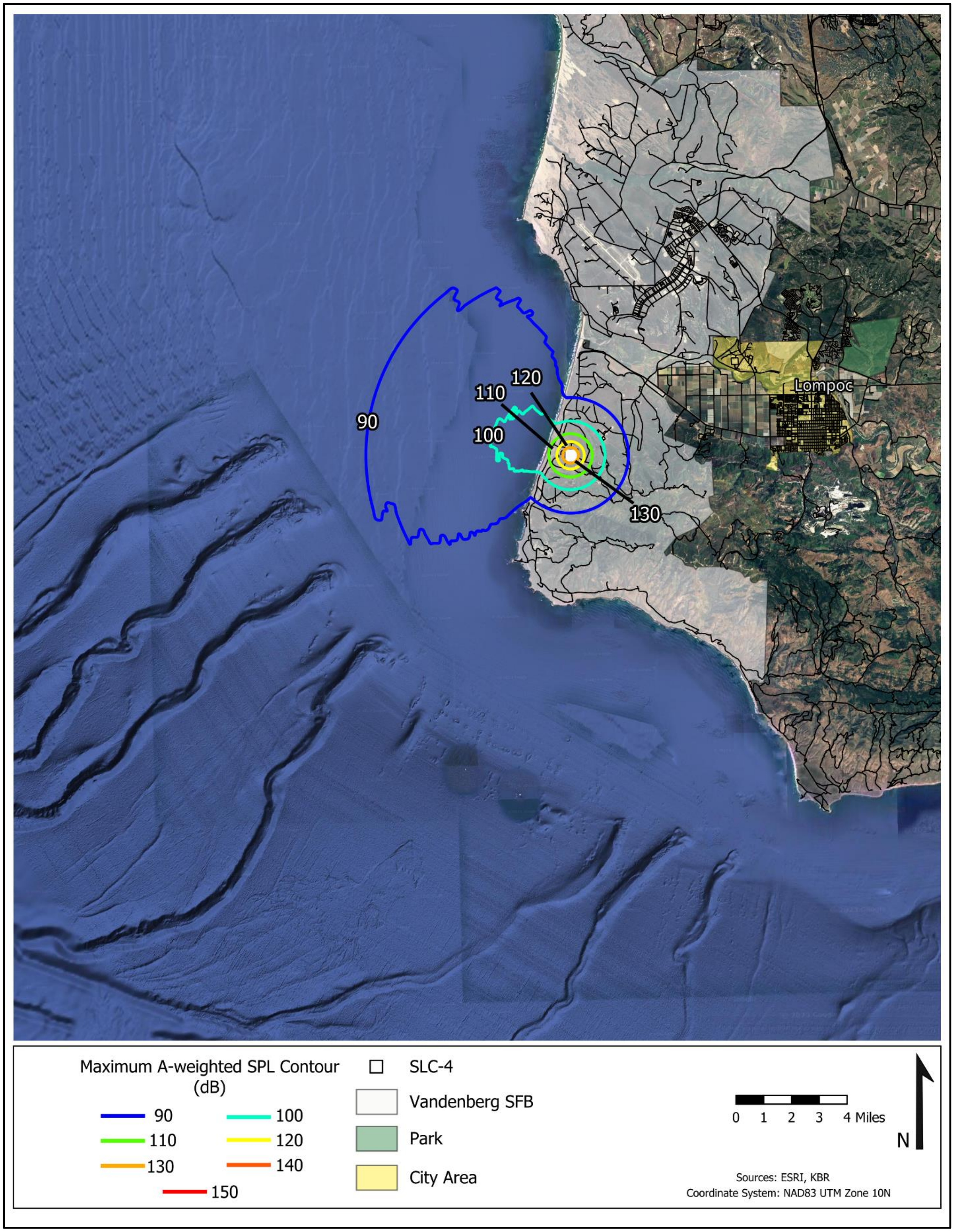

Figure 31. Falcon 9 Static Fire Test at SLC-4: Maximum A-Weighted Sound Levels (Zoom In)

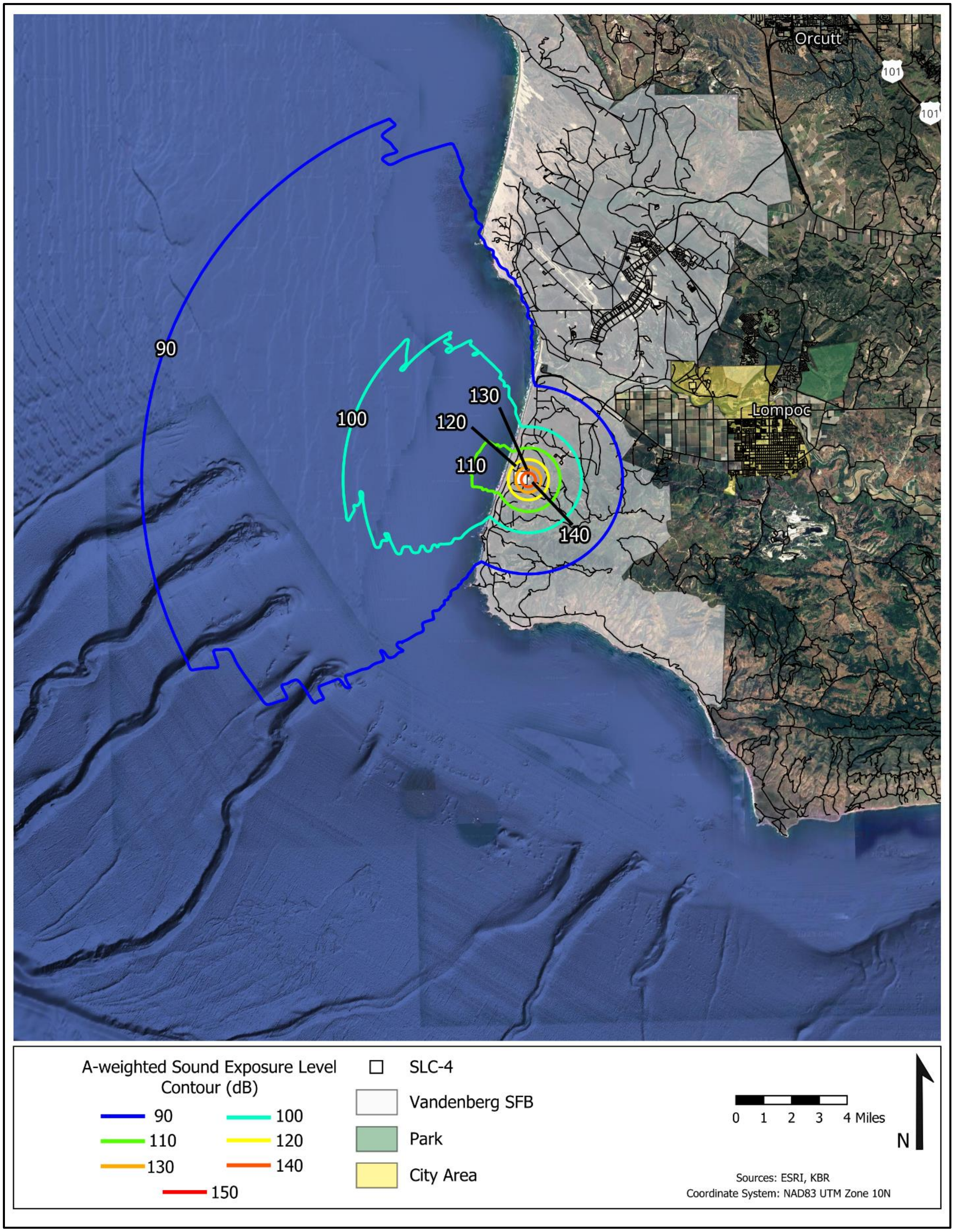

Figure 32. Falcon 9 Static Fire Test at SLC-4: Sound Exposure Levels (Zoom In)

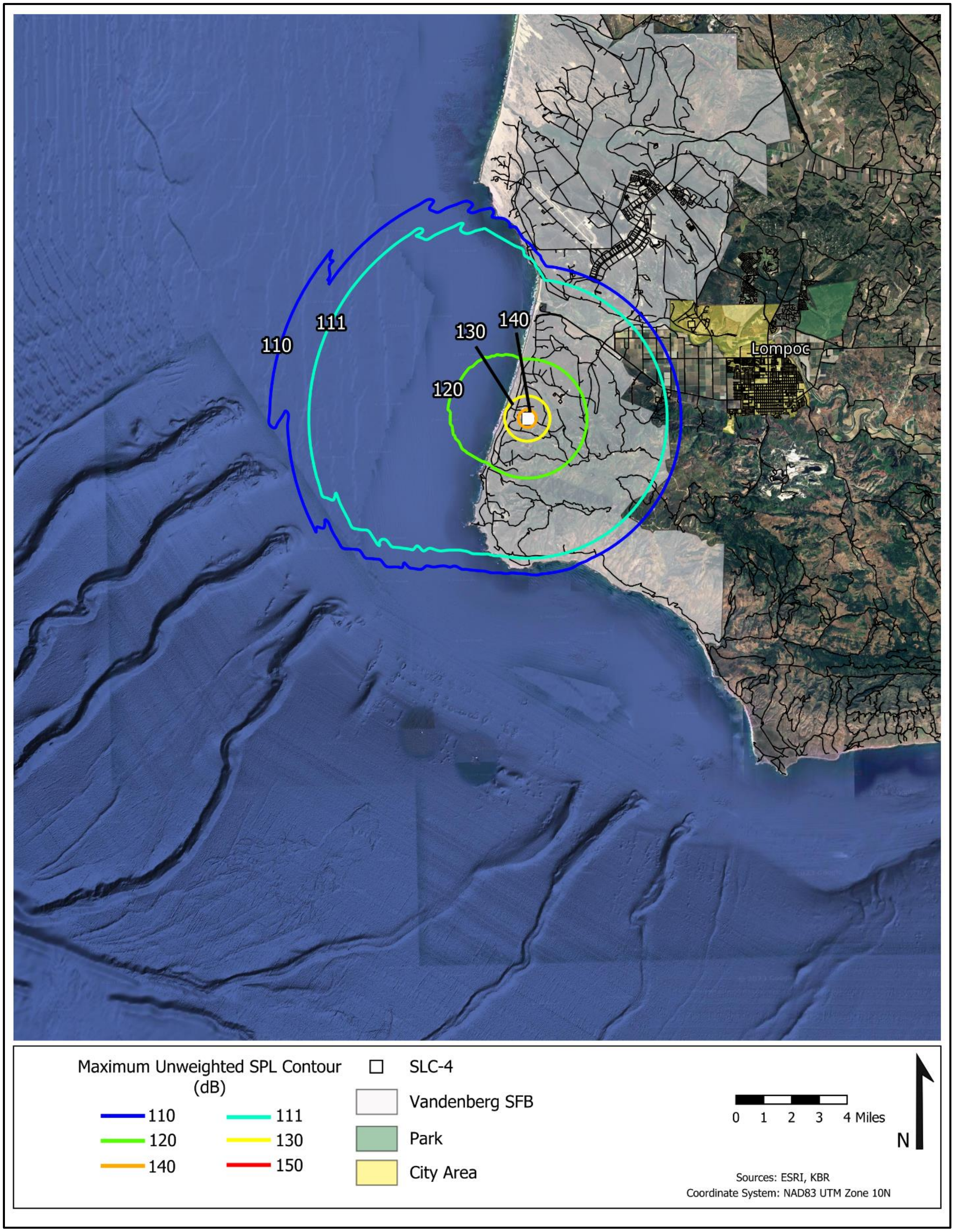

Figure 33. Falcon 9 Static Fire Test at SLC-4: Maximum Un-Weighted Sound Levels (Zoom In)

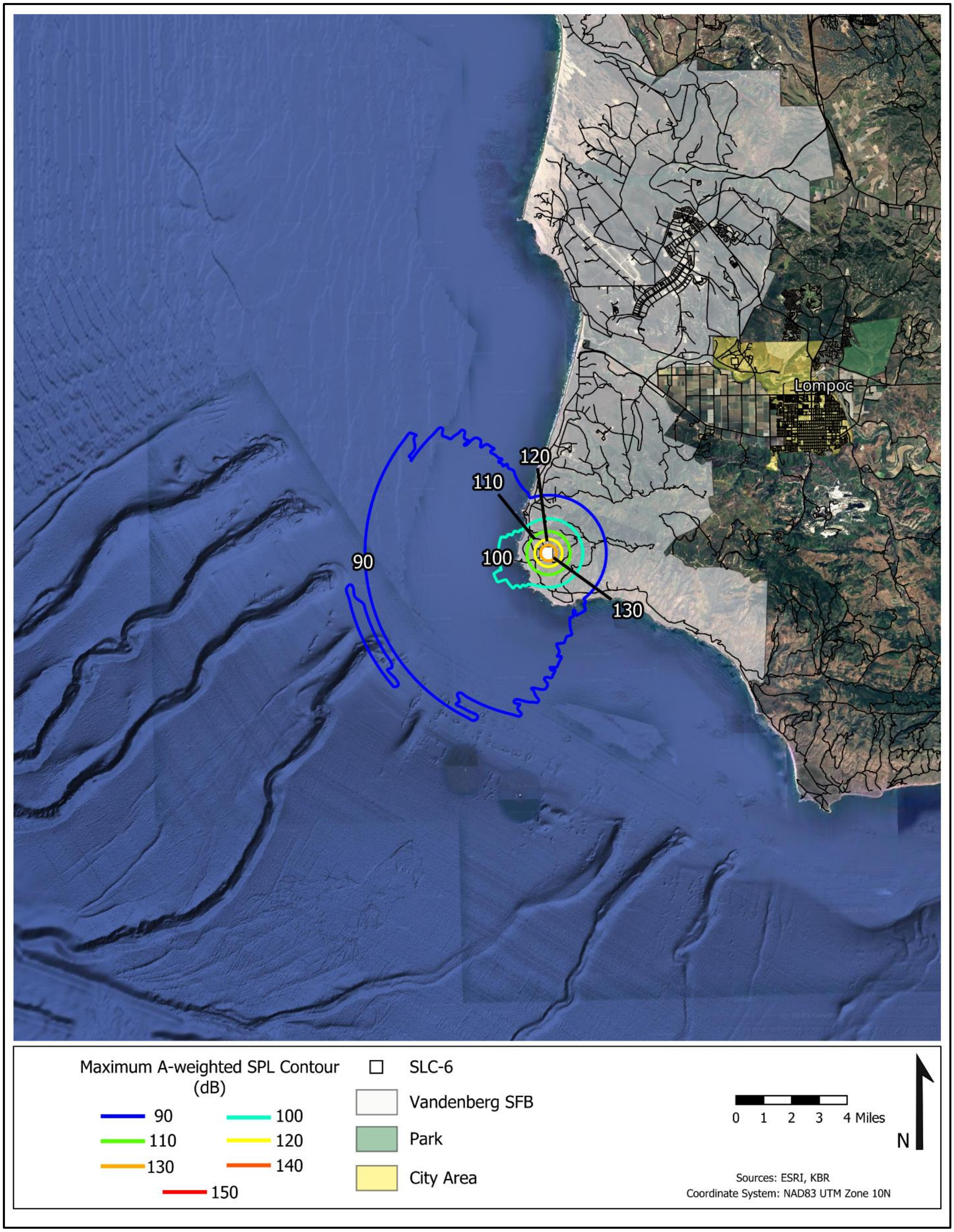

Figure 34. Falcon 9 Static Fire Test at SLC-6: Maximum A-Weighted Sound Levels (Zoom In)

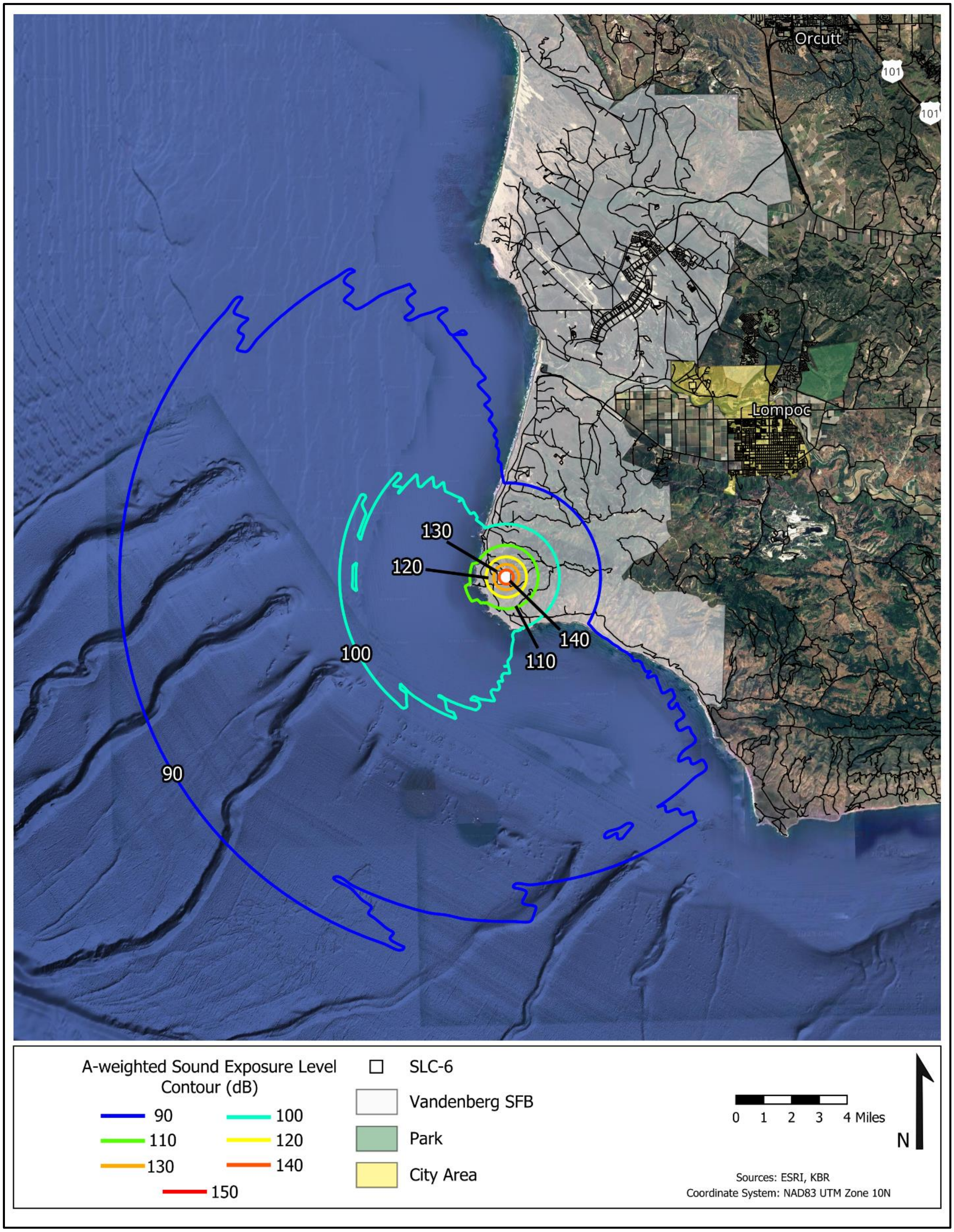

Figure 35. Falcon 9 Static Fire Test at SLC-6: Sound Exposure Levels (Zoom In)

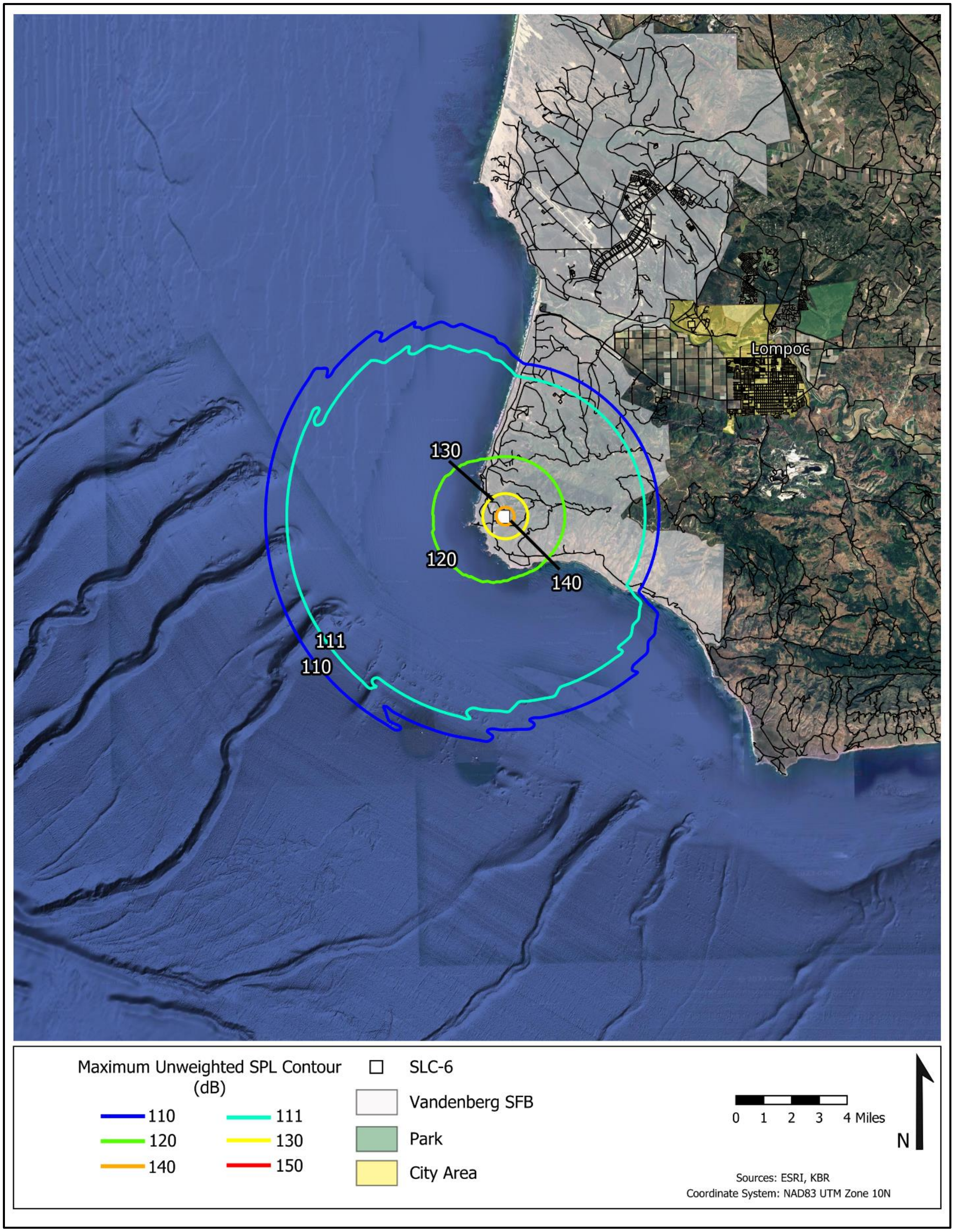

Figure 36. Falcon 9 Static Fire Test at SLC-6: Maximum Un-Weighted Sound Levels (Zoom In)

5.2 Falcon Heavy Static Fire Tests at SLC-6

Falcon Heavy static fire tests are planned to occur at SLC-6 where 27 engines, that each generate 190 Klbs of thrust at sea level, will be fired for 7 seconds. Figures 37 through 39 show the estimated L_{Amax}, SEL, and L_{max} contours, respectively, for a Falcon Heavy static fire test at SLC-6. The L_{Amax} 90 dB contour (Figure 37) and SEL 90 dB contour (Figure 38) do not extend off Vandenberg SFB property, except the SEL 90 dB contour extends south of Vandenberg to the coastline. The L_{max} 111 dB contour in Figure 39, used to assess the potential for structural damage, extends off VSFB property to the east, but not to the residential development. To the west of SLC-6, these contours extend much farther out due to modeling sound propagation over water compared with propagation over land to the east. The L_{max} 130 dB and 140 dB contours in Figure 39, and the 134 dB contour in between (not shown), are entirely within VSFB property, such that structural damage is not expected to occur to off base residences using either criteria. Residents of Lompoc, CA may hear Falcon 9 Heavy static test events above 60 dB, and particularly at night and if onshore wind conditions favor sound propagation to the east.

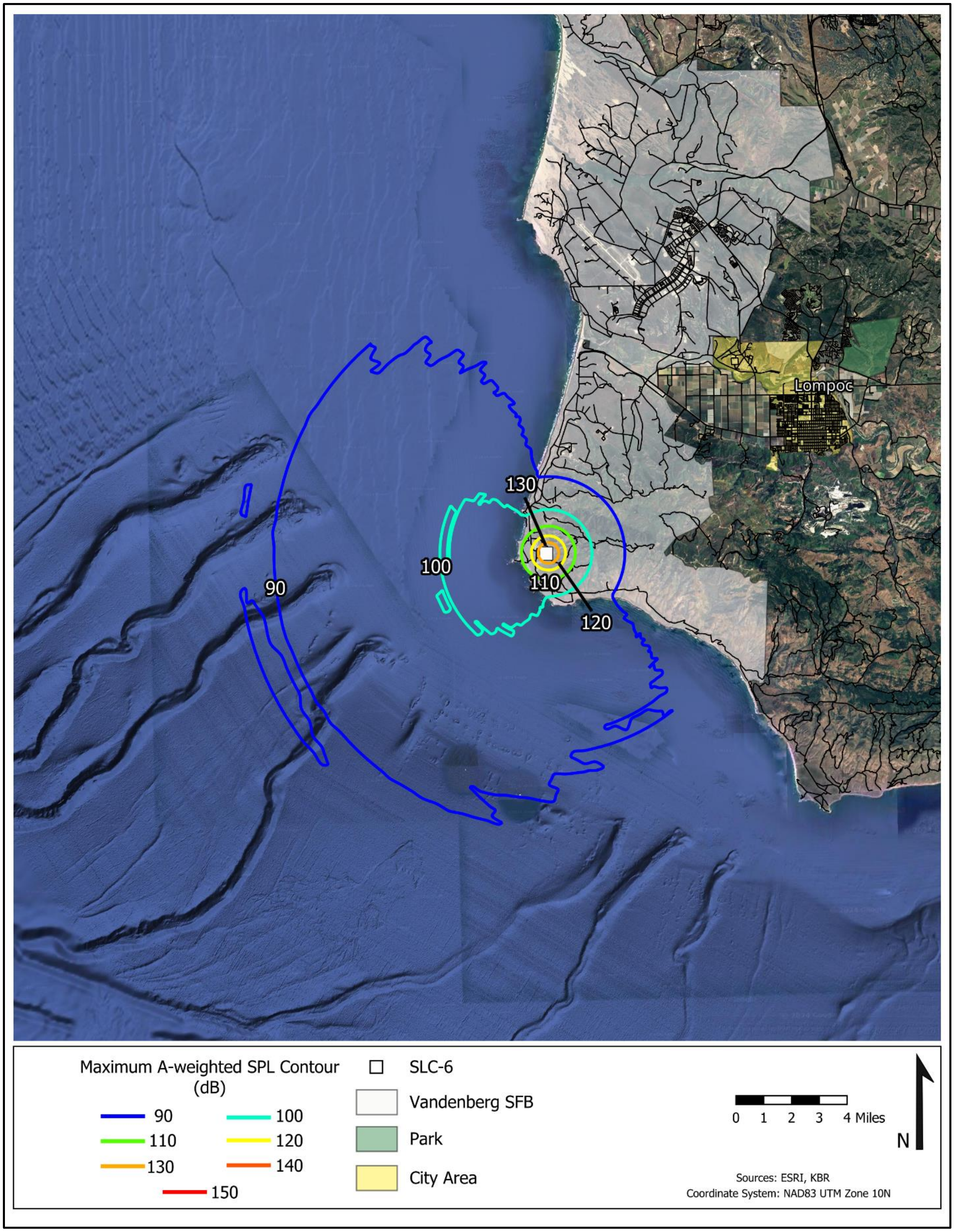

Figure 37. Falcon Heavy Static Fire Test at SLC-6: Maximum A-Weighted Sound Levels (Zoom In)

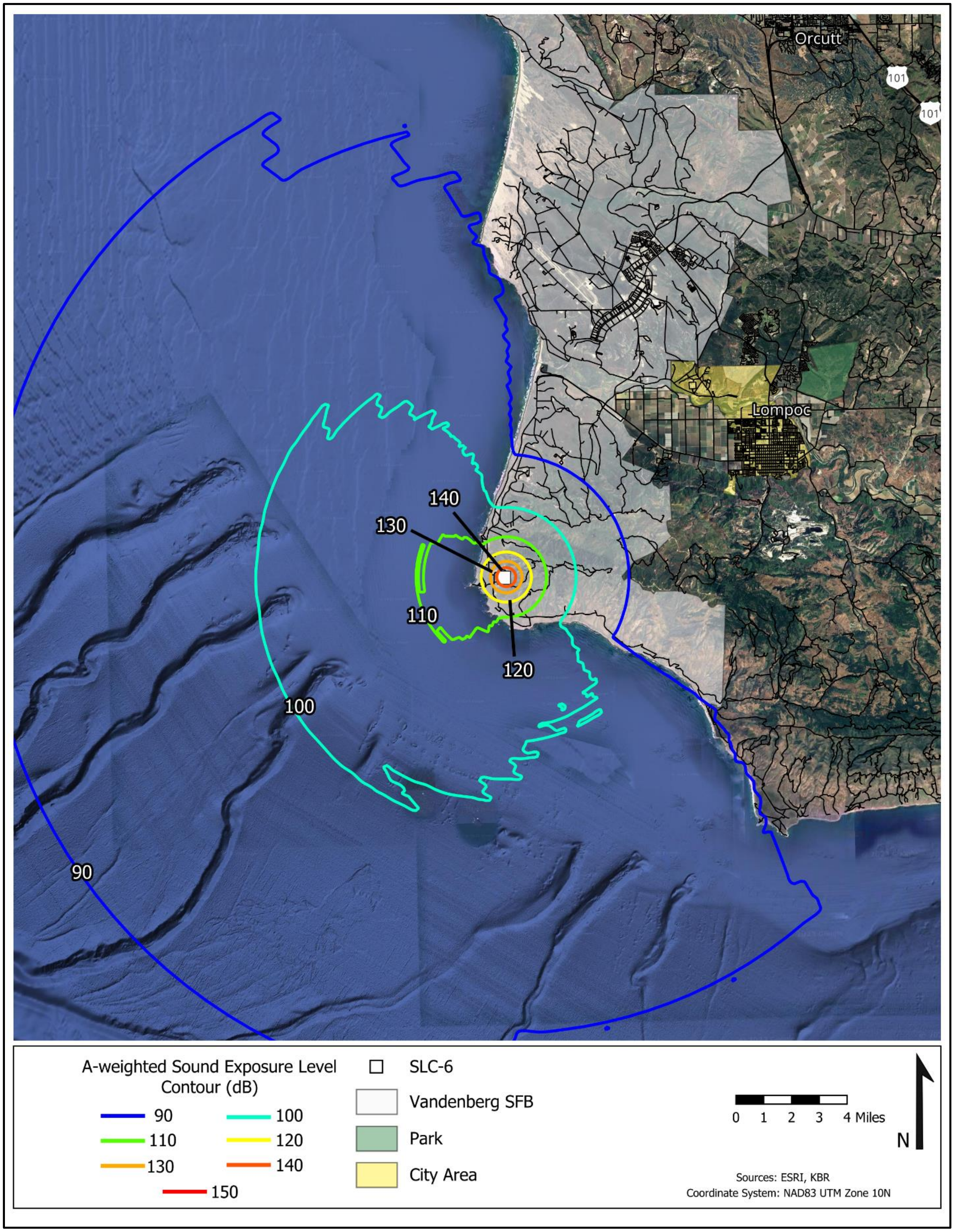

Figure 38. Falcon Heavy Static Fire Test at SLC-6: Sound Exposure Levels (Zoom In)

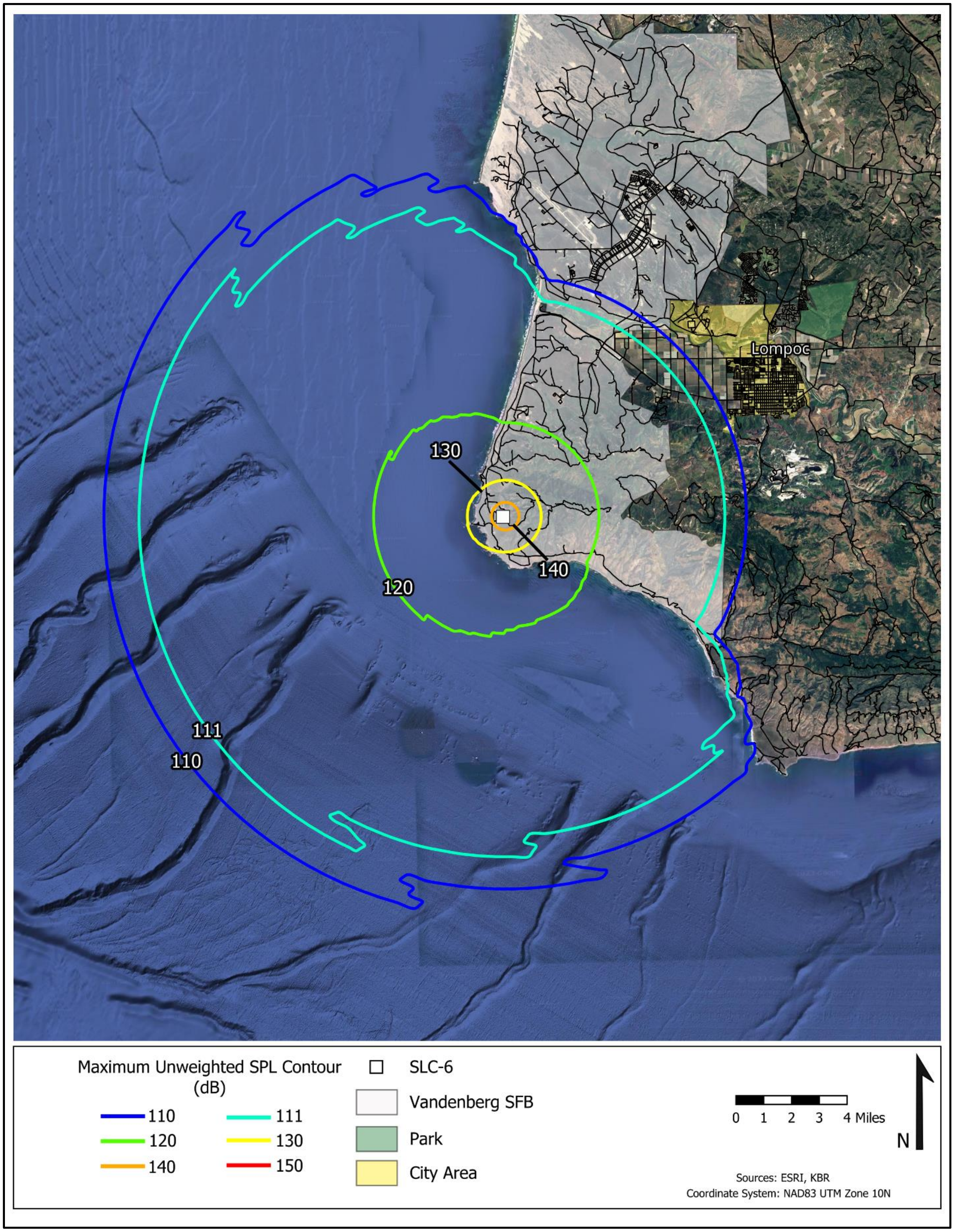

Figure 39. Falcon Heavy Static Fire Test at SLC-6: Un-Weighted Sound Levels (Zoom In)

6 Cumulative Noise Levels for Falcon 9 and Falcon Heavy Operations

6.1 Projected Falcon 9 and Falcon Heavy Launch, Landing, and Static Tests at SLC-4 and SLC-6

Cumulative noise levels were estimated, using CNEL, for projected launch, landing, and static fire test operations at SLC-4 and SLC-6. These estimates were made for each operation type (i.e., Falcon 9 orbital launches, landings, and static fire tests at SLC-4 and SLC-6 and Falcon Heavy orbital launches, landings, and static fire tests at SLC-6) and results indicate that none of the operation types alone are expected to cause adverse community noise exposure using the 65 CNEL contour for assessment purposes. Additionally, when cumulative noise is assessed for a projected combination of these operation types, as described below, noise exposure is still estimated to be less than 65 CNEL in populated areas east of the Vandenberg SFB property line.

One scenario was analyzed for a combination of projected annual Falcon 9 and Falcon Heavy launch, landing, and static fire operations at SLC-4 and SLC-6 that are expected to fulfill mission and test requirements at Vandenberg SFB as follows.

SLC-4

- 70 Falcon 9 launches (35 day / 35 night)
- 12 Falcon 9 stage 1 landings (6 day / 6 night)
- 30 Falcon 9 static fire tests (15 day / 15 night)

SLC-6

- 5 Falcon Heavy launches (2 day / 3 night)
- 5 Falcon Heavy landing events (2 day / 3 night)
- 5 Falcon Heavy static fire tests (2 day / 3 night)
- 25 Falcon 9 launches (13 day / 12 night)
- 7 Falcon 9 stage 1 landings (4 day / 3 night)
- 15 Falcon 9 static fire tests (8 day / 7 night)

The above operations at SLC-4 and SLC-6 include the projected daytime/nighttime split. Each Falcon Heavy landing event at SLC-6 includes 2 booster landings. Estimated CNEL contours in the vicinity of Vandenberg SFB for the combined annual operations above are shown in Figure 40. For these combined Falcon 9 and Falcon Heavy operations, it can be seen from Figure 40 that the 65 CNEL contour is located entirely within Vandenberg SFB property; the area within the 65 CNEL contour includes facilities associated with Space Launch Complex 4 and Space Launch Complex 6 but does not include residential land use.

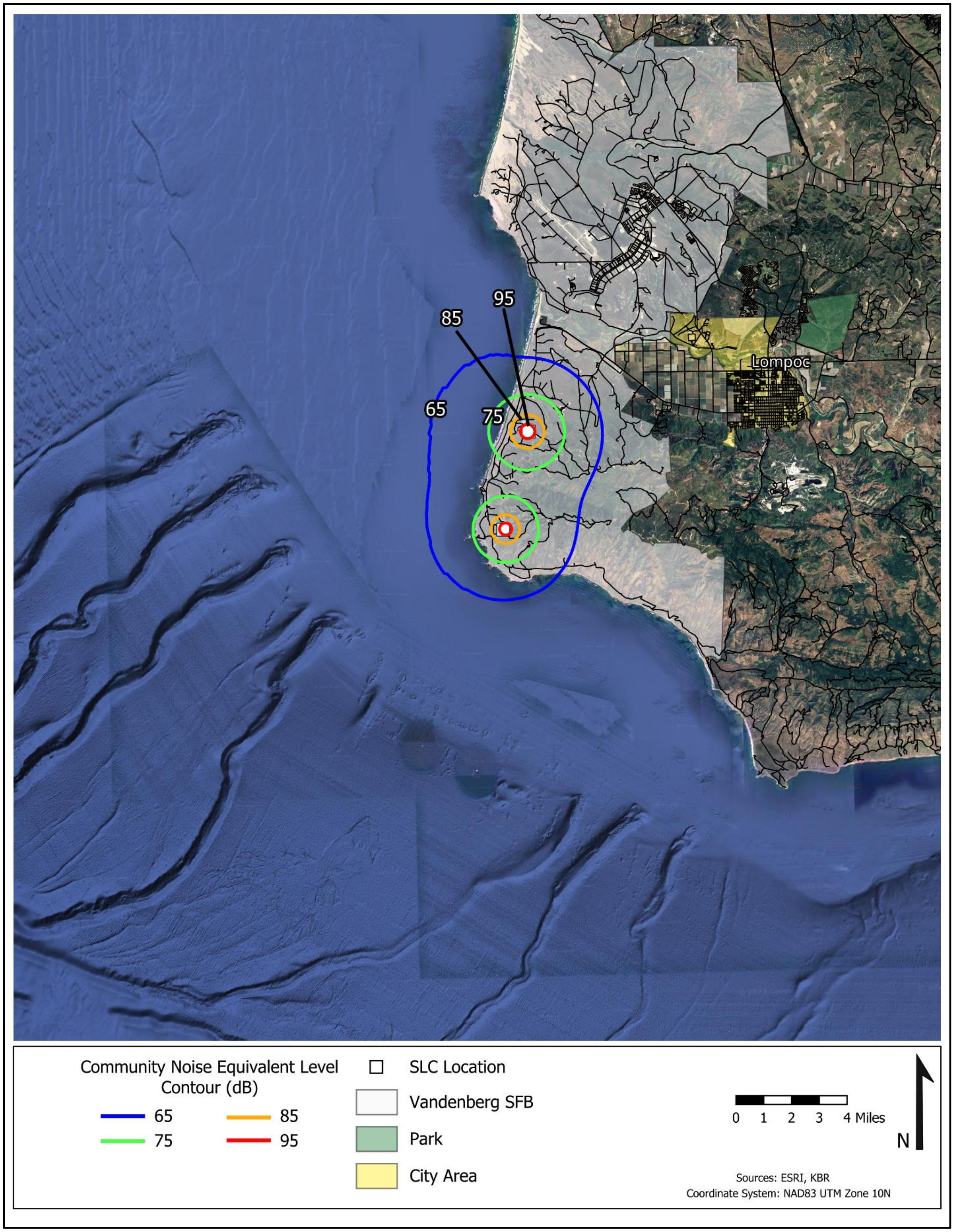

Figure 40. Falcon 9 and Falcon Heavy Combined Operations at SLC-4 and SLC-6: CNEL Contours

7 Sonic Boom Background

A sonic boom is the wave field about a supersonic vehicle. As the vehicle moves, it pushes the air aside. Because flight speed is faster than the speed of sound, the pressure waves can't move away from the vehicle, as they would for subsonic flight, but stay together in a coherent wave pattern. The waves travel with the vehicle. Figure 41 is a classic sketch of sonic boom from an aircraft in level flight. It shows a conical wave moving with the aircraft, much like the bow wave of a boat. While Figure 41 shows the wave as a simple cone, whose ground intercept extends indefinitely, temperature gradients in the atmosphere generally distort the wave from a perfect cone to one that refracts upward, so the ground intercept goes out to a finite distance on either side. A sonic boom is not a onetime event as the aircraft "breaks the sound barrier" but is often described as being swept out along a "carpet" across the width of the ground intercepts and the length of the flight track. Booms from steady or near-steady flight are referred to as carpet booms.

The waveform at the ground is generally an "N-wave" pressure signature, as sketched in the figure, where compression in the forward part of the vehicle and expansion and recompression at the rear coalesce into a bow shock and a tail shock, respectively, with a linear expansion between.

Figure 41 is drawn from the perspective of aircraft coordinates. The wave cone exists as shown at a particular time but is generated over a time period. Booms can also be viewed from the perspective of rays propagating relative to ground-fixed coordinates. Figure 42 shows both perspectives. The cone represents rays that are generated at a given time, and which reach the ground at later times. The intercept of a given ray cone with the ground is called an "isopemp." When computing sonic booms the ray perspective is appropriate, since one starts the analysis from the aircraft trajectory points and each isopemp is identified with flight conditions at a given time. As sketched in Figure 42, the isopemps are forward facing crescents.

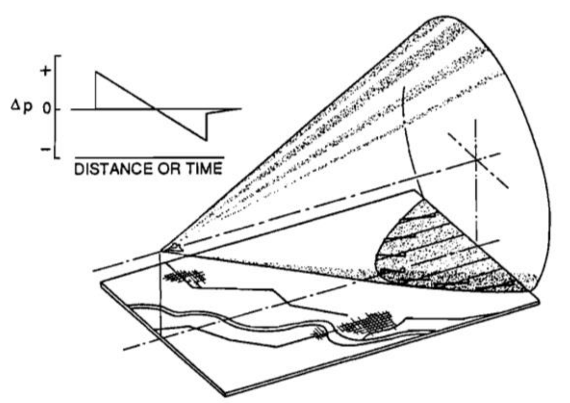

Figure 41. Sonic Boom Wave Field

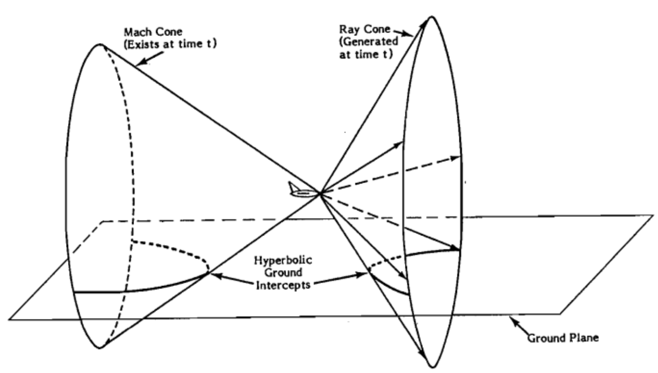

Figure 42. Wave versus Ray Viewpoints

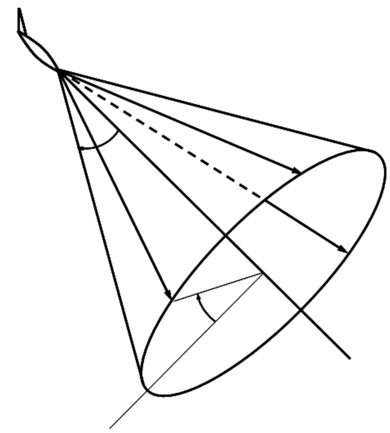

Figure 43. Ray Cone in Diving Flight

Figures 41 and 42 are drawn for steady level flight. If the aircraft climbs or dives, the ray cone tilts along with it. Figure 43 shows a ray cone in diving flight. At the angle in the figure the isopemp would still be a forward-facing crescent but would wrap around further than shown in Figure 42. In a steeper dive the isopemp could go full circle. If the vehicle is climbing at an angle steeper than the ray cone angle, there will be no boom at the ground. During very steep descent (near vertical) and at high Mach numbers the rays can be emitted at a shallow enough angle that they would refract upward and not reach the ground. For a descending vehicle that eventually decelerates to subsonic speed, some part of the trajectory will generate boom that reaches the ground.

Supersonic vehicles can turn and accelerate or decelerate. That affects the boom loudness, and under some conditions cause focused superbooms. Figure 44 is a sketch of rays from an accelerating aircraft. As the Mach number increases the ray angles steepen. The rays cross and overlap, with the focus along the "caustic" line indicated in the figure. The boom on a focusing ray is a normal N-wave before it gets close to the caustic, is amplified by a factor of two to five as it reaches the caustic, then is substantially attenuated as a "post-focus" boom after it passes the caustic.

Figure 45 shows the isopemps for this type of acceleration focus. The focal zone is the concentrated region at the left end of the footprint. The maximum focus area – where the boom is more than twice the unfocused normal boom – is very narrow, generally a hundred yards or less.

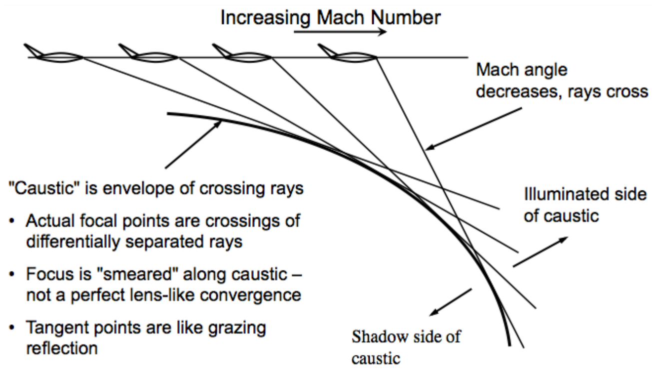

Figure 44. Ray Crossing and Overlap in an Acceleration Focus

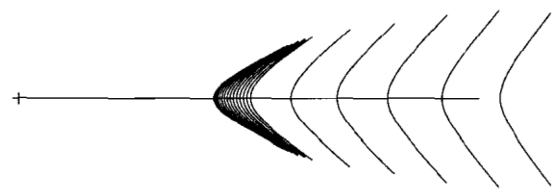

Figure 45. Isopemp Overlap in an Acceleration Focus

7.1 Potential for Structural Damage from Falcon 9 and Falcon Heavy Launches and Landings at SLC-4 and SLC-6

Falcon 9 and Falcon Heavy launches and landings at SLC-4 and SLC-6 have the potential to cause damage to structures depending on the overpressure levels the structures are exposed to as well as the construction quality and condition of the structures. Launches typically generate sonic booms over water which are not expected to damage structures; though the Northern Channel Islands, located near the California coastline south of VSFB, are an example of a place where structures (including historic structures) get exposed to sonic booms, in this case from VSFB launches.

In the following sections we present a metric and criteria level for damage assessment, describe the potential for structural damage using a couple of applicable sonic boom levels as examples (i.e., levels that are generated over land by the VSFB launch and landing operations), and then assess the damage potential for each type of Falcon 9 or Falcon Heavy launch or landing operation examined in this study.

Structural damage assessments are based on data in the FAA's Hershey and Higgins 1976 report '*Statistical Model of Sonic Boom Structural Damage*',[14] which describes damage probabilities for different structural components, for various sonic boom overpressure levels. We use 2 psf (pounds per square foot) and 4 psf primarily to assess the potential for structural damage, since areas off VSFB property are most likely to be exposed to booms, within this range of overpressure levels, from booster landing operations; also, 2 psf is taken to be the low threshold level for window (glass) breakage.

The following is a summary of the structural damage potential, for overpressure levels of 2 and 4 psf, from the Hershey and Higgins report:

2 psf

- Windows: The probability of window breakage at 2 psf is relatively low but not negligible. Studies have shown that the breakage probability for windows can range from about 1 in 10,000 to 1 in 1,000,000.
- Plaster and Bric-a-Brac: Items like plaster and small decorative objects (bric-a-brac) have a slightly higher probability of damage, but it is still quite low. For plaster, the probability can range from about 1 in 1,000 to 1 in 10,000.
- Structural Damage: Significant structural damage, such as to brick walls, is very unlikely at 2 psf. The probability is extremely low, often less than 1 in 1,000,000.

4 psf

- Windows: The probability of window breakage increases significantly at 4 psf. Studies suggest that the breakage probability for windows can range from about 1 in 100 to 1 in 1,000.
- Plaster and Bric-a-Brac: Items like plaster and small decorative objects have a higher probability of damage at 4 psf. For plaster, the probability can range from about 1 in 100 to 1 in 1,000.
- Structural Damage: While significant structural damage to well-built buildings is still relatively low, the probability increases. For example, brick walls might have a damage probability ranging from about 1 in 10,000 to 1 in 100,000.

Overall, while 4 psf sonic booms are more likely to cause damage compared to 2 psf, the extent of damage still depends on other factors, including the construction quality and maintenance of the structures.

8 Launch Sonic Boom Levels

8.1 Sonic Boom from Falcon 9 Launches at SLC-4 and SLC-6

Falcon 9 launch trajectories from SLC-4 and SLC-6 were provided by SpaceX in data files “EROS_C_ASCENT_80_12_RNOISE2.TXT” and “TRANSPORTER8_SLC6E_SLC6LANDING_ASCENT_80_12.ASC”, respectively. These files contain the ascent part of each trajectory which is supersonic above approximately 24,000 feet (launch from SLC-4) and 27,000 feet (launch from SLC-6) until Stage 1 apogee.

The sonic boom footprint for each Falcon 9 launch was computed using PCBoom[15,16]. A shape factor estimated for the Falcon 9 launch, using Carlson’s method[17], was used as the sonic boom source in PCBoom (and likewise for modeling of the Falcon 9 and Falcon Heavy launches and landings described following). Figure 46 shows the sonic boom footprint, in the form of overpressure contours, pounds per square foot (psf) for the Falcon 9 launch from SLC-4 and Figure 47 shows the sonic boom footprint from the Falcon 9 launch from SLC-6. The ground tracks from the launch at each site are also shown in the figures. In both cases, the ascent phase of the launch generates a broad forward-facing crescent region (contour at the bottom of each map) as the vehicle pitches over.

- Peak overpressure levels from Falcon 9 launch at SLC-4, shown in Figure 46, are between 0.1 and 1.0 psf (1.0 psf represented by several red colored, narrow focus regions located on the eastern side of the crescent); and the crescent-shaped contour is located entirely over water.

- Peak overpressure levels from Falcon 9 launch at SLC-6 (Figure 47), are higher than those from launch at SLC-4, between 0.1 and 5.0 psf (5.0 psf represented by several magenta colored, narrow focus regions located on the northern side of the crescent; and the crescent-shaped contour is located entirely over water. Neither of the booms from these Falcon 9 launches are over land or would damage structures.

Differences in the sonic boom levels for Falcon 9 launches at SLC-6 versus at SLC-4, are due to the different launch trajectories. The primary difference is that the launch trajectory from SLC-4 has a much steeper climb and pitches over much more slowly into the ascent, and at higher altitudes, than the launch trajectory from SLC-6. This results in the lower boom levels shown in Figure 46 (launch from SLC-4), compared with the boom levels in Figure 47 (launch from SLC-6).

8.2 Sonic Boom from Falcon Heavy Launches at SLC-6

A Falcon Heavy launch trajectory from SLC-6 was provided by SpaceX in data file "NSSL23_MOLNIYA_SLC6E_SLC6LANDING_ASCENT_80_12.ASC". This file contains the ascent part of the trajectory which is supersonic above approximately 24,000 feet until Stage 1 apogee.

PCBoom[14,15] was used to compute the sonic boom footprint for the Falcon Heavy launch. Figure 48 shows the sonic boom footprint, in the form of overpressure contours, pounds per square foot (psf) for the Falcon Heavy launch from SLC-6. The ascent phase of the launch generates a broad forward-facing crescent region (contour at the bottom of the map) as the vehicle pitches over. The Falcon Heavy pitches over faster (at a lower altitude) than the Falcon 9 which, along with its shape factor, contributes to the wider crescent-shaped contour and higher maximum overpressure levels shown in Figure 48.

- Peak overpressure levels from Falcon Heavy launch at SLC-6, shown in Figure 48, are between 0.1 and 7.0 psf (7.0 psf represented by several magenta colored, narrow focus regions located on the northern side of the crescent); in this case, the crescent-shaped contour is located mostly over water, except for the exposed land areas of the Northern Channel Islands as well as Oxnard, CA and areas just north of Los Angeles, CA. All these land areas are exposed to peak overpressure levels ranging from 0.1 psf (over most areas) to 2.0 psf (over limited areas of the Northern Channel Islands) and with a narrow focus region (between 5.0 and 7.0 psf) over a limited area of the Northern Channel Islands. Structural damage is not expected from Falcon Heavy launches from SL-6 since the exposed areas are mostly below 2 psf.

In general, booms in the 0.2 to 0.3 psf range could be heard by someone who is expecting it and listening for it, but usually would not be noticed. Booms of 0.5 psf are more likely to be noticed, and booms of 1.0 psf are certain to be noticed. Therefore, people in Oxnard, CA or most parts of the Northern Channel Islands are not likely to even notice a Falcon Heavy launch sonic boom (with levels near 0.1 psf). While structures in good condition have been undamaged by overpressures of up to 11 psf, rare minor damage may result from boom levels with peak overpressures between 2 and 5 psf[18].

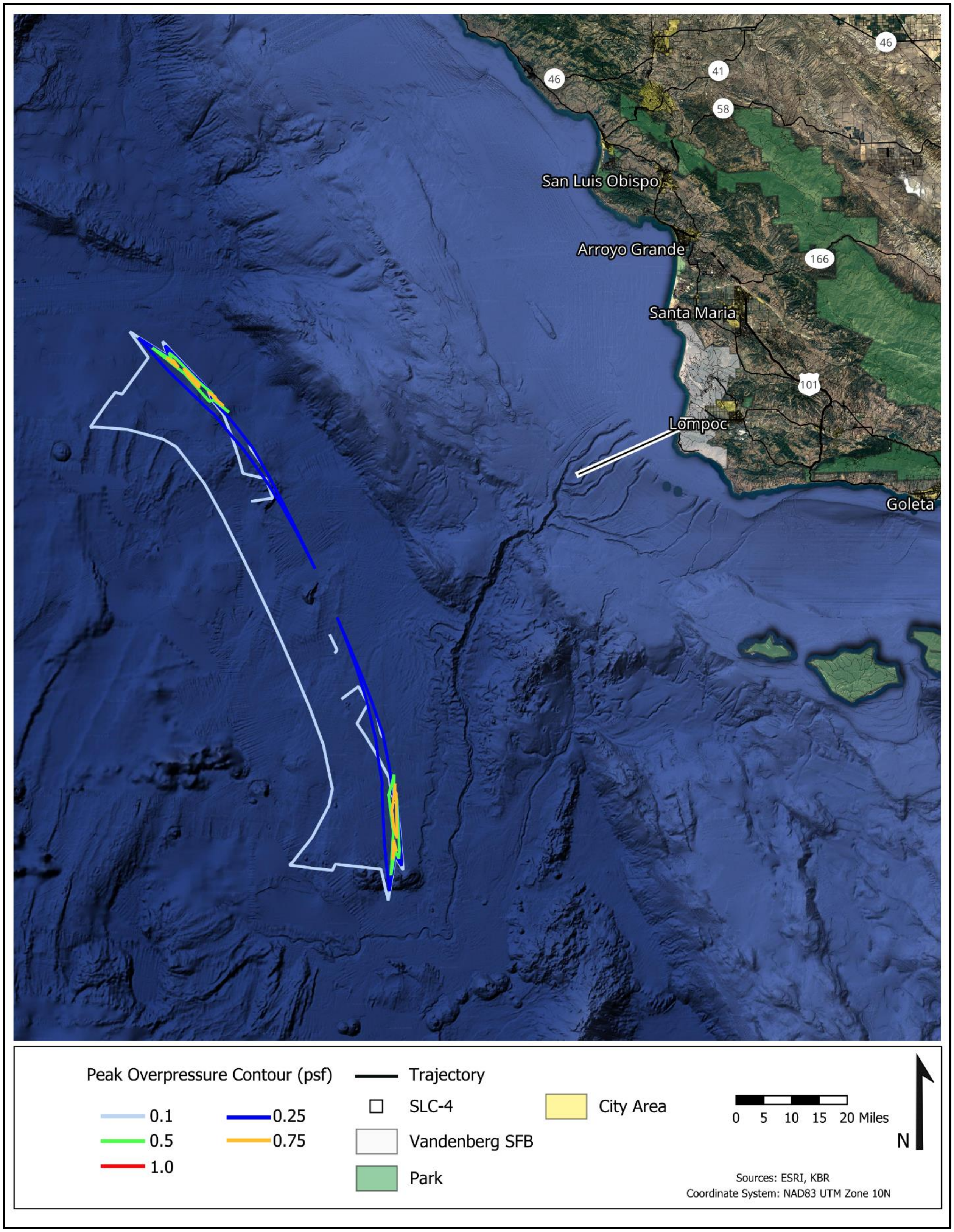

Figure 46. Sonic Boom from Falcon 9 Launch at SLC-4: psf Contours

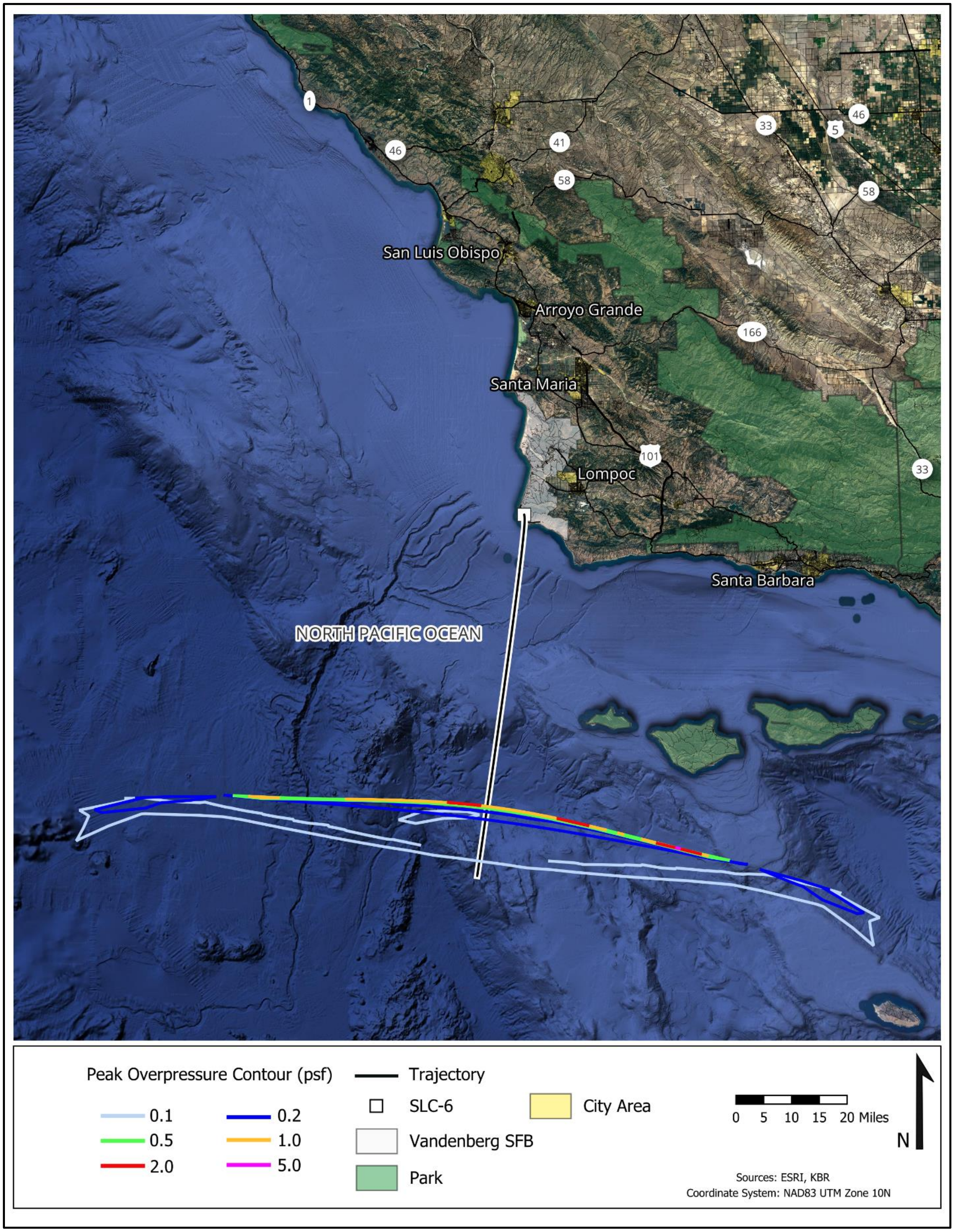

Figure 47. Sonic Boom from Falcon 9 Launch at SLC-6: psf Contours

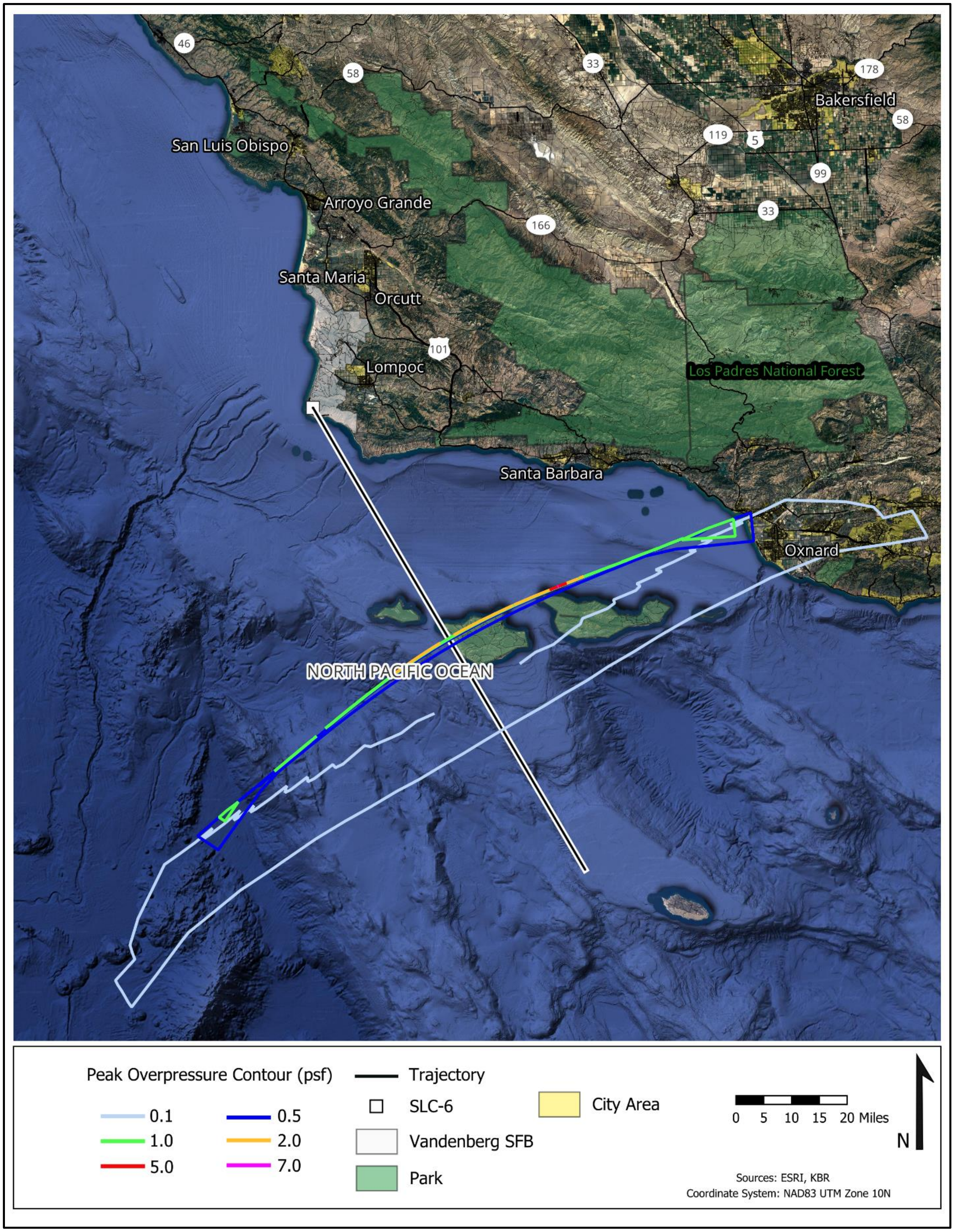

Figure 48. Sonic Boom from Falcon Heavy Launch at SLC-6: psf Contours

9 Landing Sonic Boom Levels

9.1 Sonic Boom from Falcon 9 Landings at SLC-4 and SLC-6

Falcon 9 launches at Vandenberg SFB will result in a limited number of stage 1 booster recoveries via landing operations. Falcon 9 landing trajectories for SLC-4 and SCL-6 were provided by SpaceX in data files "EROS_C_SLC6E_SLC4LANDING_STAGE1_80_12.ASC" and "TRANSPORTER8_SLC6E_SLC6LANDING_STAGE1_80_12.ASC", respectively. The descent portion of the landing at SLC-4 is supersonic from shortly after the apogee until it passes through an altitude just below 16,000 feet. The descent portion of the landing at SLC-6 is supersonic from shortly after the apogee until it passes through an altitude just below 12,000 feet. In both cases, most of the descent is unpowered.

The boom footprints at SLC-4 and SLC-6 were computed using PCBoom.[14,15] The vehicle is a cylinder generally aligned with the velocity vector, descending engines first. The landing trajectory kinematics includes the effect of atmospheric drag and the retro burn in each case.

Figure 49 shows the sonic boom footprint, in the form of overpressure contours, pounds per square foot (psf) for the Falcon 9 landing at SLC-4. The ground track of the entire trajectory is also shown in Figure 49. There is a broad forward-facing crescent region generated as the vehicle descends below 200,000 feet at a heading of approximately 68 degrees. After the burn finishes there is an oval boom footprint region that ends when vehicle speed becomes subsonic. There are two narrow focus lines (magenta color), with contour levels in the 5.0 psf to 7.5 psf range, located on the northern edge of the crescent, generated as the vehicle accelerates at the end of the retro burn. At lower altitudes drag slows the descent, so boom following the focus is a conventional carpet boom.

- The boom levels in the vicinity of the landing pad, located at latitude 34.632989 degrees and longitude -120.615203 degrees, range from about 5.0-7.5 psf.

- Boom levels on Vandenberg SFB range from 0.1-5.0 psf in areas away from the landing pad.

- The highest boom levels offshore are up to 7.5 psf in the narrow focus region just inside the north facing crescent shown in Figure 49. This zone is narrow – about 100 yards wide. The location will vary with weather conditions, so it is very unlikely that any given location will experience the focus more than once over multiple events.

- The broad crescent, with boom levels of 0.1 psf is located mostly over the Pacific Ocean, however this contour surrounds VSFB and Lompoc, Orcutt to the east, as well as Conception, to the south.

Figure 50 shows the sonic boom footprint, in the form of overpressure contours, pounds per square foot (psf) for the Falcon 9 landing at SLC-6. The ground track of the landing trajectory is also shown in Figure 50. The sonic boom footprint for the landing at SLC-6 has a similar shape and overpressure levels as the footprint for the landing at SLC-4 as described previously. The differences are that the landing trajectory at SLC-6 is at a heading of approximately 12 degrees and vehicle speed transitions from supersonic to subsonic at a lower altitude (12,000 feet).

- The boom levels in the vicinity of the landing pad, located at latitude 34.580207 degrees and longitude -120.624949 degrees, range from about 5.0-8.0 psf.

- Boom levels on Vandenberg SFB range from 0.1-5.0 psf in areas away from the landing pad.

- The highest boom levels offshore are up to 5 psf in the narrow focus region just inside the north facing crescent shown in Figure 50. This zone is narrow – about 100 yards wide and its location will vary with weather conditions, making it unlikely that any given location will experience a focus repeatedly.

- The broad crescent, with boom levels of 0.1 psf is located mostly over the Pacific Ocean, however this contour surrounds Vandenberg SFB and Lompoc, CA and Orcutt, CA to the east as well as Conception, CA and the Northern Channel Islands to the south where boom levels range from 0.1 to 2.0 psf.

These contour estimates show that the residential areas in Lompoc experience Falcon 9 landing boom levels of approximately 2 psf which relate to the low probabilities of damage described in Section 7.1.

9.2 Sonic Boom from Falcon Heavy Landings at SLC-6

Falcon Heavy launches at Vandenberg SFB will also result in stage 1 booster recoveries via landing operations. A Falcon Heavy landing trajectory for SLC-6 was provided by SpaceX in data file "EROS_C_SLC6E_SLC4LANDING_STAGE1_80_12.ASC". The descent portion of the landing at SLC-6 is supersonic from shortly after the apogee until it passes through an altitude just below 11,000 feet.

Figure 51 shows the sonic boom overpressure contours (psf), computed using PCBoom.[14,15], for one Falcon Heavy stage 1 landing at SLC-6. The sonic boom footprint for the landing at SLC-6 has a similar shape to the Falcon 9 landings described previously. Overpressure levels for the Falcon Heavy stage 1 landing at SLC-6 are also like those for Falcon 9 landings, except higher overpressure levels are expected near the oval boom footprint region, centered on the landing pad, due to the vehicle transitioning from supersonic to subsonic at a lower altitude. While Figure 51 shows the sonic boom footprint for one Falcon Heavy stage 1 landing, each recovery operation may involve two stage 1 boosters landing at SLC-6 at close to the same time such that multiple booms are expected to be heard from both vehicles; the contours shown are applicable to both of the landing booms due to the similarity in trajectories, hence multiple contours are not provided. These contours show that the residential areas in Lompoc experience Falcon Heavy landing boom levels of approximately 2 psf, which corresponds to a low probability of damage.

In general, booms in the 0.2 to 0.3 psf range could be heard by someone who is expecting it and listening for it, but usually would not be noticed. Booms of 0.5 psf are more likely to be noticed, and booms of 1.0 psf are certain to be noticed. Therefore, people in the western half of Lompoc, CA are likely to notice booms from Falcon 9 landings as are people located on Vandenberg SFB. People located on Vandenberg SFB within the 1.0 psf and 2.0 psf region could be startled and possibly annoyed. Announcements of upcoming Falcon 9 and Falcon Heavy launches and landings serve to warn people about these noise events and are likely to help reduce adverse reactions to these noise events.

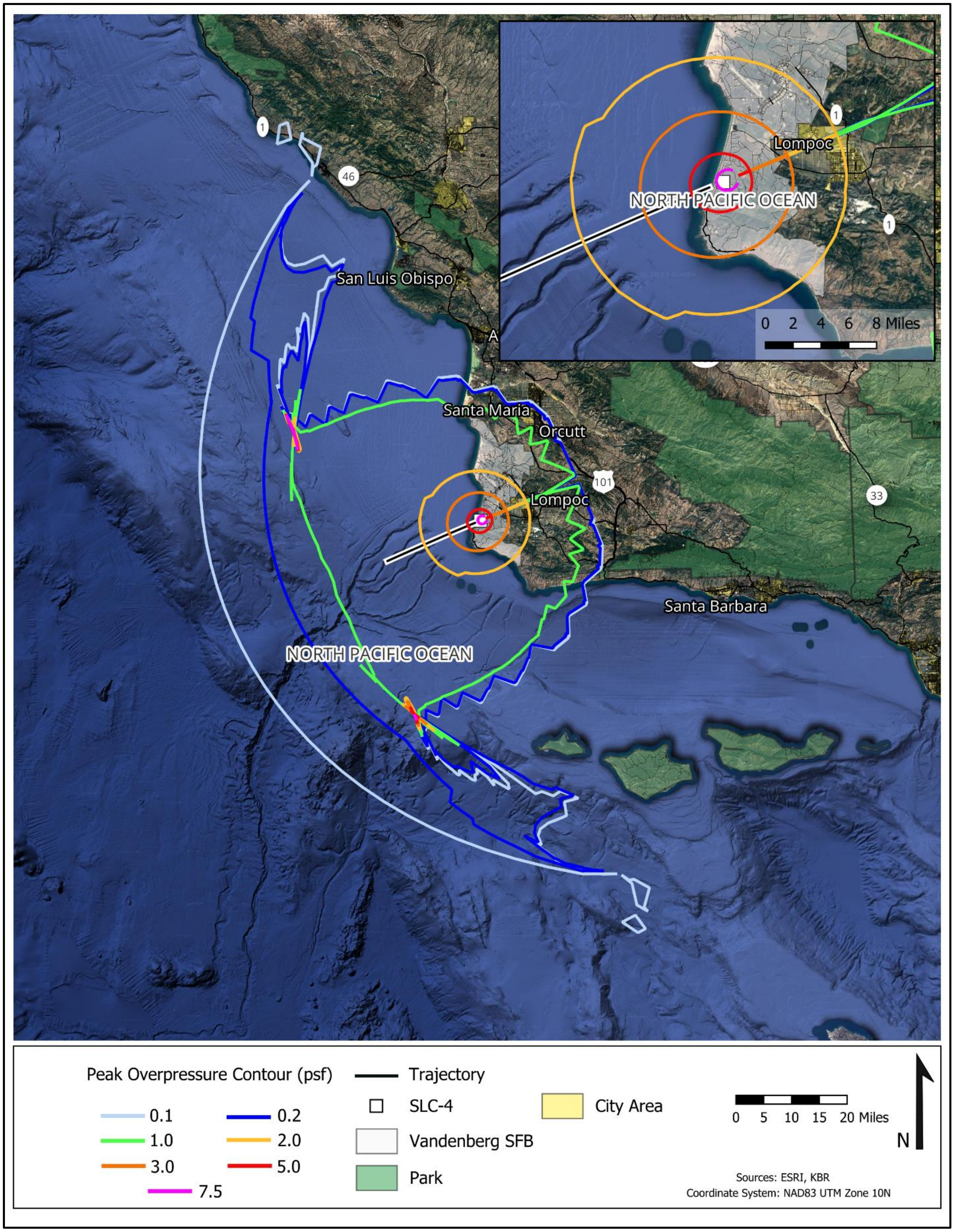

Figure 49. Sonic Boom from Falcon 9 Landing at SLC-4: psf Contours

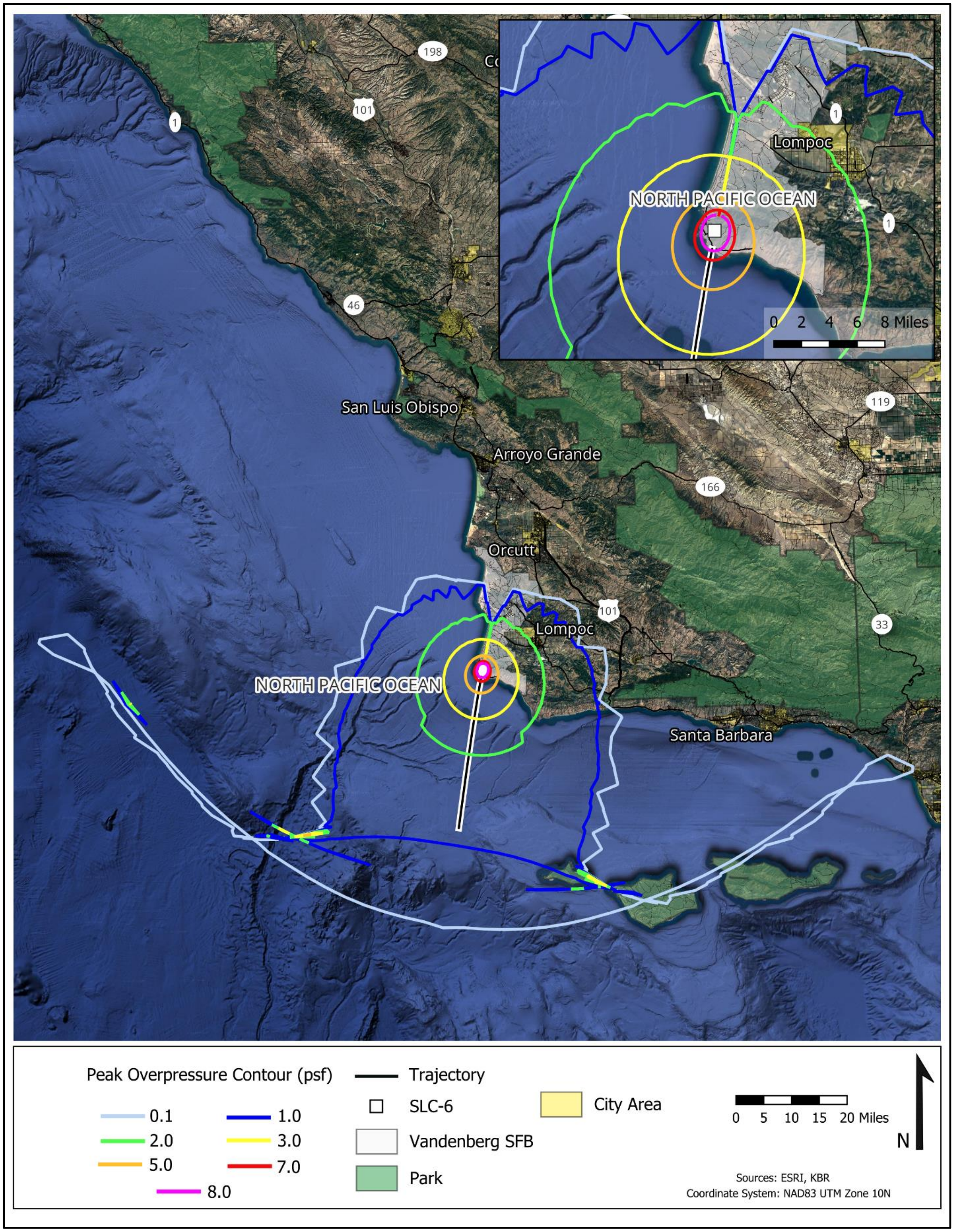

Figure 50. Sonic Boom from Falcon 9 Landing at SLC-6: psf Contours

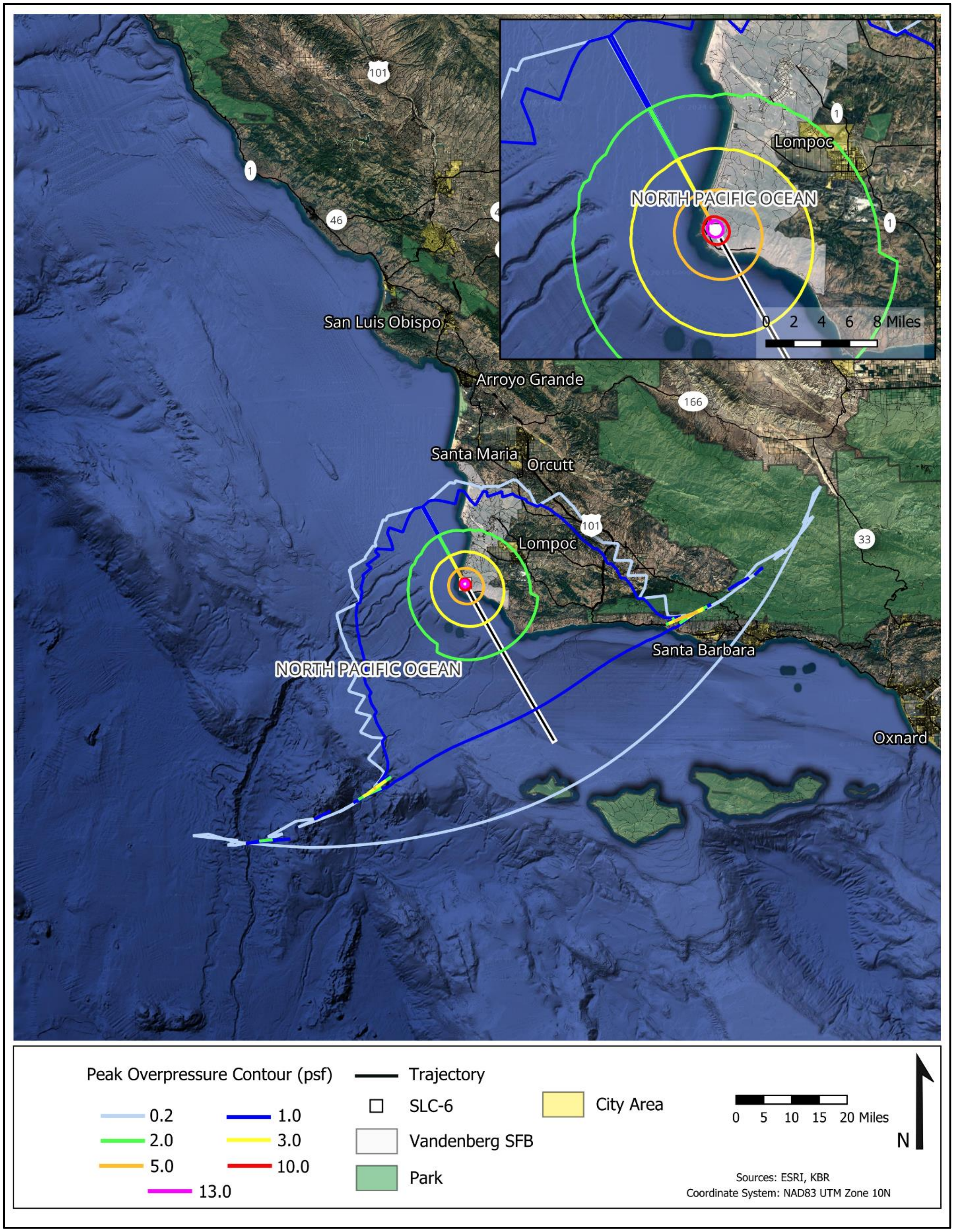

Figure 51. Sonic Boom from Falcon Heavy Landing at SLC-6: psf Contours

10 Cumulative Sonic Boom Levels

Cumulative sonic boom levels were estimated, using C-weighted Day-Night Average Sound Level (CDNL), for the projected annual Falcon 9 and Falcon Heavy landing operations at SLC-4 and SLC-6 (shown below). CDNL is DNL computed with C-weighting (more emphasis is placed on low frequencies below 1,000 hertz). The CDNL metric is used as a cumulative measure of noise events having lower frequency content and higher levels (e.g., sonic booms, large caliber weapons, and blast noise events). Cumulative sonic boom levels would include the CDNL exposure due to all the annual Falcon 9 and Falcon Heavy landings combined.

SLC-4

- 12 Falcon 9 stage 1 landings (6 day / 6 night)

SLC-6

- 5 Falcon Heavy landing events (2 day / 3 night)
- 7 Falcon 9 stage 1 landings (4 day / 3 night)

As can be seen on Figures 49-51, the maximum overpressure expected to occur at the western side of the residential area in Lompoc is about 2.2 psf. CDNL from these operations can be estimated by converting 2.2 psf to a C-weighted Sound Exposure Level (CSEL) of 108.4 and then using the projected daytime/nighttime operations split to estimate CDNL 55.5 dBC; assuming instead that all operations occurred at nighttime, the result would be CDNL 58.0 dBC. Since the FAA uses CDNL 60 dB as the significance threshold for determining land use compatibility[9], the cumulative sonic boom levels from Falcon 9 and Falcon Heavy landing operations would be below the threshold for acceptable land use.

Falcon 9 launches from SLC-4 and SLC-6 would generate sonic boom footprints that are entirely over the ocean (see Figures 46 and 47) and Falcon Heavy launches from SLC-6 would generate low overpressure levels on the coast near Oxnard, CA (0.1 to 0.5 psf as shown on Figure 48); these levels would result in cumulative levels well below the CDNL 60 dB threshold.

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Appendix H

Terrestrial Biological Resources

H.1 Tidewater Goby (Federally Listed Endangered Species)

H.1.1 Status

The tidewater goby (TWG) was listed as endangered on 7 March 1994 (59 Federal Register [FR] 5494). On 24 June 1999, the United States Fish and Wildlife Service (USFWS) proposed to remove the populations occurring north of Orange County, California, from the endangered species list (64 FR 33816). In November 2002, the USFWS withdrew this proposed delisting rule and retained the TWG's listing as endangered throughout its range (67 FR 67803). The USFWS published a Recovery Plan for the TWG in 2005 (USFWS 2005). In January 2014, USFWS proposed to reclassify the TWG from endangered to threatened (79 FR 14340-14362). In addition, the USFWS is considering a proposed taxonomic split between northern and southern populations of this species, with an expectation to delist the northern population (including all individuals at VSFB). A decision on this proposal has not been made.

H.1.2 Life History

The TWG is a small, bottom-dwelling fish found in California's coastal estuaries, wetlands, lagoons, and lower reaches of coastal streams and rivers. It is an annual species, with individuals typically not living for more than a year. TWG population size is heavily influenced by environmental conditions. In years experiencing high rains, when lagoons are breached, TWG numbers fall as fish are washed out to sea. Individuals able to access refugia, such as that provided by vegetation in littoral marshes, are able to survive flood events. These surviving individuals breed after the lagoons close, allowing populations to rebound the following summer (Swift et al. 1989). Breeding may occur year-round (Swenson 1999), with peak spawning activity usually occurring during the spring and a second peak during the late summer (Swift et al. 1989).

The key threat to TWG is the degradation of coastal lagoons as a result of diversion of water (dewatering streams affects marsh habitat extent, and alters temperature and salinity within the marshes), pollution from agricultural and sewage effluents, siltation (often through sediment generated during cattle overgrazing and feral pig activity), and coastal development. In addition, introduced predatory fish (especially centrarchids and channel catfish [*Ictalurus punctatus*], crayfish [*Procambarus clarkii*], and mosquito fish [*Gambusia affinis*]) pose a direct threat to TWG populations through predation of eggs, larvae, and adults.

H.1.3 Occurrence in the Action Area

TWG have been reported in all the major drainages on VSFB, including Shuman Creek, San Antonio Creek, Santa Ynez River, Honda Creek, and Jalama Creek (Swift et al. 1997). TWG typically favor areas within the fresh-saltwater interface with salinities of less than 12 parts per thousand (Swift et al. 1989). However, this species will range into fresh water and has been recorded up to 7.5 mi (12 km) upstream from the ocean in the Santa Ynez River (Swift et al. 1997).

Suitable habitat for TWG is found in Honda Creek. TWG were first found in the Honda estuary lagoon in 1995 (Lafferty et al. 1999). The species was again documented in 2001; however, seine net surveys conducted in Honda Creek in 2008 indicated that TWG were no longer present (MSRS 2009a). Seine net surveys were again conducted in Honda Creek in 2015 and 2016 with no TWG present (MSRS 2016, 2018). Despite being easily detectable in shallow water with a flashlight during night frog surveys, no TWG were observed during night CRLF surveys of the Honda Creek estuary for SpaceX launch monitoring activities in January 2022 (J. LaBonte, pers. obs.).

In 2013, the estuary lagoon dried and stayed dry through 2016 before rehydrating in the winter of 2016–2017 (MSRS 2018). Since 2017, the lagoon has been subject to drying during late summer months, making more than short-term occupancy by fish dependent on them being able to establish in areas east of Coast Road, but the narrowness and shallowness of the creek in this area makes this unlikely. Occurrence within the Proposed Action Area would be dependent on TWG recolonizing the lagoon if it fills and breaches in response to winter rains. Unless environmental conditions return to a consistently wetter regime conducive to perennial water in the Honda lagoon, any TWG occupancy is likely to be of short duration.

H.1.4 Critical Habitat

The USFWS issued a final rule for designation of critical habitat for the TWG on 6 February 2013 (78 FR 8745-8819). Critical habitat does not include VSFB, since it is owned by the DoD and is exempted under section 4(a)(3) of the ESA. Further, USFWS has adopted VSFB's Integrated Natural Resources Management Plan (INRMP; USSF 2021), prepared under section 101 of the Sikes Act (16 U.S.C. 670a).

H.2 Unarmored Threespine Stickleback (Federally Listed Endangered Species)

H.2.1 Status

The UTS was listed as endangered in 1970 (35 FR 16047-16048). A Recovery Plan was issued in 1985 (USFWS 1985a).

H.2.3 Life History

UTS are small fish (approximately 6 centimeters) that are short-lived (i.e., rarely surviving 2–3 years; USFWS 1985a). UTS reproduce throughout the year with highest recruitment noted from May to September (USFWS 1985a). These fish are opportunistic feeders and primarily feed on invertebrates and aquatic insects (USFWS 1985a). In San Antonio Creek, UTS coexist with other native and introduced species, many of which likely prey on UTS.

H.2.4 Occurrence within the Action Area

UTS was abundant throughout the Los Angeles basin, but was reported to be extirpated by 1942. As of 1985, UTS was generally restricted to the Santa Clara River drainage in Los Angeles County and the San Antonio Creek drainage in Santa Barbara County (USFWS 1985). On VSFB, UTS have are found in San Antonio Creek from Barka Slough to the lagoon and found mostly in the creek channel rather than the lagoon (MSRS 2009a, Swift et al. 1997). UTSs were previously documented as being most concentrated near the El Rancho Road bridge (Swift et al. 1997).

UTS were introduced into Honda Creek in 1984 (MSRS 2009a). Extensive aquatic surveys conducted in 2008, 2016, and 2017 did not detect any fish in the creek (MSRS 2009a, 2016, 2018a). Between 2008 and 2022, Honda Creek has gone through multiple cycles of drying and rehydration, which would preclude occupancy by and persistence of fish.

H.2.5 Critical Habitat

Critical habitat for the UTS was proposed in 1980 (45 FR 76012-76015), but has not been finalized

H.3 California Red-Legged Frog (Federally Threatened Species)

H.3.1 Status

The UFSWS listed the California red-legged frog (*Rana draytonii*; CRLF) as threatened on 23 May 1996 (61 FR 25813-25833). In 2002, USFWS issued a Recovery Plan to stabilize and restore CRLF populations (USFWS 2002).

H.3.2 Life History

The CRLF is a member of the family Ranidae and is California's largest native frog. In order to breed, CRLF require water bodies with sufficient hydroperiods and compatible salinity levels to accommodate larval and egg development. Breeding typically takes place from November through April with most egg deposition occurring in March. Eggs require 7 to 28 days, depending on water temperature, to develop into tadpoles (Cook 1997). Tadpoles typically require 11 to 20 weeks to develop into terrestrial frogs (USFWS 2002), although some individuals may overwinter in the tadpole stage (Fellers et al. 2001).

Adult CRLF have been documented traveling distances of over 1 mile (1.6 km) during the wet season and spending considerable time in terrestrial riparian vegetation. Christopher (2018) found that 90 percent of the CRLF observations at Vandenberg Air Force Base within the dry season occurred within 197 ft (60 m) of riparian or other aquatic habitats. It is thought that riparian vegetation provides good foraging habitat, as well as good dispersal corridors, due to canopy cover and presence of adequate moisture (USFWS 2002).

Habitat loss and degradation, combined with over-exploitation and introduction of exotic predators, were important factors in the decline of CRLF in the early to mid-1900s. Continuing threats to CRLF include direct habitat loss due to stream alteration and loss of aquatic habitat and drought, and indirect effects of expanding urbanization, competition or predation from non-native species including the bullfrog (*Lithobates catesbeianus*), catfish (*Ictalurus* spp.), bass (*Micropterus* spp.), mosquitofish (*Gambusia affinis*), and crayfish (*Procambarus clarkii*). Chytrid fungus (*Batrachochytrium dendrobatidis*) is a waterborne fungus that can decimate amphibian populations and is considered a threat to CRLF populations.

H.3.3 Occurrence in the Action Area

CRLF have been documented in nearly all permanent streams and ponds on VSFB as well as most seasonally inundated wetland and riparian sites (Christopher 1996, 2004). CRLF have been consistently documented in Honda Creek (Christopher 1996, 2004; MSRS 2009b, 2016, 2018, 2021) and during SpaceX launch monitoring activities in January 2022 (MSRS 2022). The Santa Ynez River and Bear Creek, to the north of SLC-4, have CRLF populations and suitable breeding habitat (Christopher 2004; MSRS 2009b, 2014).

Spring Canyon is an ephemeral drainage located approximately 200 ft. (61 m) south of SLC-4. Spring Canyon has no definable channel through the majority of the drainage and minimal evidence of potential pooling or flow of surface water (MSRS 2013). Depending on annual rainfall levels, several small areas of Spring Canyon may constitute suitable habitat for CRLF during wet periods when adequate surface water is present; however, in July 2017, after an above-average rain year, a USFWS-permitted biologist reassessed the drainage in support of the 2017 Falcon 9 BA (MSRS 2017) and found no significant changes from the habitat assessment conducted in 2013, including no suitable breeding habitat within the vegetation removal area or downstream. Since 2017, across 11 survey efforts to perform minimization measures associated with the 2017 BO, no suitable habitat has been found, likely a result of the protracted drought conditions in Santa Barbara County. It is therefore unlikely that CRLF occupy this area on a regular basis, other than as transitory habitat.

Suitable upland dispersal habitat exists throughout VSFB between the various riparian zones and ponds on Base but, as noted above, dispersal into these upland habitats is not likely to be as extensive as has been observed in more mesic parts of the range of this species. CRLF also occur throughout San Antonio Creek on VSFB from Barka Slough to the estuary (MSRS 2009a, 2009b, 2016).

H.3.4. Critical Habitat

The USFWS issued a final rule revising the CRLF's critical habitat on 16 March 2010 (75 FR 12816–12959). The USFWS excluded VSFB from this designation pursuant to Section 4(b)(2) of the ESA. However, USFWS designated critical habitat for the species along the southeastern (Unit STB-4) and northeastern (Unit STB-2) perimeters of VSFB.

H.4 Marbled Murrelet (Federally Threatened Species)

H.4.1 Status

The USFWS listed the marbled murrelet (*Brachyramphus marmoratus*; MAMU) as threatened on 1 October 1992 (57 FR 45328) and published a Recovery Plan for the species in 1997 (USFWS 1997). The USFWS completed a 5-year review of the species in 2009 (USFWS 2009).

H.4.2 Life History

The MAMU is a small seabird that breeds along the Pacific coast, foraging in nearshore marine waters on small fish and invertebrates, and flying inland to breed. The species requires nearshore marine habitats with abundant prey (fish and invertebrates). Among alcids, the species is unique because it uses old-growth coniferous forests and mature trees for nesting (USFWS 1997). MAMU are wing-pursuit divers. Although little has been known about the MAMU movement and home range, more information is becoming available. The first MAMU nest was not documented until 1974. Since then, the MAMU's home range has been observed as 655 square kilometers (km^2) for non-nesters and 240 km^2 for nesters within California. In addition, at-sea resting areas have also been observed an average of 5.1 km from the mouths of drainages. MAMU spend nighttime hours resting in the ocean at these areas and commute to foraging areas during the day. Nests have been observed from sea level to 5,020 ft. (USFWS 2009). MAMU range from Alaska to California and may occur as far south as Baja California.

H.4.3 Occurrence within the Action Area

MAMU have been observed semi-regularly off the coast in nearshore waters between the Santa Maria River and offshore of VSFB from on-land observation sites. Specifically, one individual was observed at an unreported distance offshore from an observation site located approximately 0.5 mi (0.8 km) west of SLC 4 in 2011 (eBird 2022). Two separate sightings were also documented in 1995 offshore of Purisima Point (eBird 2022). MAMU has never been documented breeding on VSFB, nor is any old-growth coniferous forest present on VSFB or in the Action Area.

H.4.4 Critical Habitat

The USFWS designated critical habitat for the MAMU on 24 May 1996 (61 FR 26257) and revised this designation on 4 August 2016 (81 FR 51348–51370). There is no designated critical habitat for this species within or adjacent to the Action Area. The nearest critical habitat is over 160 mi (97 km) to the north near Santa Cruz, California.

H.5 Western Snowy Plover (Federally Threatened Species)

H.5.1 Status

The USFWS listed the Pacific coast population of the western snowy plover (*Charadrius nivosus*; SNPL) as federally threatened in March of 1993 (58 FR 12864–12874).

H.5.2 Life History

The SNPL is a small shorebird with pale tan back, white underparts, and dark patches on the sides of the neck reaching around to the top of the chest. The Pacific coast population of snowy plovers is limited to individuals that nest adjacent to tidal waters. The population's range extends from Southern Washington to Baja California, Mexico.

H.5.3 Occurrence within the Action Area

VSFB provides important breeding and wintering habitat for SNPL, which includes all sandy beaches and adjacent coastal dunes from the rocky headlands at the north end of Minuteman Beach to the pocket beaches and dune areas adjacent to Purisima Point on north VSFB (approximately 7.7 mi [12.4 km]). Also included are all sandy beaches and adjacent coastal dunes from the rocky headlands at the north end of Wall Beach south to the rock cliffs at the south end of Surf Beach on South VSFB (approximately 4.8 mi [7.7 km]).

VSFB has consistently supported one of the largest populations of breeding SNPL along the west coast of the United States (Robinette et al. 2016). VSFB has performed annual monitoring of SNPL since 1993 (Robinette et al. 2021). In 2014, VSFB supported an estimated 11 percent of California's breeding population (USFWS 2014). The breeding population of SNPL on VSFB has been highly variable but relatively stable since 2007, with 235 adults and 472 nests initiated in 2021 (Robinette et al. 2021). The nearest SNPL nesting area to SLC-4 is on South Surf Beach, approximately 0.7 mi (1.1 km) northwest of SLC-4.

The SNPL is considered a permanent resident of Santa Rosa Island (SRI). On San Miguel Island (SMI), a high count of 61 SNPL was documented during the 2016–2017 winter window survey; however, counts at SMI typically document very few to no individuals (USFWS 2017a).

H.5.4 Critical Habitat

The USFWS designated Critical Habitat for the SNPL in 1999 and revised this designation on 29 September 2005 (70 FR 56969–57119) and on 19 June 2012 (77 FR 36727). VSFB was exempted from Critical Habitat designation under section 4(a)(3) of the ESA. The nearest Critical Habitat is approximately 8 mi (13 km) to the south on SRI

H.6 California Least Tern (Federally Endangered Species)

H.6.1 Status

The USFWS listed the California least tern (*Sternula antillarum browni*; LETE) as federally endangered on 13 October 1970 (35 FR 16047–16048). The USFWS published a Recovery Plan for the species in 1985 (USFWS 1985b).

H.6.2 Life History

The LETE is the smallest of the North American terns and is found along the Pacific Coast of California, from San Francisco southward to Baja California. It has a distinctive black cap with stripes running across the eyes to the beak. The upperparts are gray and the underparts are white.

The California populations are localized and increasingly fragmented, due to coastal development resulting in habitat loss. LETEs are migratory and winter along the Pacific coast of southern Mexico and the Gulf of California. They usually arrive at breeding grounds by the last week of April and return to wintering grounds in August. This species nests in colonies on relatively open beaches kept free of vegetation by natural scouring from tidal or wind action.

The total population of LETE increased from less than 700 pairs circa 1985 to greater than 7,000 pairs circa 2006. The population has since declined and remains steady at 4,000 to 5,000 pairs since 2006. The majority of the population is south of Point Conception (Robinette et al 2016).

H.6.3 Occurrence within the Action Area

Historically, LETE nested in colonies in several locations along the coastal strand of the north VAFB coastline. Since 1998, with the exception of two nests established south of San Antonio Creek in 2002, LETE have nested only at the primary colony site, in relatively undisturbed blufftop open dune habitat at Purisima Point. The population of LETE at VSFB represents a small percentage of all known breeding colonies. Robinette et al. (2016) estimated that VSFB supports a breeding population of 25 pairs of LETE. Although this population is small, VSFB is one of only three breeding colonies that nest between Monterey and Point Conception; therefore, the Purisima Point breeding colony is considered important. This colony is approximately 8 mi (12.9 km) north of SLC-4. Adult LETE forage in the Santa Ynez River lagoon and estuary, approximately 3.7 mi (6.0 km) north of SLC-4. After young have fledged in late summer, LETE also disperse to this location to forage in the lagoon and roost on adjacent sandbars before migrating south for the winter (Robinette & Howar 2010).

H.6.4 Critical Habitat

The USFWS has not designated critical habitat for the LETE

H.7 California Condor (Federally Listed Endangered Species)

H.7.1 Status

The USFWS listed the California condor (*Gymnogyps californianus*) as endangered on 11 March 1967 (32 FR 4001) and completed a Recovery Plan for the species on 25 April 1996 (USFWS 1996). In 1982, there were only 23 California condors in existence. To prevent the condor from going extinct, all remaining condors were placed into a captive breeding program in 1987. The USFWS and its partners began releasing condors back into the wild in 1992. The nearest release site to the Action Area is Bitter Creek National Wildlife Refuge (USFWS 2017). Other release sites include the Ventana Wilderness and Pinnacles National Park. Almost all condors released into Santa Barbara County have either died or were brought back into captivity, with the last nesting attempt occurring in 2001 (Lehman 2020).

H.7.2 Life History

Condors nest in rock formations (e.g., ledges and crevices) and less frequently in giant sequoia trees (*Sequoiadendron giganteum*). They normally lay a single egg between late January and early April. Both parents incubate the egg and share responsibilities for feeding the nestling after hatching. Condors require large remote areas and can range up to 150 mi (241 km) a day in search of food. Chicks usually take their first flight around 6 to 7 months from hatching. The cause of the California condor's decline is inconclusive, but experts believe that lead poisoning and hunting greatly contributed to their decline (USFWS 1996).

H.7.3 Occurrence within the Action Area

The California condor's current range is not within the Action Area. However, in March 2017, the USSF learned that telemetry data from USFWS showed there was a California condor ranging within VSFB. This condor was SB 760 (“VooDoo”), an immature, non-reproductive female (USFWS, personal communication, 27 March 2017). She hatched in captivity on 22 May 2014, was released at the Ventana Wilderness on 9 November 2016 (Ventana Wildlife Society 2017), and departed the VSFB area on or about 22 April 2017. Several months later, SB 760 was found deceased, in northern San Luis Obispo County. VSFB natural resource managers maintain routine communications with the USFWS and Ventana Wildlife Society for SpaceX launch monitoring requirements and condors have not been present since. However, given the wide ranging nature of this species, individuals may occur on Base in the future.

H.7.4 Critical Habitat

The USFWS designated critical habitat for the California condor in 1976 and revised it in 1977 (42 FR 47840). The nearest designated critical habitat for the California condor is near San Luis Obispo, approximately 44 mi (70 km) from the Action Area. There is no critical habitat within or adjacent to the Action Area.

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Appendix I
Marine Biological Resources

I.1 Regulatory Setting

Marine species and habitats are regulated under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and Marine Mammal Protection Act (MMPA). The ESA of 1973 (16 USC §1531 et seq.) established protection over and conservation of threatened and endangered species and the ecosystems upon which they depend. Sensitive and protected biological resources include plant and animal species listed as threatened, endangered, or special status by the USFWS and NMFS. Under the ESA (16 USC §1536), an “endangered species” is defined as any species in danger of extinction throughout all or a significant portion of its range. A “threatened species” is defined as any species likely to become an endangered species in the foreseeable future.

Section 7 of the ESA requires all Federal agencies to consult with the USFWS and/or NMFS before initiating any action that may affect a listed species or designated critical habitat. The MSA requires agencies to consult with NMFS on actions that may affect Essential Fish Habitat for managed commercial fisheries. The MMPA prohibits take of marine mammals without a Letter of Authorization requiring formal rulemaking.

I.1 ESA-Listed Fishes

I.1.1 Steelhead (*Onchorhynchus mykiss*)

I.1.1.1 Status

The National Marine Fisheries Service (NMFS) listed several Evolutionarily Significant Units of anadromous steelhead as endangered or threatened, including the Southern California Distinct Population Segment (DPS) of steelhead, which encompasses the populations occurring from the Santa Maria River in Santa Barbara County to the California-Mexico border, as endangered in 1997 (62 Federal Register [FR] 43937). In January 2012, NMFS issued a final Recovery Plan to stabilize and restore steelhead trout populations in coastal streams from the Santa Maria River in Santa Barbara County south to the United States and Mexico border (NMFS 2012).

Steelhead populations have experienced significant declines along the Pacific Coast of North America since the early 1900s. The Santa Ynez River in Santa Barbara County, California, once supported what was likely the largest steelhead run south of San Francisco Bay. The run size for the Santa Ynez, Santa Clara, and Ventura Rivers and Malibu Creek is estimated to have been between 32,000 and 46,000 individuals (Boughton & Fish 2003; Helmbrecht & Boughton 2005; Good et al. 2005; Williams et al. 2011). Even after the construction of Gibraltar Dam in 1920, 72 mi (116 km) upstream of the Santa Ynez River mouth, historic run sizes for the Santa Ynez River were estimated at 12,995 to 25,032 individuals (Shapovalov & Taft 1954; Busby et al. 1996). Runs remained large and supported a recreational fishing industry until the construction of Bradbury Dam in 1954 (Alagona et al. 2012). Bradbury Dam is located 48 mi (77 km) upstream from the Pacific Ocean on the mainstem of the Santa Ynez River. It is an impassable barrier that blocks two-thirds of the former steelhead spawning and rearing habitat (Alagona et al. 2012). Following Bradbury Dam’s construction, runs of steelhead on the Santa Ynez River were reported at less than 100 individuals on an annual basis (Nehlsen et al. 1991; Reavis 1991). Between 2001 and 2011, an average of 3.4 adult steelhead were trapped per year at a lower Santa Ynez River monitoring station and no adults were observed between 2010 and 2016 (NMFS 2016a).

I.1.1.2 Life History

There is considerable variation in this life history pattern within the population, partly due to Southern California's variable seasonal and annual climatic conditions. Some winters produce heavy rainfall and flooding, which allow juvenile steelhead easier access to the ocean, while dry seasons and periods of drought may close the mouths of coastal streams and rivers, limiting juvenile steelheads' access to marine waters (NMFS 1997) as well as adult access to spawning grounds (U.S. Bureau of Reclamation 2013).

I.1.1.3 Occurrence within the Action Area

The natural range of anadromous steelhead includes the U.S. Pacific Coast to Southern California (Good et al. 2005), but it has been introduced throughout the world. Spawning and rearing habitat are found outside of the ROI in freshwater creek and river systems, where adults may migrate up to 930 mi (1,497 km) from their ocean habitats to reach their freshwater spawning grounds in high-elevation tributaries. Near the Action Area, the primary rivers that steelhead migrate into are the Santa Maria and Santa Ynez Rivers (Good et al. 2005), as well as Jalama Creek. Steelhead hatch in freshwater streams, where they spend their first 1 to 3 years. They later move into the ocean, where most of their growth occurs. After spending between 1 and 4 years in the ocean, steelhead return to their home freshwater stream to spawn. Unlike other species of Pacific salmon, steelhead do not necessarily die after spawning and are able to spawn more than once.

I.1.1.4 Critical Habitat

In September 2005, the NMFS issued the final critical habitat designation for the Southern California Steelhead DPS (70 FR 52488). This critical habitat designation does not include VSFB because it was excluded under section 4(b)(2) of the ESA and exempted under section 4(a)(3) of the ESA. In addition, designated critical habitat for steelhead in Southern California is restricted to rivers and estuaries and therefore does not overlap with the Action Area

I.1.2 Chinook Salmon (*Onchorhynchus mykiss*)

Several ESUs of chinook salmon may be present in the ROI in the Pacific Ocean offshore of California, which are described with specific details below.

I.1.2.1 Lower Columbia River ESU

The Lower Columbia River Chinook Salmon ESU was listed as threatened on 24 March 1999 (64 FR 14308), their status reaffirmed on 28 June 2005 (70 FR 37160), and status subsequently updated on 14 April 2014 (79 FR 20802). This ESU includes naturally spawned Chinook salmon originating from the Columbia River and its tributaries downstream of a transitional point east of the Hood and White Salmon Rivers, and any such fish originating from the Willamette River and its tributaries below Willamette Falls.

In general, the more abundant juvenile Lower Columbia River fall-run Chinook migrate north upon entering the Pacific Ocean (Fisher et al. 2014). However, the less-abundant juvenile Lower Columbia River spring-run Chinook, though more common beyond the continental shelf, with most migrating far offshore after their first year of marine residence (Quinn & Myers 2005; Sharma 2009), have been detected in the coastal waters of Oregon and Washington for much of the year (Fisher et al. 2014). Occurrence of chinook salmon from the Lower Columbia River ESU would be rare in the ROI.

I.1.2.2 California Coastal ESU

The California Coastal Chinook Salmon ESU was listed as threatened on 16 September 1999 (64 FR 50394), their status reaffirmed on 28 June 2005 (70 FR 37160), and status subsequently updated on 14 April 2014

(79 FR 20802). This ESU includes naturally spawned Chinook salmon originating from rivers and streams south of the Klamath River to and including the Russian River (79 FR 20802).

The California Coastal Chinook salmon ESU produces primarily ocean-type juveniles that reside for less than a year in fresh water before moving to the ocean between March and August of their first year. In the ocean, California coastal Chinook remain primarily between Pt. Reyes and southern Oregon, with highest abundances in the Fort Bragg and Klamath subareas (Bellinger et al. 2015; Satterthwaite et al. 2015). Adults of the California Coastal Chinook DPS (fall-run) migrate from September through December or January in larger rivers that remain open to the ocean all summer (NMFS 2019a). This ESU occurs within the ROI.

I.1.2.3 Sacramento River Winter-Run ESU

The Sacramento River Winter-Run Chinook Salmon ESU was listed as threatened on 4 August 1989 (54 FR 32085) and was reclassified as endangered in 1994 (55 FR 46515). This ESU includes all naturally spawned populations of winter-run Chinook salmon in the Sacramento River and its tributaries, as well as two conservation programs maintained at the Livingston-Stone National Fish Hatchery (79 FR 20802).

Juvenile fry and smolts emigrate downstream from July through March through the Sacramento River and reach the Delta from September through June (Satterthwaite et al. 2015). Due to limited data, Teel et al. (2015) combined this ESU with other California ESUs. They found that the distribution of these fish largely occurred in Oregon and California coastal waters, consistent with other authors (Hendrix et al. 2019; Moyle 2002; Windell et al. 2017). Returning adults migrate through coastal waters and enter San Francisco Bay, then migrate up the Sacramento River in November and continue upstream from December through early August (California Department of Fish and Wildlife [CDFW] 2022a). Due to the coastal distribution of this ESU, Sacramento River Winter-Run Chinook salmon occur in the ROI.

I.1.3 Coho Salmon (*Oncorhynchus kisutch*)

Several ESUs of coho salmon may be present in the ROI in the Pacific Ocean offshore of California, which are described with specific details below.

I.1.3.1 Southern Oregon and Northern California Coast ESU

The Southern Oregon and Northern California Coast Coho Salmon ESU was listed as threatened on 6 May 1997 (62 FR 24588), their status reaffirmed on 28 June 2005 (70 FR 37160), and status subsequently updated on 14 April 2014 (79 FR 20802). This ESU includes naturally spawned coho salmon originating from coastal streams and rivers between Cape Blanco, Oregon, and Punta Gorda, California (79 FR 20802).

Although juvenile behaviors, life histories, and habitat associations can be variable, the majority of coho juveniles reside about one year in fresh water before migrating to sea (NMFS 2019a). Upon entry into the open ocean, juvenile coho use nearshore marine habitats, with some fish remaining in local waters and others moving northward along the continental shelf to central Alaska (Fisher et al. 2014). In general, fish in this ESU exhibit a three-year life cycle, with adults entering natal streams and rivers from mid-November to January (NMFS 2019a). Due to prevalence of coho in Oregon coastal waters, Southern Oregon and Northern California Coast coho salmon are present in the ROI.

I.1.3.2 Central California Coast ESU

The Central California Coast Coho Salmon ESU was listed as threatened on 31 October 1996 (61 FR 56138) and downgraded to endangered on 28 June 2005 (70 FR 37160). The ESU status was reaffirmed as endangered on 2 April 2012, (77 FR 19552) and subsequently updated on 14 April 2014 (79 FR 20802).

This ESU includes naturally spawned coho salmon originating from rivers south of Punta Gorda (Monterey County, CA) to and including Aptos Creek (Ventura County, CA), as well as such coho salmon originating from tributaries to San Francisco Bay (79 FR 20802).

Coho smolts from this population begin migrating downstream to the ocean in late March or early April but can sometimes begin prior to March and persist well into July (CDFW 2022b). Once in the ocean, immature coho remain in in-shore waters, congregating in schools as they move north along the continental shelf (CDFW 2022b; Fisher et al., 2014). Adults in this ESU generally enter freshwater to spawn from September through January, with spawning mainly from November to January, although it can extend into February or March (CDFW 2022b). Due to prevalence of coho in Oregon coastal waters, Central California Coast coho salmon occur in the ROI.

I.1.4 Green Sturgeon (*Acipenser medirostris*)

I.1.4.1 Status

The Southern DPS of North American Green Sturgeon was listed as threatened on 7 April 2006 (71 FR 17757) and critical habitat for this DPS was designated on 9 October 2009 (74 FR 52300).

I.1.4.2 Occurrence within the Action Area

Subadult green sturgeon leave their Californian natal rivers and disperse widely along continental shelf waters of the West Coast within the 360 ft. (110-meter [m] contour (Erickson & Hightower 2007; Moyle 2002; NMFS 2005). This DPS preferentially distributes north of their natal river during fall and moves into bays and estuaries during summer and fall (Heironimus et al. 2022; Israel et al., 2009). Sub-adult and mature fish exhibit a narrow and shallow depth distribution in marine habitat of < 328 ft. (100 m) within the 360 ft. (110 m) contour of the continental shelf, typically occupying depths of 130 to 230 ft. (40–70 m; Erickson & Hightower, 2007; NMFS 2005; Payne et al., 2015). While Huff et al. (2011) found that green sturgeon appeared to prefer marine areas with high seafloor complexity and boulder presence, Payne et al. (2015) found that that green sturgeon are also associated with flat, soft bottom habitats that lack high relief bottoms. Information regarding their preference for areas of high seafloor complexity and prey selection in coastal waters (benthic prey) indicate green sturgeon reside and migrate along the seafloor while in coastal waters. Huff et al. (2011) found that green sturgeon in the open ocean may also occupy the upper 65 ft. (20 m) of the water column on a seasonal basis (July to November) and use deeper habitats throughout the rest of the year.

The primary concentration of sturgeon is estimated to be approximately 41–51.5° North within the 656 ft. (200 m) isobath in the coastal waters of Washington, Oregon, and Vancouver Island (Huff et al. 2012). Additionally, Huff et al. (2011) suggested that green sturgeon occur at low densities in the coastal marine environment. Southern DPS are likely to be present in the ROI.

I.1.4.3 Critical Habitat

Critical habitat includes coastal U.S. marine waters within 360 ft. (110 m) depth from Monterey Bay, California north to Cape Flattery, Washington, including the Strait of Juan de Fuca, Washington, to the U.S. boundary. Critical habitat includes several rivers and estuaries along the U.S. West Coast (74 FR 52300).

For coastal marine areas, the physical or biological features of critical habitat designated for green sturgeon include food resources, migratory corridors, and water quality. Corresponding species life history events include subadult growth and development, movement between estuarine and marine areas, and migration between marine areas, as well as adult sexual maturation, growth and development, movements between estuarine and marine areas, migration between marine areas, and spawning migration (74 FR 52300). Green sturgeon critical habitat does not overlap the ROI.

I.1.5 Oceanic Whitetip Shark (*Carcharhinus longimanus*)

I.1.5.1 Status

NMFS completed a comprehensive status review of the oceanic whitetip shark and based on the best scientific and commercial information available, including the status review report (Young et al. 2016), and listed the species as threatened on 1 March 2018 (83 FR 4153).

I.1.5.2 Occurrence within the Action Area

Oceanic whitetip sharks are found worldwide in warm tropical and subtropical waters between the 30° North and 35° South latitude near the surface of the water column (Young et al. 2016). Oceanic whitetips occur throughout the Central Pacific, including the Hawaiian Islands south to Samoa Islands and in the eastern Pacific from Southern California to Peru, including the Gulf of California. This species has a clear preference for open ocean waters, with abundances decreasing with greater proximity to continental shelves. In terms of California fish fauna, Allen and Cross (2006) categorized oceanic white tip sharks as holoepipelagic and individuals would be found mostly far from shore. Preferring warm waters near or over 20°C (68°F), and offshore areas, the oceanic whitetip shark is known to undertake seasonal movements to higher latitudes in the summer (NOAA 2016) and may regularly survey extreme environments (deep depths, low temperatures) as a foraging strategy (Young et al. 2016).

Oceanic whitetip sharks could occur in deep open ocean areas in the California Current Large Marine Ecosystem. They are known to occur in Baja California and may be found in surface waters off the continental shelf (Baum et al. 2015). Oceanic whitetip sharks are therefore expected to occur within the ROI.

I.1.5.3 Critical Habitat

Critical habitat has not been designated for this species.

I.1.6 Scalloped Hammerhead Shark (*Sphyrna lewini*)

I.1.6.1 Status

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

I.1.6.2 Occurrence in the Action Area

The scalloped hammerhead shark is a coastal and semi-oceanic species distributed in temperate and tropical waters (Froese & Pauly 2016). Distribution in the eastern Pacific Ocean extends from the coast of southern California, including the Gulf of California, to Ecuador and possibly Peru (Compagno 1984), and off Hawaii in the central Pacific Ocean. A genetic marker study suggests that females remain close to coastal habitats, while males disperse across larger open ocean areas (Daly-Engel et al. 2012).

Juveniles rear in coastal nursery areas in the southern California portion of the Action Area (Duncan & Holland 2006), but rarely inhabit the open ocean (Kohler & Turner 2001). Sub adults and adults occur over shelves and adjacent deep waters close to shore and entering bays and estuaries (Compagno 1984). In the California Current Large Marine Ecosystem, records of the presence of scalloped hammerhead sharks in this area are very rare. Sighting and landings in the ROI are documented to have occurred in San Diego Bay in 1981, 1996, and 1997 (Shane 2001).

I.1.6.3 Critical Habitat

Critical habitat has not been designated for this species.

I.2 Sea Turtles

I.2.1 General Background

Sea turtles are highly migratory, long-lived reptiles that occur throughout the open-ocean and coastal regions of the Action Area. Generally, sea turtles are distributed throughout tropical to subtropical latitudes (i.e., in warmer waters closer to the equator), with some species extending poleward into temperate seasonal foraging areas. In general, sea turtles spend most of their time at sea, with the notable exception of mature females returning to land, primarily beaches, to nest. The habitat preferred by sea turtles and their distribution at sea varies by species and life stage (i.e., hatchling, juvenile, adult).

I.2.2 Green Sea Turtle (*Chelonia mydas*)

I.2.2.1 Status

The green sea turtle was listed under the ESA in July 1978 because of excessive commercial harvest, a lack of effective protection, evidence of declining numbers, and habitat degradation and loss (NMFS and USFWS 2007a). A revised final rule listing the East Pacific and Central North Pacific DPSs of the green sea turtle was issued in 2016 (81 FR 20057).

I.2.2.2 Occurrence in the Action Area

The green sea turtle is found in tropical and subtropical coastal and open ocean waters, between 30° North and 30° South. Green sea turtles are widely distributed in the subtropical coastal waters of southern Baja California, Mexico, and Central America (Cliffton et al. 1995; NMFS and USFWS 1998a). Another green sea turtle population resides in Long Beach, California, although less is known about this population (Eguchi et al. 2010). Ocean waters off southern California and northern Baja California are designated as areas of occurrence because of the presence of rocky ridges and channels and floating kelp habitats suitable for green sea turtle foraging and resting (Stinson 1984); however, these waters are often at temperatures below the thermal preferences of this primarily tropical species.

I.2.2.3 Critical Habitat

Critical habitat has been proposed in the Pacific Ocean (88 FR 46572) but would not overlap the action area.

I.2.3 Loggerhead Turtle (*Caretta caretta*)

I.2.3.1 Status

In September 2011, NMFS listed all three Pacific Ocean distinct population segments of loggerhead sea turtles as endangered (76 FR 588868). In the Pacific, there are two distinct population segments of loggerheads. The North Pacific Ocean DPS nests only on the coasts of Japan. This population has declined 50 to 90 percent during the last 60 years, however the overall nesting trend in Japan has been stable or slightly increasing over the last decade. The South Pacific Ocean DPS nests primarily in Australia with some nesting in New Caledonia. In 1977, about 3,500 females may have nested in the South Pacific—today there are only around 500 per year.

I.2.3.2 Occurrence in the Action Area

Loggerhead turtles are found worldwide mainly in subtropical and temperate regions of the Atlantic, Pacific, and Indian Oceans, and in the Mediterranean Sea (Conant et al. 2009). In the eastern Pacific, the loggerheads primary range extends from offshore of Vancouver Island, south to Central America. The highest densities of loggerheads can be found just north of Hawaii in the North Pacific Transition Zone (Polovina et al. 2000). The North Pacific Transition Zone is defined by convergence zones of high productivity that stretch across the entire North Pacific Ocean from Japan to California (Polovina et al. 2001). The loggerhead turtle is known to occur at sea off of southern California, but does not nest on southern California beaches.

I.2.3.3 Critical Habitat

There is no critical habitat designated for the North Pacific Ocean DPS.

I.2.4 Olive Ridley Sea Turtle (*Lepidochelys olivacea*)

I.2.4.1 Status

The breeding population along the Pacific coast of Mexico was listed as endangered under the ESA in 1978 (43 FR 32800), because of extensive overharvesting of olive ridley turtles in Mexico, which caused a severe population decline (NMFS and USFWS 1998b). Olive ridleys offshore of California and Baja Mexico would likely belong to this population. All other populations are listed under the ESA as threatened. A five-year review was completed in 2014 (NMFS and USFWS 2014).

I.2.4.2 Occurrence in the Action Area

Most olive ridley turtles lead a primarily open ocean existence (NMFS and USFWS 1998b). Individuals occasionally occur in waters as far north as California and as far south as Peru, spending most of their life in the oceanic zone (NMFS and USFWS 2007b). The olive ridley has a large range in tropical and subtropical regions in the Pacific Ocean, and is generally found between 40° North and 40° South. There are few documented occurrences of olive ridley sea turtles in waters off the west coast of the United States (NMFS and USFWS 1998b). One deceased olive ridley sea turtle washed up on North VSFB in April 2023 (Evans pers comm, 2024).

I.2.4.3 Critical Habitat

Critical habitat has not been designated for the olive ridley turtle.

I.2.5 Hawksbill Sea Turtle (*Eretmochelys imbricata*)

I.2.5.1 Status

The hawksbill turtle is listed as endangered throughout its range in 1970 under the ESA (35 FR 8491). A five-year review was completed in 2013 (NMFS and USFWS 2013a).

I.2.5.2 Occurrence in the Action Area

Water temperature in the southern California offshore waters is generally too low for hawksbills, and their occurrence offshore of California would be considered rare. They are more common in nearshore foraging grounds, including coral reefs and mangrove estuaries from Baja California to South America (NMFS and USFWS 2013a). However, hatchlings utilize floating algal mats and drift lines in pelagic (open sea) habitat (NMFS and USFWS 2013a) and therefore may be found in the ROI.

I.2.5.3 Critical Habitat

Critical habitat has not been designated for the hawksbill in the Pacific Ocean.

I.2.6 Leatherback Sea Turtle (*Dermochelys coriacea*)

I.2.6.1 Status

The leatherback sea turtle is listed as a single population and is classified as endangered under the ESA (35 FR 8491). Although USFWS and NMFS believe the current listing is valid, preliminary information indicates an analysis and review of the species should be conducted under the DPS policy (NMFS and USFWS 2013b). In early 2018, NMFS and the USFWS initiated a status review for the globally listed endangered leatherback sea turtles, to determine if DPS existed and if so, given their status, to consider whether the listing (currently "endangered") should be changed for each DPS. The status review was completed in 2020 (NMFS and USFWS 2020). While seven populations of leatherbacks were found globally distinct due to their genetic discontinuity, spatial differences (i.e., marked separation of the seven populations at nesting beaches), and separation due to physical factors, including land masses, oceanographic features and currents, all populations were found to be at risk of extinction. This is as a result of reduced nesting female abundance, declining nest trends, and numerous, severe threats (NMFS and USFWS 2020). Therefore, the leatherback sea turtle remains globally endangered under the ESA.

Most leatherback nesting populations in the Pacific Ocean are faring poorly and have declined by more than 80 percent since the 1980s. The International Union for Conservation of Nature has predicted a decline of 96 percent for the western Pacific subpopulation and a decline of nearly 100 percent for the eastern Pacific subpopulation by the year 2040 (Sarti-Martinez et al. 1996; Clark et al. 2010; NMFS 2016c). Causes for the decline in the Pacific include the intensive, illegal egg harvest at leatherback rookeries and high levels of mortality through the 1980s associated with bycatch in gill net fisheries (NMFS 2016c).

I.2.6.2 Occurrence in the Action Area

The leatherback sea turtle is the most widely distributed of all sea turtles, found from tropical to subpolar oceans. Because leatherback nest on tropical and occasionally subtropical beaches, it has the most extensive range of any turtle (Eckert 1995; Myers & Hays 2006; NMFS and USFWS 2013b; NMFS and USFWS 2020). Leatherbacks are also the most migratory sea turtles, with populations traversing the Pacific, Atlantic, and Indian oceans between nesting and foraging grounds, and migratory routes extending into subpolar regions (Spotila 2004; Bailey et al. 2012; Gaspar & Lalire 2017).

Pacific leatherbacks are split into western and eastern Pacific subpopulations based on their distribution and biological and genetic characteristics (Bailey et al. 2012). Eastern Pacific leatherbacks nest along the Pacific coast of the Americas, primarily in Mexico and Costa Rica, and forage throughout coastal and pelagic habitats of the eastern tropical Pacific. Western Pacific leatherbacks nest in the Indo-Pacific, primarily in Indonesia, Papua New Guinea, and the Solomon Islands, disperse after hatching into the central North Pacific along the North Pacific Transition Zone, and forage in the eastern North Pacific as juveniles and adults (Bailey et al. 2012; Gaspar & Lalire 2017; NMFS and USFWS 2020).

Leatherback sea turtles are regularly seen off the west coast of the United States, with the greatest densities found in waters along Central California during summer and fall when sea surface temperatures are highest (Bailey et al. 2012). The Action Area does not include any known or suitable leatherback sea turtle nesting habitat (NMFS and USFWS 2020).

I.2.6.3 Critical Habitat

In 2012, NMFS designated critical habitat for the leatherback sea turtle in California waters from Point Arena to Point Arguello out to the 3,000-m isobath (77 FR 4169; Figure 3.2-1). The Primary Constituent Elements (PCEs) defining leatherback critical habitat are the occurrence of prey species, primarily scyphomedusae, commonly known as jellies, of the order Semaeostomeae (Chrysaora, Aurelia, Phacellophora, and Cyanea), of sufficient condition, distribution, diversity, abundance, and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks…" (50 C.F.R. 226.207).

I.3 Marine Mammals

I.3.1 Blue Whale (*Balaenoptera musculus*)

I.3.1.1 Status

The world's population of blue whales can be separated into three subspecies, based on geographic location and some morphological differences. Within the ROI the subspecies *Balaenoptera musculus* is present. The blue whale is listed as endangered under the ESA and as depleted under the Marine Mammal Protection Act (MMPA) throughout its range. A revised Recovery Plan was completed in 2020 (NMFS 2020).

I.3.1.2 Occurrence in the Action Area

The blue whale inhabits all oceans and typically occurs near the coast, over the continental shelf, though they are also found in oceanic waters (Stafford et al. 2001; Stafford et al. 2004; Ferguson 2005; Hamilton et al. 2009; Bradford et al. 2013; Klinck et al. 2015; Barlow 2016).

The Eastern North Pacific Stock of blue whales includes animals found in the eastern north Pacific from the northern Gulf of Alaska to the eastern tropical Pacific (Carretta et al. 2019). Relatively high densities of blue whales occur off Central and Southern California during the summer and fall (Barlow et al. 2009; Becker et al. 2010; Becker et al. 2012; Forney et al. 2012; Becker et al. 2016). Data from year-round surveys conducted off Southern California from 2004 to 2013 show that the majority of blue whales were sighted in summer (62 sightings) and fall (9 sightings), with only single sightings in winter and spring (Campbell et al. 2015).

Most baleen whales spend their summers feeding in productive waters near the higher latitudes and winters in the warmer waters at lower latitudes (Širović et al. 2004). Blue whales in the eastern north Pacific are known to migrate between higher latitude feeding grounds of the Gulf of Alaska and the

Aleutian Islands to lower latitudes, including Southern California; Baja California, Mexico; and the Costa Rica Dome (Calambokidis & Barlow 2004; Calambokidis et al. 2009a; Calambokidis et al. 2009b; Mate et al. 2015b; Mate et al. 2016; Palacios et al. 2019). The West Coast is known to be a blue whale feeding area for the Eastern North Pacific stock during summer and fall (Bailey et al. 2012; Calambokidis et al. 2015; Mate et al. 2015b; Calambokidis et al. 2019; Palacios et al. 2019). Of the nine feeding areas for blue whales identified by Calambokidis et al. (2015) along the U.S. West Coast as "Biologically Important Areas" (BIAs), the "Point Conception/Arguello" feeding area overlaps the Action Area in the summer to fall (June through October) feeding season.

The blue whale feeding areas identified in waters extending from Point Conception to the Mexico border represent only a fraction of the total area within those waters where habitat models predict high densities of blue whales (Calambokidis et al. 2015; Ferguson et al. 2015). Additionally, while those identified areas tend to have the highest blue whale density from July through October when averaged over multiple years, the areas are associated with ephemeral prey distributions that are less predictable over the short term (Ferguson et al. 2015; Abrahms et al. 2019).

Blue whales have shown site fidelity, returning to their mother's feeding grounds on their first migration (Calambokidis & Barlow 2004), and exhibit strong foraging site fidelity, even when conditions are not conducive to successful foraging in less than optimal years (Palacios et al. 2019). However, a sufficient density of prey is necessary to balance the energy requirements of their lunge feeding strategy (Goldbogen et al. 2015; Hazen & Goldbogen 2015; Straley et al. 2017), and there are daily, seasonal, interannual, and decadal variability in the locations and density of krill at a given feeding location (Brinton & Townsend 2003).

I.3.1.3 Critical Habitat

There is no designated critical habitat for this species.

I.3.2 Fin Whale (*Balaenoptera physalus*)

I.3.2.1 Status

The fin whale is listed as depleted under the MMPA and endangered under the ESA throughout its range, but there is no designated critical habitat for this species. A Recovery Plan was completed for the fin whale in 2010 (NMFS 2010a). In the North Pacific, NMFS recognizes three fin whale stocks: (1) a Northeast Pacific stock in Alaska; (2) a California, Oregon, and Washington stock; and (3) a Hawaii stock. NMFS does not recognize fin whales from the Northeast Pacific stock as being present in Southern California.

I.3.2.2 Occurrence in the Action Area

The fin whale is found in all the world's oceans and is the second-largest species of whale (Jefferson et al. 2008). Fin whales prefer temperate and polar waters and are scarcely seen in warm, tropical waters (Reeves et al. 2002). This species has been documented from 60° North to 23° North. Fin whales have frequently been recorded in waters within Southern California and are present year-round (Širović et al. 2004; Barlow & Forney 2007; Mizroch et al. 2009).

Fin whales are not known to have a specific habitat and are highly adaptable, following prey, typically off the continental shelf (Azzellino et al. 2008; Panigada et al. 2008; Scales et al. 2017). Off the U.S. West Coast, fin whales typically congregate in areas of high productivity, allowing for extended periods of localized residency that are not consistent with the general baleen whale migration model (Scales et al. 2017).

Based on predictive habitat-based density models derived from line-transect survey data collected between 1991 and 2009 off the U.S. West Coast, relatively high densities of fin whales are predicted off Southern California during the summer and fall (Barlow et al. 2009; Becker et al. 2010; Becker et al. 2012; Becker et al. 2016). Aggregations of fin whales are present year-round in Southern and Central California (Forney et al. 1995; Forney & Barlow 1998; Douglas et al. 2014; Jefferson et al. 2014; Campbell et al. 2015; Scales et al. 2017), although their distribution shows seasonal shifts. In 2005–2006, during a period of cooler ocean temperatures, fin whales were encountered more frequently than during normal years (Peterson et al. 2006). Sightings from year-round surveys off Southern California from 2004 to 2013 show fin whales farther offshore in summer and fall and closer to shore in winter and spring (Douglas et al. 2014; Campbell et al. 2015).

I.3.2.3 Critical Habitat

No critical habitat has been designated for the fin whale.

I.3.3 Western North Pacific Gray Whale (*Eschrichtius robustus*)

I.3.3.1 Status

There are two north Pacific populations of gray whales: the Western subpopulation and the Eastern subpopulation designated in the Pacific Stock Assessment Report (SAR) (Weller et al. 2013). Both DPSs could be present in the Action Area during their northward and southward migration (Sumich & Show 2011).

The Western North Pacific DPS is considered depleted (Weller et al. 2002; Cooke 2019). This subpopulation is endangered and should be very few in number in the Action Area given the small population and their known wintering areas in waters off Russia and Asia (Mate et al. 2015a). Analysis of the data available for 2005 through 2016 estimates the combined Sakhalin Island and Kamchatka populations are increasing (Cooke 2019). The Eastern North Pacific subpopulation has recovered and was delisted under the ESA in 1994 (Swartz et al. 2006; Carretta et al. 2020).

I.3.3.2 Occurrence in the Action Area

Gray whales of the Western North Pacific DPS primarily occur in shallow waters over the U.S. West Coast, Russian, and Asian continental shelfs and are considered to be one of the most coastal of the great whales (Jefferson et al. 2008; Jones & Swartz 2009). Feeding grounds for the population are the Okhotsk Sea off Sakhalin Island, Russia, and in the southeastern Kamchatka Peninsula (in the southwestern Bering Sea) in nearshore waters generally less than 225 ft. (68 m) deep (Jones & Swartz 2009). The breeding grounds consist of subtropical lagoons in Baja California, Mexico, and suspected wintering areas in southeast Asia (Urban-Ramirez et al. 2003). At least 12 members of the Western North Pacific DPS have been detected in waters off the Pacific Northwest (Weller & Brownell 2012; Mate 2013; Moore & Weller 2018). NMFS reported that 18 Western North Pacific gray whales have been identified in waters far enough south to have passed through Southern California waters (NMFS 2014).

Gray whales migrate along the Pacific coast twice a year between October and July (Calambokidis et al. 2015). Although they generally remain mostly over the shelf during migration, some gray whales may be found in more offshore waters to the west of San Clemente Island and the Channel Islands (Calambokidis et al. 2015; Schorr et al. 2019; Guazzo et al. 2019). In aerial surveys occurring in December and April each year, gray whales were the third-most encountered large cetacean in Southern California (Smultea 2014).

The main gray whale migrations that pass through the Action Area can be loosely categorized into three phases (Rugh et al. 2008; Calambokidis et al. 2015). Calambokidis et al. (2015) note these migration phases are not distinct, the timing for a phase may vary based on environmental variables, and a migration phase typically begins with a rapid increase in migrating whales, followed by moderate numbers over a period of weeks, and then slowly tapering off. A southward migration from summer feeding areas in the Chukchi Sea, Bering Sea, Gulf of Alaska, and the Pacific Northwest begins in the fall (Mate et al. 2013; Calambokidis et al. 2015; Mate et al. 2015a). This Southbound Phase includes all age classes as they migrate primarily to the nearshore waters and lagoons of Baja California, Mexico, as a destination. During this southward migration, the whales generally are within 10 km of the coast (Calambokidis et al. 2015), although there are documented exceptions where migrating gray whales have bypassed the coast by crossing sections of the open ocean (Rice & Wolman 1971; Mate & Urban-Ramirez 2003; Mate 2013; Mate et al. 2015a).

The northward migration for gray whales to the feeding grounds in Arctic waters, Alaska, the Pacific Northwest, and Northern California occurs in two phases (Calambokidis et al. 2015). Northbound Phase A consists mainly of adults and juveniles that lead the beginning of the north bound migration from late January through July, peaking in April through July. Newly pregnant females go first to maximize feeding time, followed by adult females and males, then juveniles (Jones & Swartz 2009). The Northbound Phase B consists primarily of cow-calf pairs that begin their northward migration later (March to July) remaining on the reproductive grounds longer to allow calves to strengthen and rapidly increase in size before the northward migration (Urban-Ramirez et al. 2003; Jones & Swartz 2009).

The gray whale migration corridors (north of Point Conception), the potential presence buffer area, and the months these four sections of the Pacific coastal waters were designated as cumulatively in use (October through July), were identified by Calambokidis et al. (2015) as BIAs for gray whales. A portion of the gray whale potential presence migration area and the migration routes off Southern California pass through the ROI.

I.3.3.3 Critical Habitat

There has been no designated critical habitat for the Western North Pacific gray whale DPS.

I.3.4 Humpback Whale (*Megaptera novaeangliae*), Mexico Distinct Population Segment and Central American Distinct Population Segment

I.3.4.1 Status

Humpback whales that are seasonally present in the Action Area are from two DPSs, given they represent populations that are both discrete from other conspecific populations and significant to the species of humpback whales to which they belong (NMFS 2016c). These DPSs are based on animals identified in breeding areas in Mexico and Central America (Bettridge et al. 2015; Muto et al. 2019). Humpback whales of the Mexico DPS are listed as threatened, and those from the Central America DPS are listed as endangered under the ESA (NMFS 2016c).

Although estimates show variable trends in the number of humpback whales along the U.S. West Coast, the overall trend in the estimates is consistent with growth rate of 6–7 percent for the California, Oregon, Washington stock and appears consistent with the highest-yet abundances of humpback whales in the most recent 2014 survey of that stock. For the DPSs in Mexico and in Central America, photo identification data collected between 2004 and 2006 are the main basis for the estimates for specific to those populations (Bettridge et al. 2015; NMFS 2016c; Wade et al. 2016). The new best overall estimate of abundance of humpback whales along the U.S. West Coast has been provided by photo identification data gathered between 2015 and 2018 along the U.S. West Coast (Calambokidis & Barlow 2020). This estimate, which includes the Mexico DPS and the Central America DPS, is 4,973, which is higher than the abundance (2,900) in the 2019 Pacific SAR (Calambokidis & Barlow 2020).

I.3.4.2 Occurrence in the Action Area

The habitat requirements of wintering humpbacks appear to be controlled by the conditions necessary for calving, such as warm water (75–80 ^{o}F) and relatively shallow, low-relief ocean bottom in protected areas, nearshore, or created by islands or reefs (Smultea 1994; Clapham 2000; Craig & Herman 2000). In breeding grounds, females with calves occur in significantly shallower waters than other groups of whales, and breeding adults use deeper, more offshore waters (Smultea 1994; Ersts & Rosenbaum 2003). Breeding and calving areas for the Mexico DPS and for the Central America DPS are both located within the ROI.

Off the U.S. West Coast, humpback whales are more abundant in shelf and slope waters (<2,000 m deep) and are often associated with areas of high productivity (Becker et al. 2010; Becker et al. 2012; Forney et al. 2012; Redfern et al. 2013; Campbell et al. 2015; Becker et al. 2016; Calambokidis et al. 2019). While most humpback whale sightings are in nearshore and continental shelf waters, humpback whales frequently travel through deep oceanic waters during migration (Dohl et al. 1983; Forney & Barlow 1998; Campbell et al. 2015). Humpback whales migrating from breeding grounds in Central America to feeding grounds at higher latitudes may cross the Action Area.

Peak occurrence during migration occurs in the Action Area from December through June (Calambokidis et al. 2015). In quarterly surveys undertaken in the 10-year period between 2004 and 2013 off Southern California, humpback whales were generally encountered in coastal and shelf waters, with the largest concentration occurring in relatively shallow waters, north of Point Conception (Campbell et al. 2015). During winter and spring, a substantially greater proportion of the humpback whale population is found farther offshore than during the summer, with (in all seasons) the majority of the population found north of the Channel Islands (Forney & Barlow 1998; Campbell et al. 2015; Becker et al. 2017; Calambokidis et al. 2017).

BIAs for humpback whales overlap the ROI. Passive acoustic monitoring at Monterey Bay California from 2015 to 2018 demonstrated that the timing of humpback whales feeding and migration in that area is variable, with detections generally occurring from September through May (Ryan et al. 2019). Location data from satellite tags also has demonstrated that, in some cases, the feeding BIAs do not represent the core area of humpback whale presence, at least for the time and sample of the population represented by humpback whales that were tagged and otherwise present in or around the area (Mate et al. 2018). In 2014, 2015, and 2016, humpback whales were more commonly sighted in coastal waters of Santa Monica Bay, and from Long Beach south to waters off Dana Point (Calambokidis et al. 2017). The variable use of the Santa Barbara Channel–San Miguel feeding BIA was also evident, corresponding to the 2014–2016 increase in ocean temperatures off California that resulted in the changes to the nominal distribution and availability of krill and anchovy (Zaba et al. 2018; Fiechter et al. 2020; Santora et al. 2020) and the distribution of humpback whales in 2014, resulting in a much higher density off Central California than a nominal year (Becker et al. 2018). Similar high ocean temperatures in 2016 also corresponded to a documented scarcity of healthy humpback whales in the Santa Barbara Channel–San Miguel feeding BIA and vicinity. However, more humpback whales were found further north off Central California and in better condition, which investigators suggested was indicative of good feeding areas that were likely to be sustained in that region in that anomalous year (Oregon State University 2017).

I.3.4.3 Critical Habitat

A final rule to designate critical habitat for humpback whales for the endangered Central America DPS and the threatened Mexico DPS was published on 21 April 2021 (75 FR 21082) pursuant to Section 4 of the ESA. This action followed a 9 October 2019 proposed rule to designate critical habitat for the humpback whales within the U.S. Exclusive Economic Zone (EEZ) in the Pacific for the endangered Central America DPS and the threatened Mexico DPS pursuant to section 4 of the ESA (84 FR 54378). In the proposal, NMFS considered 19 Regions/Units of habitat as critical habitat for the listed humpback whale DPSs. These 19 areas include almost all coastal waters off California, Oregon, Washington, and Alaska in the Pacific. Humpback whale critical habitat is depicted in Figure 3.3-4; as shown, there is overlap between the Action Area and the critical habitat.

Region/Unit 17 has been referred to by NMFS in the proposed rule as the "Central California Coast Area," which covers an area of 6,697 square nm extending from 34° 30' to 36° 00' north latitude. Within those south and north boundaries, Region/Unit 17 begins at the 98 ft. (30 m) depth contour out to the 12,139 ft. (3,700 m) depth contour. This region's area includes waters off of southern Monterey, San Luis Obispo, and Santa Barbara counties. This region/unit of habitat is characterized by NMFS as having a very high conservation value (84 FR 54378).

The essential feature for the Central America DPS as defined by NMFS (2019b) is "Prey species, primarily euphausiids (Thysanoessa, Euphausia, Nyctiphanes, and Nematoscelis) and small pelagic schooling fishes, such as Pacific sardine (*Sardinops sagax*), northern anchovy (*Engraulis mordax*), and Pacific herring (*Clupea pallasii*), of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth. The Mexico DPS is very similar, but adds capelin (*Mallotus villosus*), juvenile walleye pollock (*Gadus chalcogrammus*), and Pacific sand lance (*Ammodytes personatus*) to the essential prey species lists. NMFS has noted that prey as an essential feature may require special management considerations or protections as a result of ecosystem shifts driven by climate change, commercial fisheries, and pollution (NMFS 2019b).

Humpback whales are generalists, taking a variety of prey while foraging and switching between target prey depending on what is most abundant in the system (Witteveen et al. 2014; Szabo 2015; Fleming et al. 2016). Consistent with the designated critical habitat, the humpback whales' diet is dominated by euphausiids and small pelagic fishes, such as northern anchovy, Pacific herring, Pacific sardine, and capelin (Santora et al. 2010; Szabo 2015; Fleming et al. 2016; Keen et al. 2017; Gabriele et al. 2017; Straley et al. 2017; Witteveen & Wynne 2017). Like other large mysticetes, they are a "lunge feeder," taking advantage of dense prey patches and engulfing as much food as possible in a single gulp. All feeding behavior seem to involve patches of prey with sufficient density to support feeding bouts (Mate et al. 2019; Frisch-Jordan et al. 2019). The size of individual krill seems to be an aspect of prey quality for the species (Santora et al. 2010; Szabo 2015; Burrows et al. 2016). For example, Santora et al. (2010) found that different species of baleen whales aggregated to krill hotspots that were differentiated by the size of individual krill, with humpback whales having preference for small (<35 mm) juvenile krill.

In the California Current Ecosystem, changing oceanographic factors (e.g., upwellings, temperatures, winds, salinity) result in seasonal, interannual, and decadal variability in the locations and density of krill and forage fish (Brinton & Townsend 2003; Keister et al. 2011; Santora et al. 2011; Deutsch et al. 2015;

Santora et al. 2017a; Zaba et al. 2018; Cimino et al. 2020; Rockwood et al. 2020; Fiechter et al. 2020; Santora et al. 2020). As a result, the location, timing, and intensity of prey aggregations can vary greatly both seasonally and from year to year. Given that concentrations of prey tend to be spatially and temporally ephemeral at scales on the order of tens of meters to kilometers and hours to days (Zaba et al. 2018; Hazen et al. 2018; Rockwood et al. 2020; Fiechter et al. 2020; Santora et al. 2020), the presence of feeding humpback whales and prey as an essential feature of the critical habitat are also highly variable over these small spatial and temporal scales.

The critical habitat overlaps with the humpback whale feeding BIAs designated in 2015 (Calambokidis et al. 2015), but in the Action Area it extends farther offshore to incorporate the maximum extent of the predicted humpback abundance in cooler months (Becker et al. 2016; Becker et al. 2017) and farther inshore to incorporate distributions derived from satellite telemetry data for 13 humpback whales (Mate et al. 2018). Although the location, timing, and intensity of humpback whale prey vary greatly (Santora et al. 2011; Santora et al. 2017a; Zaba et al. 2018; Santora et al. 2020; Fiechter et al. 2020), static spatial management strategies such as the designation of critical habitat can effectively mitigate risks associated with fixed large and long-term actions such as established commercial vessel traffic lanes (associated with ship strikes) or within fishery regulations (associated with entanglement) (Rockwood et al. 2017; Moore & Weller 2018; Redfern et al. 2019; Redfern et al. 2020; Rockwood et al. 2020; Santora et al. 2020).

I.3.5 Killer Whale (*Orcinus orca*)

I.3.5.1 Status

NMFS listed the Southern Resident killer whale DPS as endangered in 2005 (70 FR 69903) and adopted a recovery plan in 2008 (73 FR 4176; NMFS 2008). There are 73 Southern Resident killer whales in the DPS (Couture et al. 2022). The Southern Resident DPS is divided into three pods identified as J, K, and L (Carretta et al. 2021).

Concerns over impacts on the population from several sources have been raised in recent years, including disturbance from whale watching vessels (Ferrara et al. 2017; Holt et al. 2017; Lacy et al. 2017; NMFS 2021), commercial shipping noise (Cominellli et al. 2018; McWhinnie et al. 2021), and prey availability (Hanson et al. 2021).

I.3.5.2 Occurrence in the Action Area

Southern Resident killer whales occur mainly along the outer coast and inland waters of Washington and British Columbia, Canada. In recent years the population has shifted and expanded its range to areas up to hundreds of miles from Washington waters both north (as far as Southeast Alaska) and south as far as central California (Cogan 2015; Dahlheim et al. 2008). Specifically, K-pod and L-pod have ranged widely along the coast and been sighted as far south as Monterey Bay in recent years; L-pod is known to have traveled as far north as Chatham Strait, Southeast Alaska. J-pod has largely remained in inland waters (Carretta et al. 2021).

Satellite-tag locations found that Southern Resident killer whales generally inhabit nearshore waters (Hanson et al. 2018; Hanson et al. 2017). Ninety-five percent of reported locations were within 18 nm (34 km) of shore, and 50 percent were within 5 nm (10 km) of shore. On the outer coast, 75 percent of tag locations were in a narrow corridor between 1.6 and 10 nm (3 and 19 km) offshore (Hanson et al. 2017). The proposed landing and fairing recovery area is in deep waters between approximately 46–400 nm off Rockport, California in the north to 158–910 nm off Baja California, Mexico in the south and no recovery activities would occur within 12 nm of islands. Therefore, relatively few killer whales are expected to occur in areas where these activities would be conducted.

I.3.5.3 Critical Habitat

NMFS amended and expanded the critical habitat designation for Southern Resident killer whales to include nearshore waters along the coasts of Washington, Oregon, and California in 2021. The elements of critical habitat essential for conservation of the Southern Resident killer whale are (1) water quality to support growth and development; (2) prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth; and (3) passage conditions to allow for migration, resting, and foraging. The amended critical habitat designation extends along the entire Oregon coastline but is outside the ROI.

I.3.6 Sei Whale (*Balaenoptera borealis*)

I.3.6.1 Status

The sei whale is listed as endangered under the ESA and as depleted under the MMPA throughout its range. A recovery plan for the sei whale was completed in 2011 and provided a research strategy for obtaining data required to estimate population abundance and trends, and to identify factors that may be limiting the recovery of this species (NMFS 2011). Sei whales along the U.S. West Coast are assigned to the Eastern North Pacific stock within the U.S. EEZ (Carretta et al. 2020). NMFS has determined that an assessment of the sei whale population trend will likely require additional survey data and reanalysis of all datasets using comparable methods (Carretta et al. 2018b). There are no data on Eastern North Pacific sei whale trends in abundance (Carretta et al. 2020).

I.3.6.2 Occurrence in the Action Area

Sei whales have a worldwide distribution and are found primarily in cold temperate to subpolar latitudes. During the winter, sei whales are found in warm tropical waters. Sei whales are also encountered during the summer off California and the North America coast from approximately the latitude of the Mexican border to as far north as Vancouver Island, Canada (Masaki 1976; Horwood 2009; Smultea et al. 2010).

A total of 10 sei whale sightings were made during systematic ship surveys conducted off the U.S. West Coast in summer and fall between 1991 and 2008 (Barlow 2010), with an additional 14 groups sighted during a 2014 survey (Barlow 2016). Sei whales are expected to be present in offshore waters in the ROI.

I.3.6.3 Critical Habitat

There is no designated critical habitat for this species.

I.3.7 Sperm Whale (*Physeter macrocephalus*)

I.3.7.1 Status

The sperm whale has been listed as endangered since 1970 under the precursor to the ESA (NMFS 2009) and is depleted under the MMPA throughout its range. In the North Pacific sperm whales are divided into three stocks in the Pacific; one (California/Oregon/Washington) occurs within the Action Area (Carretta et al. 2020). Based on genetic analyses, Mesnick et al. (2011) found that sperm whales in the California Current are demographically independent from animals in the rest of the tropical Pacific. A Recovery Plan was completed for the sperm whale in 2010 (NMFS 2010b).

Line-transect surveys conducted off the U.S. West Coast from 1991 to 2014 include a high level of uncertainty but indicate that sperm whale abundance has appeared stable, with some evidence for an increasing number of sperm whales (Moore & Barlow 2014; Moore & Barlow 2017; Carretta et al. 2020).

I.3.7.2 Occurrence in the Action Area

This species is primarily found in the temperate and tropical waters of the Pacific (Rice 1989; Merkens et al. 2019). Its secondary range includes areas of higher latitudes up to and including the Gulf of Alaska (Whitehead & Weilgart 2000; Jefferson et al. 2008; Whitehead et al. 2008; Whitehead et al. 2009). This species appears to prefer deep waters and the continental shelf break and slope (Rice 1989; Whitehead 2003; Jefferson et al. 2008; Whitehead et al. 2008; Baird 2013). Typically, sperm whale concentrations also correlate with areas of high productivity, generally near drop offs and areas with strong currents and steep topography (Gannier & Praca 2007; Jefferson et al. 2008).

Sperm whales are found year-round in California waters, but their abundance is temporally variable, most likely due to the availability of prey species (Forney & Barlow 1993; Barlow 1995; Barlow & Forney 2007; Smultea 2014). Based on habitat models derived from line-transect survey data collected between 1991 and 2008 off the U.S. West Coast, sperm whales show an apparent preference for deep waters (Barlow et al. 2009; Becker et al. 2010; Becker et al. 2012; Forney et al. 2012). During quarterly ship surveys conducted off Southern California between 2004 and 2008, there were a total of 20 sperm whale sightings, the majority (12) occurring in summer in waters greater than 2,000 m deep (Douglas et al. 2014).

Sperm whales are somewhat migratory. General shifts in distribution occur during summer months for feeding and breeding, while in some tropical areas sperm whales appear to be largely resident (Rice 1989; Whitehead 2003; Whitehead et al. 2008; Whitehead et al. 2009). Pods of females with calves remain on breeding grounds throughout the year, between 40° North and 45° North (Rice 1989; Whitehead 2003), while males migrate between low-latitude breeding areas and higher-latitude feeding grounds (Pierce et al. 2007). In the northern hemisphere, “bachelor” groups (males typically 15 to 21 years old and bulls [males] not taking part in reproduction) generally leave warm waters at the beginning of summer and migrate to feeding grounds that may extend as far north as the perimeter of the arctic zone. In fall and winter, most return south, although some may remain in the colder northern waters during most of the year (Pierce et al. 2007).

I.3.7.3 Critical Habitat

There is no designated critical habitat for this species.

I.3.8 Southern Sea Otter (Federally Threatened Species)

I.3.8.1 Status

The USFWS listed the Southern sea otter (*Enhydra lutris nereis*) as federally threatened on 14 January 1977 (42 FR 2965) and published a Recovery Plan in 2003 (USFWS 2003). The USWFS completed a 5-year review of the species in 2015 (USFWS 2015).

I.3.8.2 Life History

The Southern sea otter is the smallest species of marine mammal in North America. It inhabits the nearshore marine environments of California from San Mateo County to Santa Barbara County with a small geographically isolated population around San Nicolas Island. On occasion, Southern sea otters have been observed beyond these limits and have been documented as far south as Baja, Mexico (USFWS 2015).

This species breeds and gives birth year-round and pups are dependent for 120–280 days (average 166 days; Riedman & Estes 1990). Sea otters are opportunistic foragers known to eat mostly abalones, sea urchins, crabs, and clams. They play a key ecological role in kelp bed communities by controlling sea urchin grazing.

I.3.8.3 Occurrence in the Action Area

Southern sea otters occur regularly off the coast of VSFB, with animals occasionally in the kelp beds offshore of Purisima Point on north VSFB, and frequently offshore of Sudden Flats on south VSFB. Transitory otters occasionally traverse the coast between SLC-4 and Point Arguello. This area is, however, not regularly occupied and no otters have been detected at this location during the last three annual spring census counts from 2011 to 2016 (U.S. Geological Survey Western Ecological Resource Center 2017, 2018, 2019, 2020).

I.3.8.4 Critical Habitat

There is no designated critical habitat for this species.

I.3.9 California Sea Lion

I.3.9.1 Status

The California sea lion (*Zalophus californianus*) is not listed under the ESA, and the population has been designated as the U.S. stock by NMFS.

I.3.9.2 Life History

Typically, during the summer, California sea lions congregate near rookery islands and specific open-water areas. The primary rookeries off the coast of the United States are on San Nicolas, San Miguel, Santa Barbara, and San Clemente Islands (Le Boeuf & Bonnell 1980; Lowry et al. 1992; Carretta et al. 2000; Lowry & Forney 2005; Lowry et al. 2017). Haulout sites are also found on Richardson Rock, Santa Catalina Island, Santa Cruz Island, and Santa Rosa Island in the Southern California Bight (Le Boeuf 2002; Lowry et al. 2017).

In the nonbreeding season, beginning in late summer, adult and subadult males migrate northward along the coast of California to Washington and return south the following spring (Lowry & Forney 2005; Laake 2017). Females and juveniles also disperse somewhat but tend to stay in the Southern California area, although north and west of the Channel Islands (Melin & DeLong 2000; Lowry & Forney 2005; Thomas et al. 2010). Tagging results showed that lactating females foraging along the coast would travel as far north as Monterey Bay and offshore to the 1,000-meter isobath (Melin & DeLong 2000; Melin et al. 2008; Henkel & Harvey 2008; Kuhn & Costa 2014; McHuron et al. 2017). There is a general distribution shift northwest in fall and southeast during winter and spring, probably in response to changes in prey availability (DeLong et al. 2017a; DeLong et al. 2017b; Lowry et al. 2017). California sea lions are usually found in waters over the continental shelf and slope; they are also known to occupy locations far offshore in deep, oceanic waters, such as Guadalupe Island and Alijos Rocks off the Baja Peninsula, Mexico (Zavala-Gonzalez & Mellink 2000; Jefferson et al. 2008; Melin et al. 2008; Urrutia & Dziendzielewski 2012). California sea lions are the most frequently sighted pinnipeds offshore of Southern California during the spring, and peak abundance is during the May through August breeding season (Green et al. 1992; Keiper et al. 2005; Lowry et al. 2017). Overall, the California sea lion population is abundant and has been generally increasing (Jefferson et al. 2008; Carretta et al. 2010; Lowry et al. 2017; Carretta et al. 2020). Using count and resighting data gathered between 1975 and 2015, NMFS researchers showed that California sea lion population growth was above the maximum net productivity level and within the range of the optimal sustainable population (Laake et al. 2018).

I.3.9.3 Occurrence in the Action Area

California sea lions are common offshore of VSFB and haul out sporadically on rocks and beaches along the coastline of VSFB. This species hauls out at sites in the southern portion of VSFB, which are located approximately 3.6 mi (5.8 km) south of SLC-4, as well as the NCI (VSFB 2021). However, California sea lions rarely pup on the VSFB coastline (VSFB 2021) and one pup was observed in 2015 (VSFB, unpubl. data). California sea lions are the most abundant pinniped species in the Channel Islands (Lowry et al., 2017a). SMI is the northern extent of the species' breeding range; and, along with San Nicolas Island, it contains one of the largest breeding colonies of the species in the Channel Islands (Melin et al., 2010; Lowry et al., 2017a). Pupping occurs in large numbers on SMI at the rookeries found at Point Bennett on the west end of the island and at Cardwell Point on the east end of the island. During aerial surveys of the NCI conducted by NMFS in February 2010, 21,192 total California sea lions (14,802 pups) were observed at haulouts on San Miguel Island and 8,237 total (5,712 pups) at Santa Rosa Island (M. Lowry, NMFS, unpubl. data). During aerial surveys in July 2012, 65,660 total California sea lions (28,289 pups) were recorded at haulouts on SMI, 1,584 total (3 pups) at SRI, and 1,571 total (zero pups) at Santa Cruz Island (M. Lowry, NMFS, unpubl. data).

I.3.10 Northern Fur Seal

I.3.10.1 Status

The California stock of Northern fur seal (*Callorhinus ursinus*) that is present in the ROI is not considered depleted under the Marine Mammal Protection Act and is not listed under the ESA (Carretta et al. 2020). Animals from the California stock may remain on or near San Miguel Island throughout the year but after the breeding season in November generally move to the North Pacific in waters off Canada, Washington, Oregon, and Northern California to forage (Koski et al. 1998; Melin et al. 2012; Sterling et al. 2014; Adams et al. 2014; Lowry et al. 2017; Zeppelin et al. 2019).

I.3.10.2 Life History

Migrating seals and those along the U.S. West Coast are typically found over the edge of the continental shelf and slope (Kenyon & Wilke 1953; Sterling & Ream 2004; Gentry 2009; Adams et al. 2014). Their offshore distribution has been correlated with oceanographic features (e.g., eddies and fronts) where prey may be concentrated (Ream et al. 2005; Sterling et al. 2014). The abundance of northern fur seals at San Miguel Island, the primary rookery for the California stock, has increased steadily over the past four decades, except for two severe declines associated with El Niño-southern Oscillation events in 1993 and 1998 (DeLong & Stewart 1991; Melin et al. 2006; Melin et al. 2008; Orr et al. 2012; Carretta et al. 2020).

I.3.10.3 Occurrence in the Action Area

The California stock of Northern fur seal that is present in the project area is not considered depleted under the MMPA (Carretta et al. 2020). Animals from the California stock may remain in or near SMI throughout the year but, after the breeding season in November, generally move to the North Pacific in waters off Canada, Washington, Oregon, and Northern California to forage (Melin et al. 2012; Sterling et al. 2014; Adams et al. 2014; Lowry et al. 2017b; Zeppelin et al. 2019). Migrating seals and those along the U.S. West Coast are typically found over the edge of the continental shelf and slope (Kenyon & Wilke 1953; Sterling & Ream 2004; Gentry 2009; Adams et al. 2014). Their offshore distribution has been correlated with oceanographic features (e.g., eddies and fronts) where prey may be concentrated (Ream et al. 2005; Sterling et al. 2014). The abundance of northern fur seals at SMI, the primary rookery for the California stock, has increased steadily over the past four decades, except for two severe declines associated with El Niño-southern Oscillation events in 1993 and 1998 (DeLong & Stewart 1991; Melin et al. 2006; Melin et al. 2008; Orr et al. 2012; Carretta et al. 2017b; Carretta et al. 2020). Live northern fur seals have not been observed at any VSFB haulout location (VSFB 2021).

I.3.11 Guadalupe Fur Seal (Federally Listed Threatened Species)

I.3.11.1 Status

The Guadalupe fur seal is listed as threatened under the ESA and depleted under the Marine Mammal Protection Act throughout its range (Carretta et al. 2020). The population has been designated the Mexico to California stock (Carretta et al. 2020).

I.3.11.2 Life History

Guadalupe fur seals are most common at their primary breeding ground of Guadalupe Island, Mexico (Melin & DeLong 1999). A second rookery was found in 1997 at the San Benito Islands off the Baja Peninsula, Mexico (Maravilla-Chavez & Lowry 1999; Aurioles-Gamboa et al. 2010; Esperon-Rodriguez & Gallo-Reynoso 2012), and they have also been found in La Paz Bay in the southern Gulf of California (Elorriaga-Verplancken et al. 2016). Satellite tracking data from Guadalupe fur seals tagged at Guadalupe Island have demonstrated movements into the offshore waters between 31 and 186 miles (mi.). (50 and 300 kilometers [km]) from the U.S. West Coast (Norris et al. 2015; Norris 2017b, 2017a; Norris & Elorriaga-Verplancken 2020). Satellite tags have also documented the movement of females without pups at least as far as 800 mi. (1,300 km) north of Guadalupe Island (approximately Point Cabrillo in Mendocino County, California) (Norris 2019). Adult males have not been tagged but typically undertake some form of seasonal movement either after the breeding season or during the winter, when prey availability is reduced (Arnould 2009). The most recent stock assessment reports reflect the population of Guadalupe fur seals from a survey in 2010, which indicated a total estimated population size of approximately 20,000 animals and an average annual growth rate of 10.3 percent (Carretta et al. 2019). The ongoing Unusual Mortality Event involving Guadalupe fur seals (National Oceanic and Atmospheric Administration 2018; National Marine Fisheries Service 2019a) is likely to have impacted the recent population trend (Elorriaga-Verplancken et al. 2016; Ortega-Ortiz et al. 2019). However, based on counts off Mexico in 2018 at Guadalupe Island and the San Benito Archipelago, the minimum population estimate was 29,747 Guadalupe fur seals at those locations (Norris 2019). Valdivia et al. (2019) has noted that since being ESA-listed in 1985, the population of the Guadalupe fur seal increased about nine-fold at a rate of approximately 15 percent per year. The dispersion of Guadalupe fur seal from rookeries off Mexico may be an indicator of potential species recovery (Ortega-Ortiz et al. 2019).

I.3.11.3 Occurrence in the Action Area

Guadalupe fur seals are most common at their primary breeding ground of Guadalupe Island, Mexico (Melin & DeLong 1999). A second rookery was found in 1997 at the San Benito Islands off the Baja Peninsula, Mexico (Maravilla-Chavez & Lowry 1999; Aurioles-Gamboa et al. 2010; Esperon-Rodriguez & Gallo-Reynoso 2012), and they have also been found in La Paz Bay in the southern Gulf of California (Elorriaga-Verplancken et al. 2016a). Satellite tracking data from Guadalupe fur seals tagged at Guadalupe Island have demonstrated movements into the offshore waters between 50 and 300 km from the U.S. West Coast (Norris et al. 2015; Norris 2017b, 2017a; Norris & Elorriaga-Verplancken 2020). Based on that data, the seals can be expected to occur in both deeper waters of the open ocean and coastal waters within the project area. Adult and juvenile males have occasionally been observed at SMI since the mid-

1960s; in the late 1990s, a pup was born on that island. Rare sightings of individuals have also occurred at Santa Barbara, San Nicolas, and San Clemente Islands (Stewart 1981; Stewart & Yochem 1984; Stewart et al. 1993; Stewart & Yochem n.d.). In NMFS aerial surveys between 2011 and 2015, Guadalupe fur seals were not observed on any of the Channel Islands other than at SMI (Lowry et al. 2017; Burke 2017). Guadalupe fur seals have not been observed at any VSFB haulout locations (VSFB 2021).

Satellite tags have documented the movement of females without pups at least as far as 808 mi (1,300 km) north of Guadalupe Island (to approximately Point Cabrillo in Mendocino County, California; Norris 2019). Adult males have not been tagged but typically undertake some form of seasonal movement either after the breeding season or during the winter, when prey availability is reduced (Arnould 2009). Based on counts off Mexico in 2018 at Guadalupe Island and the San Benito Archipelago, the minimum population estimate was 29,747 Guadalupe fur seals at those locations (Norris 2019). Valdivia et al. (2019) has noted that, since being ESA-listed in 1985, the population of the Guadalupe fur seal increased about nine-fold at a rate of approximately 15 percent per year. The dispersion of Guadalupe fur seal from rookeries off Mexico may be an indicator of potential species recovery (Ortega-Ortiz et al. 2019).

I.3.12 Steller Sea Lion

I.3.12.1 Status

The Eastern U.S. stock (or DPS) of Steller sea lion (*Eumetopias jubatus*) is defined as the population occurring east of 144°W longitude, and it is not listed as threatened or endangered under the ESA (NMFS 2016; Muto et al. 2020; delisted 2013, see additional info below). The locations and distribution of the Eastern population's breeding sites along the U.S. Pacific coast have shifted northward, with fewer breeding sites in Southern California and more sites established in Washington and Southeast Alaska (Pitcher et al. 2007; Wiles 2015). Based on a 2017 survey, the Eastern U.S. stock has increased at a rate of approximately 4.25 percent per year over the last 40 years (Muto et al. 2020), but it remains uncertain how many and what trend there will be for Steller sea lions that are occasionally present in small numbers off Central and Southern California.

I.3.12.2 Life History

Steller sea lions range along the north Pacific from northern Japan to California (Perrin et al. 2009), with centers of abundance and distribution in the Gulf of Alaska and Aleutian Islands (Muto et al. 2020). There have also been reports of Steller sea lions in waters off Mexico as far south as the various islands off the port of Manzanillo in Colima, Mexico (Gallo-Reynoso et al. 2020). San Miguel Island and Santa Rosa Island were, in the past, the southernmost rookeries and haulouts for the Steller sea lions, but their range contracted northward in the 20th century, and now Año Nuevo Island off Central California is currently the southernmost rookery. Steller sea lions pups were known to be born at San Miguel Island up until 1981 (Pitcher et al. 2007; NMFS 2008; Muto et al. 2020), and so, as the population continues to increase, it is anticipated that the Steller sea lions may re-establish a breeding colony on San Miguel Island in the future. In the Channel Islands and vicinity and despite the species' general absence from the area, a consistent but small number of Steller sea lions (one to two individuals at a time) have been sighted in recent years. Approximately one to two adult and subadult male Steller sea lions have been seen hauled out at San Miguel Island each year during the fall and winter over the last decade, and adult and subadult males have occasionally been seen on rocks north of Northwest Point at San Miguel Island during the part of the summer in the past few years (Delong 2019). Aerial surveys for pinnipeds in the Channel Islands from 2011 to 2015 encountered a single Steller sea lion at San Nicolas Island in 2013 (Lowry et al. 2017).

A lone adult female who gave birth to and reared a pup on San Miguel Island in the summer of 2017 (Delong 2019).

I.3.12.3 Occurrence in the Action Area

North Rocky Point was used in April and May 2012 by Steller sea lions (Marine Mammal Consulting Group and Science Applications International Corporation [MMCG and SAIC] 2012). This observation was the first time this species had been reported at VSFB during launch monitoring and monthly surveys conducted over the past two decades. Since 2012, Steller sea lions have been observed infrequently in routine monthly surveys, with as many as 16 individuals recorded. In 2014, up to 5 Steller sea lions were observed in the affected area during monthly marine mammal counts (MSRS 2015) and a maximum of 12 individuals were observed during monthly counts in 2015 (VSFB, unpublished data). However, up to 16 individuals were observed in 2012 (MMCG and SAIC 2012). Steller sea lions once had two small rookeries on SMI, but these were abandoned after the 1982–1983 El Niño event (DeLong and Melin 2000; Lowry 2002); however, occasional juvenile and adult males have been detected since then. These rookeries were once the southernmost colonies of the eastern stock of this species. The Eastern Distinct Population Segment of this species, which includes the California coastline as part of its range, was de-listed from the federal Endangered Species Act in November 2013.

I.3.13 Pacific Harbor Seal

I.3.13.1 Status

The harbor seal (*Phoca vitulina*) is not listed under the ESA and those present in the ROI have been assigned to the California stock of harbor seals (Carretta et al. 2020).

I.3.13.2 Life History

Harbor seals are generally not present in the deep waters of the open ocean, are rarely found more than 20 km from shore, and frequently occupy bays, estuaries, and inlets (Baird 2001; Harvey & Goley 2011; Jefferson et al. 2014). Data from 180 radio tagged harbor seals in California indicated most remained within 10 km of the location where they were captured and tagged (Harvey & Goley 2011).

Harbor seals generally haul out in greatest numbers at low tides and during the afternoon, when it is usually warmest. The period from late May to early June corresponds with the peak molt season when the maximum number of harbor seals are onshore (Lowry et al. 2017). The most recent (2012) statewide survey of California harbor seal rookeries has indicated that in the Channel Islands the count has been stable or trending as a slight increase since 1995 (Carretta et al. 2020).

I.3.12.3 Occurrence in the Action Area

Pacific harbor seals congregate on multiple rocky haulout sites along the VSFB coastline. Most haulout sites are located between the Boat House and South Rocky Point, where most of the pupping on VSFB occurs (VSFB 2021). Pups are generally present in the region from March through July. Within the affected area on VSFB, up to 332 adults and 34 pups have been recorded in monthly counts from 2013 to 2015 (MSRS 2014, 2015). During aerial pinniped surveys of haulouts located in the Point Conception area by NMFS in May 2002 and May and June of 2004, between 488 to 516 harbor seals were recorded (M. Lowry, NMFS, unpubl. data). Data on pup numbers were not provided. Harbor seals also haul out, breed, and pup in isolated beaches and coves throughout the coast of SMI. During aerial surveys conducted by NMFS in May 2002 and May and June of 2004, between 521 and 1,004 harbors seals were recorded at SMI, between 605 and 972 at SRI, and between 599 and 1,102 Santa Cruz Island (M. Lowry, NMFS, unpubl.

data). Again, data on pup numbers were not provided. Lowry et al. (2017b) counted 1,367 Pacific harbor seals at the Channel Islands in July 2015.

I.3.14 Northern Elephant Seal

I.3.14.1 Status

The northern elephant seal (*Mirounga angustirostris*) is not listed under the ESA. There are two distinct populations of northern elephant seals: one that breeds in the Baja Peninsula, Mexico; and a population that breeds in California (Garcia-Aguilar et al. 2018). NMFS considers northern elephant seals in the ROI to be from the California Breeding stock, although elephant seals from the Baja Peninsula, Mexico, frequently migrate through the ROI (Aurioles-Gamboa & Camacho-Rios 2007; Carretta et al. 2020).

I.3.14.2 Life History

Northern elephant seals spend little time nearshore and migrate four times a year as they travel to and from breeding/pupping and molting areas, spending more than 80 percent of their annual cycle at sea (Robinson et al. 2012; Lowry et al. 2014; Lowry et al. 2017; Carretta et al. 2020). Peak abundance in California is during the January–February breeding season and during molting season from April to July (Lowry et al. 2014; Lowry et al. 2017). As presented in the 2019 Stock Assessment Report (Carretta et al. 2020), the population in California continues to increase Lowry et al. (2014).

I.3.14.3 Occurrence in the Action Area

Northern elephant seals haul out on rocks and beaches along the coastline of VSFB and observations of young of the year seals from May through November have represented individuals dispersing later in the year from other parts of the California coastline where breeding and birthing occur (VSFB 2021). Pupping of this species was observed on south VSFB in January 2017, for the first time in more than 40 years. Presence of all age classes have been closely recorded at VSFB, especially since 2018, with as many as 35 pups being born here. Researchers affiliated with the California Polytechnic State University, San Luis Obispo (Cal Poly) have flipper tagged nearly 200 pups since 2018 and satellite tagged 10 pups at VSFB and 5 pups at San Nicolas Island under authorization of NMFS permit 22187-04. Eleven northern elephant seals were observed during aerial surveys of the Point Conception area by NMFS in February of 2010 (M. Lowry, NMFS, unpubl. data). Northern elephant seals breed and pup at the rookeries found at Point Bennett on the west end of SMI and at Cardwell Point on the east end of the island (Lowry 2002). Northern elephant seals are abundant at the NCI from December to March (Lowry et al., 2017b). During aerial surveys of the Northern Channel Islands conducted by NMFS in February 2010, 21,192 total northern elephant seals (14,802 pups) were recorded at haulouts on SMI and 8,237 total (5,712 pups) were observed at SRI (M. Lowry, NMFS, unpubl. data). None were observed at Santa Cruz Island (M. Lowry, NMFS, unpubl. data). Lowry (2017b) stated that aerial surveys found 16,208 pups in SMI, 10,882 pups at San Nicolas Island, and 5,946 pups at SRI.

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APPENDIX J
United States Space Force, Space Launch Delta 30 and United States Coast Guard Memorandum of Agreement

MEMORANDUM OF AGREEMENT

BETWEEN THE

U.S. SPACE FORCE, SPACE LAUNCH DELTA 30

AND

U.S. COAST GUARD DISTRICT ELEVEN

FOR

SPACE VEHICLE AND MISSILE LAUNCH SUPPORT

APPROVED FOR SPACE LAUNCH DELTA 30:

STEVENS.THOMAS.E.1230451784 Digitally signed by STEVENS.THOMAS.E.1230451784 Date: 2022.12.08 16:46:59 -08'00'

THOMAS E. STEVENS
NH-04, DAF, USSF
Executive Director, SLD 30

Date: 8 Dec 22

APPROVED FOR U.S. COAST GUARD DISTRICT ELEVEN:

Andrew Sugimoto

ANDREW M. SUGIMOTO
Rear Admiral, USCG
Commander, Eleventh CG District

Date: 19 Sept 2022

1. PURPOSE:

This Memorandum of Agreement (MOA) between the Space Launch Delta 30 (SLD 30) and the U.S. Coast Guard (USCG) District Eleven, contains the provisions, procedures for implementing USCG liaison, patrol, and maritime warning assistance in support of space vehicle and missile launches on the Western Launch and Test Range (WR). The USCG District Eleven support mission to aid in mitigating risk on the high seas for marine traffic within the SLD 30 identified launch hazard areas. USCG support also includes broadcast notice to mariners (BNM), local notice to mariners (LNM), and limited access areas (LAA) authority under Captain of the Port. This MOA does not alter the jurisdiction or responsibilities of any agency. The MOA is intended only to improve the internal management of existing responsibilities within each agency and enhance interagency coordination and communication. Neither this MOA, nor any actions to implement it, shall be construed to create any right or benefit, substantive or procedural, legally enforceable by any party or person. The Parties retain discretion to deviate from the provisions of the MOA after prior notification to the other Party.

2. AUTHORITY:

The USCG's authority to enter into this Agreement can be found in the following sources: 14 U.S.C. § 504(a), 14 CFR § 431.75, 14 CFR § 450.147, 14 CFR § 417.111 and USCG Commandant Instruction 5216.18.

3. PARTIES:

The SLD 30 is responsible for the safe conduct of launch and test operations from the WR. The Launch Risk Analysis Section within the SLD 30 Launch Safety Office (SLD 30/SEL) is responsible for determining the launch hazard areas for each launch from the WR. The 2nd Range Operations Squadron (2 ROPS) conducts air and sea surveillance of these launch hazard areas for each launch from the WR. The 2 ROPS Area Surveillance Officer (ASO) is responsible for the conduct of surveillance operations within the identified launch hazard area and for reporting the location of any seaborne vessels to the SLD 30/SEL Surveillance Control Officer (SCO) and Sea Surveillance Officer (SSO). The SCO and SSO are responsible for determining the launch risk to seaborne vessels and providing vessel redirect instructions, as required, to the ASO in order to minimize the hazards to the general public and remain within established risk criteria (individual and collective).

USCG District Eleven (D11) represents the U.S. Government on matters of maritime control. They are also the interface for all USCG/USCG Auxiliary launch support for safety and security operations within the USCG District Eleven area of responsibility.

4. POINTS OF CONTACT (POC):

a. The SLD 30 Points of Contact are the 2 ROPS/DON Flight Chief, 805-606-4761 or 805-606-0002, 1602 California Blvd STE 248, Vandenberg SFB, CA 93437 and SLD 30/SE 805-605-7168.

b. The USCG POC is the District Waterways Management Office (dpw), U.S. Coast Guard District Eleven, (510) 437-5984, Coast Guard Island, Bldg. 50-2, Alameda, CA 94501-5100.

5. RESPONSIBILITIES:

Space Launch Delta 30 agrees to the following:

a. Contingency Plans: SLD 30 will provide, or ensure commercial entities provide current copies of the following plans to the Coast Guard:

(1) Ship Hazard Areas as defined through RCC-321 section 3.4 to match 14 CFR 450.135 and 14 CFR 417.111(i) requirements:

(a) A Ship Hazard Area accounting for the impact area of l debris fragments in a catastrophic failure event;

(2) Mishap Investigation Plan as prepared IAW 14 CFR 450.173(d) and 14 CFR 417.111 (h) including the following provision:

(a) Immediate notification to the National Response Center (800) 424-8802 and Coast Guard Pacific Area / District Eleven Command Center (510) 437-3701 in the event of a launch site accident over or adjacent to navigable waters.

b. Response Plans: SLD 30 will provide, or ensure commercial entities provide current copies of the following plan to Coast Guard District Eleven, Sector LA/LB, and Sector San Diego:

(1) Response Plan as prepared IAW 14 CFR 450.173(c) and 14 CFR 417.111 (h) including the following provision:

(a) The plan should include procedures to ensure the consequences of a launch accident, launch incident, reentry accident, reentry incident, or other mishap occurring in the conduct of a reusable launch vehicle mission are contained and minimized so that it does not affect a navigable waterway. The plan should include response measures for impacts that cannot be avoided, including procedures to mitigate hazards to public health and safety, and the contamination of waterways.

c. Scheduling and Notification Activities:

(1) SLD 30 will provide D11 an annual launch schedule forecast for the fiscal year by 30 September each year.

(2) (L-30 days) SLD 30 will submit launch information to D11 to request a LNM article via D11-SMB-D11-LNM@uscg.mil with a goal of at least 30 days prior to scheduled launch. It is understood that with the emerging commercial launch industry, some launch programs may provide flight trajectory updates to accommodate late breaking launch

vehicle performance reviews requiring revisions to hazardous areas or provide launch trajectory data within 30 days because of a high frequency of launch.

SLD 30 shall provide all updates as received from launch developers due to modification or changes.

Launch information should include the following:

(a) Operation Number;
(b) Vehicle type and launch description;
(c) Primary and secondary launch date and time in local and GMT;
(d) Launch Hazard Areas, perimeter coordinates in degrees, minutes, and seconds to three decimal places, if applicable;
(e) Launch/Re-entry risk evaluation, type of debris, pollution risk, safety POC's;
(f) Perimeter coordinates shall be minimized to 4 coordinate positions per area box to limit maritime confusion and charting requirements.

(3) At L-20 days or as soon as SLD30 receives the launch inf ormation, BNM request is sent: D11SPACE@uscg.mil

(4) (L-72 hours) SLD 30 shall contact the following:

(a) D11 to confirm launch information for the LNM and Local Sector BNM, NAVTEX, and SMIB notifications are scheduled and distributed.

(b) National Geospatial-Intelligence Agency (NGA) to request Navigation Area XII warning notifications for launch activities occurring over water from 150 nautical miles offshore to deep-ocean. Launch information should be sent to navsafety@nga.mil and/or (571) 557-5455.

(c) Launch information shall be sent to D11SPACE@uscg.mil and RCCAlameda1@uscg.mil.

Coast Guard District Eleven agrees to the following:

a. Scheduling and Notification Activities:

(1) Review annual forecast of scheduled launches and provisions of this agreement each year;

(2) (L-90 days) Review scheduled launch operations, coordinate waterways risk, and make determination if LAA is recommended;

(3) (L-15 days) Publish launch information in the Local Notice to Mariners;

(4) (L-72 hours) Coordinate Local Broadcast Notice to Mariners (BNM) and NAVTEX prior to launch with respective operational USCG Sector;

(5) (L-day) Confirm local Safety Marine Information Broadcast (SMIB) via VHF-FM is scheduled to be distributed 3 hours before and during launch;

(6) Fulfill any other statutory responsibility pertaining to USCG jurisdiction and authorities;

(7) Coast Guard may communicate directly with the various providers launching out of Vandenberg in support of meeting its statutory obligations to the maritime community.

6. EFFECTIVE DATE AND TERMINATION:

This MOA becomes effective upon signature by an authorized agent from each organization. It may be terminated at any time by mutual agreement or by one party upon giving the other 180 days written notice.

7. MODIFICATIONS AND REVIEW:

This MOA may be modified by mutual agreement at any time. It will be reviewed triennially to determine whether it should be continued as is, modified, or terminated.

8. OTHER FEDERAL AGENCIES:

This MOA does not bind any federal agency, other than the Parties, nor waive required compliance with any law or regulation.

9. FINANCIAL DETAILS:

This MOA does not authorize the expenditure or reimbursement of any funds, nor does it obligate the partners to expend appropriations or enter into any contract or other obligation. All obligations of the partners under this MOA shall be subject to the availability of funds and resources for such purposes. No provision in this MOA will be interpreted to require obligation or payment of funds in violation of the Anti-Deficiency Act, Section 1341 of Title 31, United States Code.

10. OTHER PROVISIONS:

Nothing in this MOA is intended to conflict with current laws or regulations or the directives of the PARTIES. If a term of this MOA is inconsistent with such authority, then that term shall be invalid, but the remaining terms and conditions of this MOA shall remain in full force and effect.

Distribution:

SLD 30 SW/FM, JA, SE
SLD 30 MSG/CC (CES, CONS, FSS/MOF, SFS, Det 1)
SLD 30/CV (RANS, SCS, WS, 2 SLS)
HQ AFSPC(A4/A7 USSF SPOC SpOC/S3/6RA, AFSOC/A3OU, HAF/A3, AF/A3T /A3)
USCG District Eleven (DXO, DRMC, DRE, DL, DM, and DMF)
USCG Sector Los Angeles/Long Beach
USCG Sector San Diego

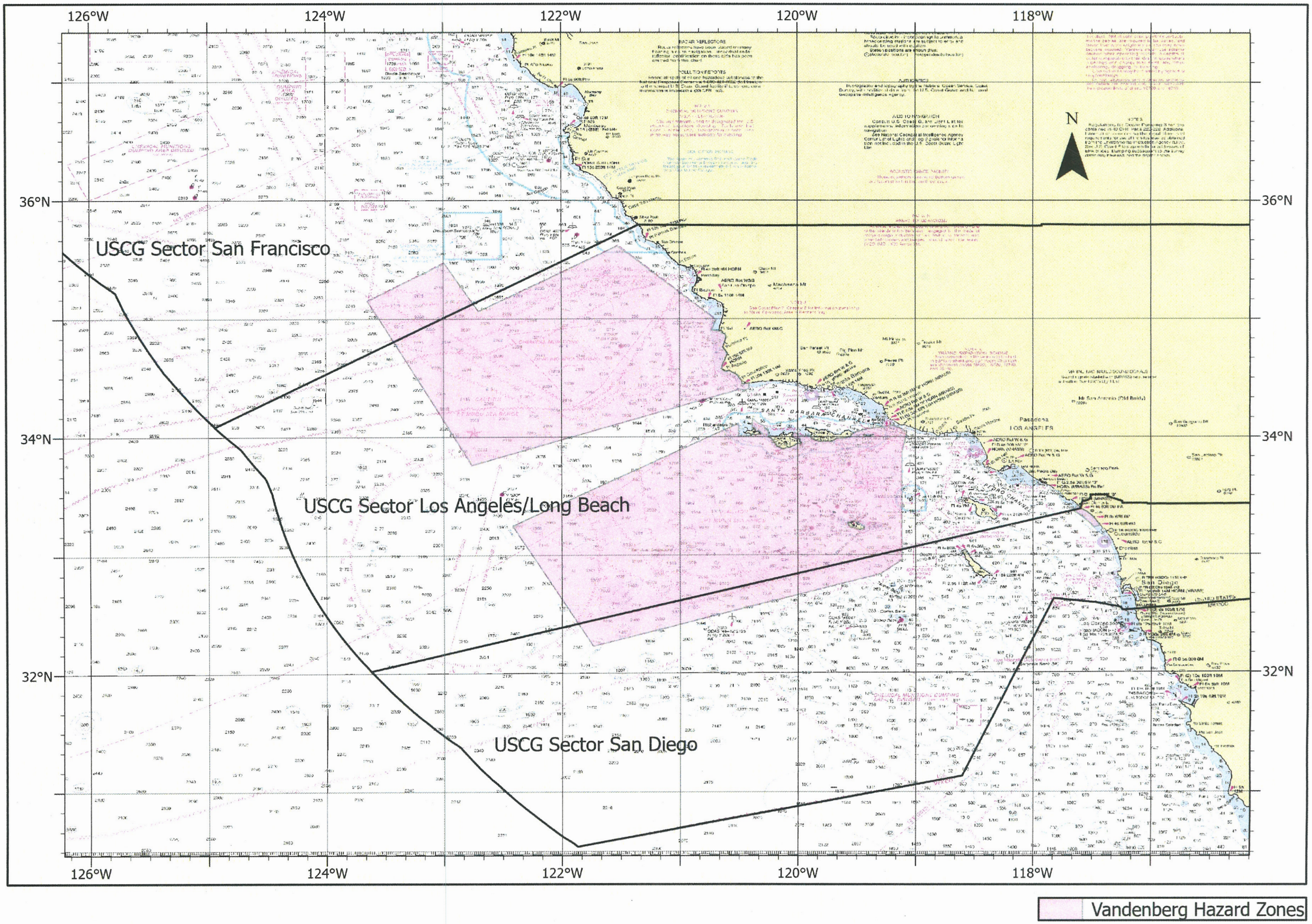
Appendix A – Specific Points of Contact

OFFICE	NUMBER	RESPONSIBILITY
Coast Guard District Eleven Waterways Management D11-DG-D11-Waterways@uscg.mil	510-437-2968	Chief, Waterways Management
Coast Guard District Eleven Marine Transportation System Officer D11-DG-D11-Waterways@uscg.mil	510-437-5984	Space Liaison Officer
Space Launch Delta 30 2ROPSDOSMailbox@us.af.mil	805-605-8011	Operations
Coast Guard District Eleven LNM Editor D11-SMB-D11-LNM@uscg.mil	510-437-2929	Publication of Local Notice to Mariners
Coast Guard Sector LA-LB Command Center D11-SMB-SECTORLALB-SCC@uscg.mil	310-521-3801	Emergency contact number for all Search and Rescue in COTP zone
Coast Guard Sector San Diego Command Center jhoc@uscg.mil	619-278-7033	Emergency contact number for all Search and Rescue in COTP zone
Coast Guard District Eleven Command Center RCCAlameda1@uscg.mil	510-437-3701	Emergency contact number for all Search and Rescue in D11

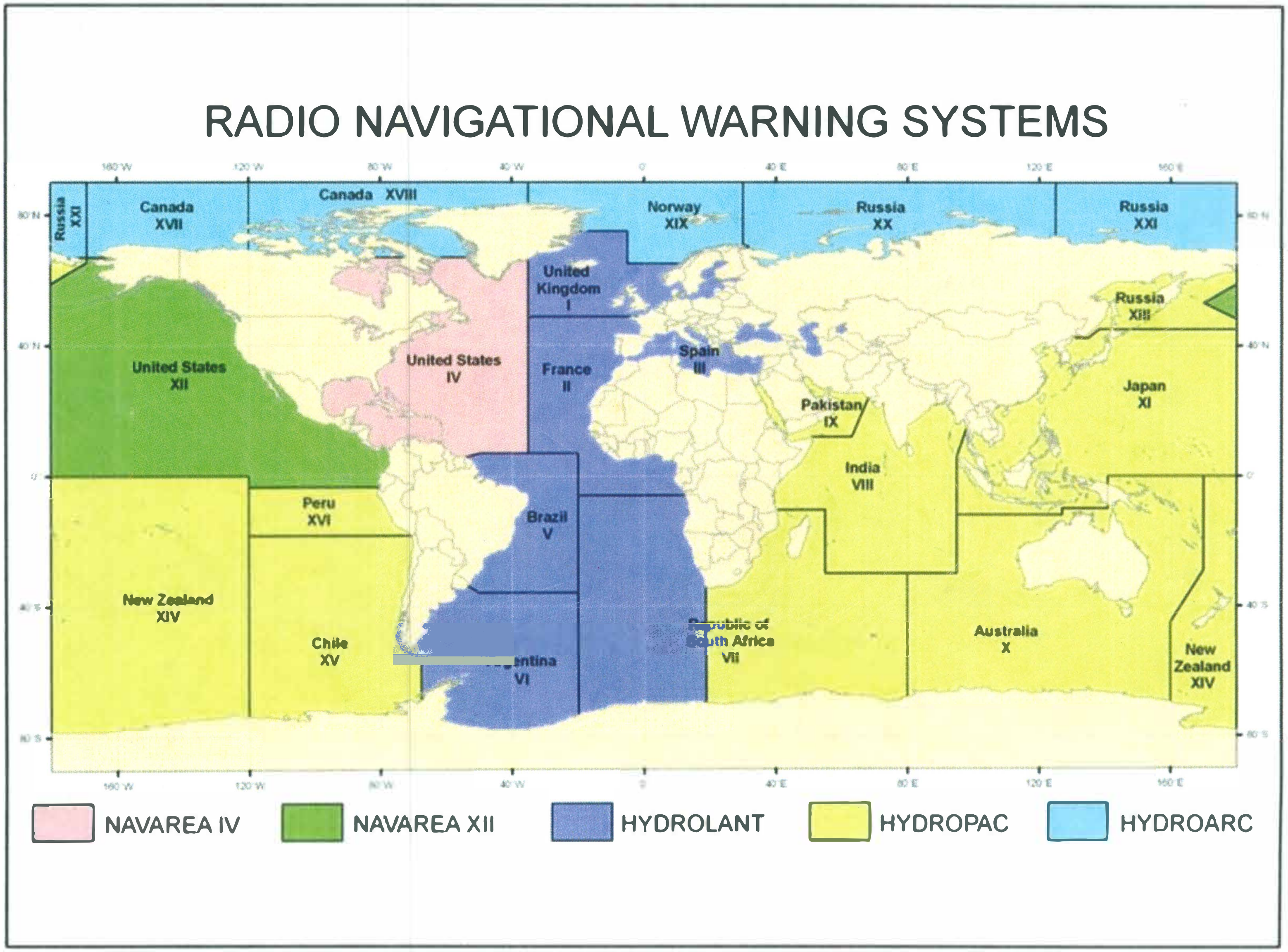
Appendix B – List of Acronyms

2ROPS 2nd Range Operations Squadron
ASO Area Surveillance Officer
BNM broadcast notice to mariners
CFR Code of Federal Regulations
COTP Captain of the Port
D11 Coast Guard District Eleven
DPW District Waterways Management Office
IAW In accordance with
LA/LB Los Angeles/Long Beach
LAA limited access areas
LNM local notice to mariners
MOA Memorandum of Agreement
NAVTEX Navigational Telex
POC Point of contact
SLD Space Launch Delta
SMIB Safety Marine Information Broadcast
SSO Sea Surveillance Officer
USCG United States Coast Guard
USSF Unites States Space Force
WR Western Launch and Test Range

Appendix C – Vandenberg Hazard Zones



Appendix D – National Geospatial-Intelligence Agency Navigation Areas



3.3.3 Aircraft Hazard Volumes for Planned Debris Releases

The range must confirm that Notices to Airmen are issued that encompass the volume and duration necessary to protect aircraft from debris capable of causing an aircraft accident due to all planned events.[22]

NOTE	Federal law[23] defines an aircraft accident as "an occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight and all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage." As described in the glossary, federal law also defines death, serious injury, and substantial damage for the purposes of accident reporting.

3.3.4 Mishap Response

The range must coordinate with the FAA to ensure timely notification[24] of any expected air traffic hazard associated with range activities. In the event of a mishap, the range must immediately inform the FAA of the volume and duration of airspace where an aircraft hazard is predicted.

3.4 Ship Protection[25]

The term "ship" includes boats and watercraft of all sizes.

3.4.1 Non-Mission Ship Criteria

a. Ship Warning Areas. Notices to Mariners (NOTMARs) shall be issued to warn non-mission ships of regions defined by one of the following approaches:[26]

(1) where the probability of debris capable of causing a casualty impacting on or near a vessel exceeds 10E−6 (1E−5), accounting for all relevant hazards; or

(2) the union of the areas where the individual probability of casualty for any person onboard exceeds the criteria in a of Subsection 3.2.1, the collective casualty expectation for an individual ship would exceed the criterion in b of Subsection 3.2.1, and the catastrophic risk for an individual ship would exceed the provisional criteria outlined in Section 3.8.

In some situations, warnings may be optional when expected ship traffic in the affected area is low and adequate observation will be performed.

b. Non-Mission Ship Risk Criteria. People on observed non-mission ships shall be included[27] in the determination of compliance with collective risk criteria in b of

[22] Planned debris releases include intercept debris, jettison stages, nozzle covers, fairings, inter-stage hardware, etc.
[23] 49 C.F. R. 830.2. 1 October 2011.
[24] This may be accomplished through preflight analyses and coordination as described in Chapter 4 of the supplement.
[25] Chapter 4 of the supplement provides important guidelines on the proper implementation of ship protection measures.
[26] The warning area may be expanded to provide additional mitigation so that risk criteria (3.2.1) are met, as discussed in Chapter 4 of the supplement.
[27] Mission risk shall include all members of the GP on land, on ships, and on aircraft.

Subsection 3.2.1 and provisional catastrophic criteria in c of Subsection 3.2.1. Observation to locate non-mission ships is an acceptable method to ensure compliance, provided that suitable observation techniques are used to include the region(s):

(1) where the individual probability of casualty exceeds the criteria in a of Subsection 3.2.1; and

(2) where the collective casualty expectation or provisional catastrophic risk criteria (b or c of Subsection 3.2.1, respectively) would be exceeded given a conservative estimate of typical ship traffic.

3.4.2 Mission-Essential Ship Criteria

a. Mission-Essential Ship Hazard Areas. Mission-essential ships will be restricted from hazard areas defined by either:

(1) the region where the probability of debris capable of causing a casualty impacting on or near a vessel exceeds 100E−6 (1E−4), accounting for all relevant hazards; or

(2) The union of the areas where the individual probability of casualty for an exposed person onboard exceeds the criteria in a of Subsection 3.2.2, the collective risk criteria in b of Subsection 3.2.2, or the catastrophic risk criteria in c of Subsection 3.2.2.

b. Mission-Essential Ship Risk Criteria. Ship-board MEP shall be included in the assessment of compliance with the collective risk criteria in b of Subsection 3.2.2 and catastrophic risk criteria in c of Subsection 3.2.2.

3.4.3 Ship Hazard Areas for Debris Releases

The range must confirm that NOTMARs are issued for each planned debris release event that encompasses the areas and durations necessary to satisfy the risks as described in a of Subsection 3.4.1 or contain, with 99% probability of containment, all resulting debris impacts capable of causing a casualty.[28]

3.4.4 Mishap Response

The range must coordinate with the United States Coast Guard or other appropriate authorities to ensure timely notification of any ship traffic hazard associated with range activities. In the event of a mishap, the range must promptly inform the appropriate authority(s) of the area and duration of navigable waters where a ship hazard is predicted.

3.5 Infrastructure Protection

3.5.1 Mission-Essential Infrastructure Criteria

Mission-essential infrastructure (such as radar equipment) is treated separately as critical assets.

[28] This 99% probability of containment region corresponds to a 3-sigma dispersion region for a single impact if the impact uncertainty can be characterized by a bivariate normal impact probability distribution.

APPENDIX K
List of Preparers

Alice Abela (ManTech SRS Technologies, Inc.), Senior Biologist

B.S., Biology, California Polytechnic State University, San Luis Obispo

Years of Experience: 25

Kevin Bradley (KBR), Engineering Manager

M.S. Aerospace Engineering

B.S. Aerospace Engineering

Danny Heilprin (ManTech SRS Technologies, Inc.), Senior Marine Scientist

M.S., Marine Science, San Jose State University

B.S., Aquatic Biology, University of California, Santa Barbara

Years of Experience: 35

Taylor Houston (ManTech SRS Technologies, Inc.), Senior Biologist

MBA Operations Management

B.A. Natural Resources Management

Years of Experience: 30

John LaBonte, Ph.D. (ManTech SRS Technologies, Inc.), Senior Biologist, Project Manager

Ph.D., Biology, University of California, Santa Barbara

B.S., Ecology, Behavior, and Evolution, University of California, San Diego

Years of Experience: 29

Heather McDaniel McDevitt, RPA (Langan) Cultural Resources Practice Director

M.A., Anthropology - Public Archaeology, California State University Northridge

M.A. (ABT), Geographical Information Science, California State University Northridge

B.A., Anthropology, California State University Northridge

Years of Experience: 20

Adam Poll (Dudek), Senior Environmental Specialist

Brian Pownall, P.E. (SpaceX), Environmental Engineer

B.S., Civil Engineering, North Carolina State University

Years of Experience: 9

Allison Turner (ManTech SRS Technologies, Inc.), Public Outreach Director

Master of Environmental Science and Management, University of California, Santa Barbara

B.A., Social Science, San Diego State University

Years of Experience: 21

Lawrence Wolski (ManTech SRS Technologies, Inc.), Senior Marine Scientist, Acoustic Specialist

M.S., Marine Sciences, University of San Diego

B.S., Biology, Loyola Marymount University

Years of Experience: 30