Revised Draft Environmental Impact Statement

Commonwealth of the Northern Mariana Islands Joint Military Training

Appendices A through L

June 2025

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APPENDICES A THROUGH L in Support of the Commonwealth of the Northern Mariana Islands Joint Military Training Environmental Impact Statement

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June 2025

The appendices of this Revised Draft EIS are compliant with Section 508 of the Rehabilitation Act. This allows assistive technology to be used to obtain the available information from the document. However, accessibility is limited to a descriptive title for some graphics, figures, tables, images, and attachments. Individuals who require assistance may submit a request through the Section 508 link on the project website at CNMIJointMilitaryTrainingEIS.com

APPENDIX K
AIR QUALITY EMISSIONS CALCULATIONS

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APPENDIX K

This appendix provides a detailed discussion on emission estimates calculated for construction and training activities associated with the No Action and Proposed Action.

K.1 REGULATORY SETTING

K.1.1. Criteria Pollutants

The U.S. Environmental Protection Agency (EPA) implements and enforces Clean Air Act requirements. The U.S. EPA Region 9 incorporates the Pacific Islands, including the CNMI. Locally, the CNMI Bureau of Environmental and Coastal Quality, Division of Environmental Quality is the primary agency for management of CNMI natural resources. Its Clean Air Program is tasked with limiting the release of air emissions from diesel-powered motor vehicles, air-polluting equipment, and other polluting industries through enforcement of local and federal environmental regulations.

Criteria pollutants, regulated under Clean Air Act amendments, are a set of common air pollutants that are harmful to human health and the environment and can cause property damage (U.S. EPA 2023a). They include carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), suspended particulate matter less than or equal to 10 micrometers in aerodynamic diameter (PM_{10}), suspended particulate matter less than or equal to 2.5 micrometers in aerodynamic diameter ($PM_{2.5}$), and lead (Pb). Under Clean Air Act amendments, the U.S. EPA has established National Ambient Air Quality Standards for these pollutants. National Ambient Air Quality Standards are classified as primary or secondary:

- Primary standards protect against adverse health effects.
- Secondary standards are designed to protect public welfare, such as prevention of damage to farm crops, vegetation, and buildings.

Some pollutants have long-term standards, designed to protect against chronic health effects, and short-term standards that target against acute health effects.

Table K-1 presents the National Ambient Air Quality Standards for the criteria pollutants, along with their averaging times (i.e., period over which pollutant concentrations are measured for comparison to the National Ambient Air Quality Standards). Per CNMI Administrative Code Chapter 65-10, *Bureau of Environmental and Coastal Quality, Division of Environmental Quality*, the National Ambient Air Quality Standards are adopted by CNMI.

Table K-1 National and CNMI Ambient Air Quality Standards

Air Pollutant	***Averaging Time[1]***	***Federal Primary Standard[2]***	***Federal Secondary Standard[3]***
CO	1-hour 8-hour	35 ppm 9 ppm	—
NO_2	1-hour Annual	100 ppb 53 ppb	— 53 ppb
PM_{10}	24-hour Annual	150 µg/m^3 —	150 µg/m^3 —
$PM_{2.5}$	24-hour Annual	35 µg/m^3 12 µg/m^3	35 µg/m^3 15 µg/m^3
O_3	8-hour	0.070 ppm	0.070 ppm
SO_2	1-hour 3-hour 24-hour Annual	75 ppb — — —	— 0.5 ppm — —
Pb	Rolling 3-month	0.15 µg/m^3	0.15 µg/m^3

Legend: "—" = none; µg/m^3 = microgram per cubic meter; CNMI = Commonwealth of the Northern Mariana Islands; CO = carbon monoxide; NO_2 = nitrogen dioxide; O_3 = ozone; Pb = lead; ppb = parts per billion; ppm = parts per million; PM_{10} = particulate matter less than or equal to 10 micrometers in diameter; $PM_{2.5}$ = particulate matter less than or equal to 2.5 micrometers in diameter; SO_2 = sulfur dioxide.

Notes: [1] The period over which pollutant concentrations are measured.
[2] Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly.
[3] Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

Source: U.S. EPA 2023b.

K.1.2 General Conformity

The Clean Air Act requires geographic areas to be designated according to their ability to attain the National Ambient Air Quality Standards. These areas are categorized for each criteria pollutant as:

- Attainment Area – Area where no exceedance of National Ambient Air Quality Standards for a specific criteria pollutant has occurred (i.e., meets or is cleaner than the national standard).
- Nonattainment Area – Area where exceedance of National Ambient Air Quality Standards for a specific criteria pollutant has occurred.
- Maintenance Area – Area that has been redesignated to attainment status but must demonstrate via the preparation of a maintenance plan how measures would be implemented to maintain attainment of the National Ambient Air Quality Standards for a period of 10 years. Most Clean Air Act rules for nonattainment areas are still applicable to a maintenance area until attainment has been maintained for 10 years.

The U.S. EPA General Conformity Rule applies to federal actions occurring in nonattainment or maintenance areas when the total direct and indirect emissions of nonattainment pollutants (or their precursors) exceed specified thresholds. The emissions thresholds that trigger requirements for a conformity analysis are called *de minimis* levels. *De minimis* levels (in tons per year) vary by pollutant and also depend on the severity of the nonattainment status for the air quality management area in question. However, as Tinian is classified by the U.S. EPA to be in attainment of the National Ambient Air Quality Standards per 40 Code of Federal Regulations (CFR) 81.354, the General Conformity Rule does not apply to the Proposed Action.

K.1.3 Hazardous Air Pollutants

In addition to the criteria pollutants, the Clean Air Act also lists 187 air toxics, known as hazardous air pollutants. While ambient standards do not exist, national regulations under Section 112 of the 1990 Clean Air Act Amendments exist for hazardous air pollutants for specific source categories, and these regulations require compliance with technology-based emission standards for major sources and certain area sources of hazardous air pollutants. Hazardous air pollutants are those pollutants that are known or suspected to cause cancer and other serious health impacts when exposure occurs at sufficient concentrations and durations. Populations most susceptible to exposures include children, the elderly, and those who already suffer from compromised health. "Major sources" are defined as a stationary source or group of stationary sources that emit or have the potential to emit 10 tons per year or more of a hazardous air pollutant or 25 tons per year or more of a combination of hazardous air pollutants.

K.1.4 Greenhouse Gases

Greenhouse gases are gas emissions that trap heat in the atmosphere. These emissions occur from natural processes and human activities. Scientific evidence indicates a trend of increasing global temperature over the past century due to an increase in greenhouse gas emissions from human activities.

Greenhouse gases can remain in the atmosphere for different amounts of time, ranging from a few years to thousands of years. All of these gases remain in the atmosphere long enough to become well mixed, meaning that the amount that is measured in the atmosphere is roughly the same all over the world regardless of the source of the emissions. The Global Warming Potential allows the comparison of the global warming impacts of different gases. Specifically, a Global Warming Potential is a relative measure of how much energy the emissions of 1 ton of a gas will absorb over a given period of time. CO_2 has a Global Warming Potential of 1 and serves as a baseline for other Global Warming Potential values. CO_2 remains in the atmosphere for a very long time; changes in atmospheric CO_2 concentrations persist for thousands of years. The larger the Global Warming Potential, the greater potential to trap heat as compared to CO_2 over time, which is most commonly defined as 100 years. Per 40 CFR Part 98, the 100-year Global Warming Potential for methane (CH_4) is 25, and the Global Warming Potential for nitrous oxide (N_2O) is 298. The concept of CO_2 equivalence (CO_2e) is used to account for the different Global Warming Potentials of greenhouse gases. Greenhouse gas emissions are typically measured in metric tons of CO_2e. For NEPA disclosure purposes, greenhouse gas emissions associated with the Proposed Action were estimated for both construction and operational activities.

K.2 CONSTRUCTION EMISSIONS

Increased direct emissions of criteria pollutants, hazardous air pollutants and greenhouse gases would result from the following potential construction activities:

- Use of diesel- and gas-powered construction equipment

- Movement of trucks containing construction and removal materials
- Commute of construction workers
- Earth disturbance dust emissions from equipment and truck operations

To estimate air emissions associated with construction activities, estimates of the equipment needed to complete the work, operational time for that equipment, and construction manpower (for purposes of estimating emissions related to worker transport) were performed first. Although projects only developed to planning-level schematics typically do not have engineering plans available from which conventional construction cost estimates would be developed, construction activity inputs for emissions estimates can be developed on the basis of the size and type of the structures, and/or site work and some basic assumptions of anticipated work.

Estimates of construction crew and equipment requirements and productivity are based on data presented in the following sources:

- 2003 RSMeans Facilities Construction Cost Data, R.S. Means Co., Inc., 2002
- 2011 RSMeans Facilities Construction Cost Data, R.S. Means Co., Inc., 2010

The Proposed Action would include the construction of various training ranges and support facilities throughout Tinian. The assumptions considered and calculations performed are based on the program cost estimates developed for the work that roughly quantify the major components of the work. Some portions of the work are considered incidental or not generally associated with heavy equipment use. For example, erosion control is expected to include relatively low-intensity, low-frequency work items. Additionally, it is assumed that the landform would be utilized largely in its existing condition, and no mass grading activities are required; other than excavation necessary specifically to constructing building foundation elements, grading would be employed only to prepare site areas and level localized areas, but earth would not be transported over large distances.

The items and the work necessary to construct the project are described below on a unit basis to match the format of the estimates and are scaled to total size for each individual project to establish total equipment requirements.

The primary components of the work include the following elements:

K.2.1 Multi-Purpose Maneuver Range

The total size of the Multi-Purpose Maneuver Range would be 200 acres, within which several training elements would be constructed:

- Clearing or thinning of vegetation to cover entire area.
- Access road that is 10,080 feet long with 50-foot clearing around the perimeter, creating fire breaks that would include grading, base courses, and gravel, back run, and compacted surface area.
- Interim fire break on existing road.
- Four objective areas with maximum of 15 acres each including vegetation removal, object construction and monitoring well construction.

- Two support-by-fire positions and firing lane: it is assumed that these elements would only be demarcated within the range but would require no construction beyond general clearing already identified.
- Clearing ammunition hazard area.
- Unimproved road down spine of training area.
- Two surface radar sites including clearing with fencing, radar towers, and flagpole for training alert flags.
- Portable water services and well field including water well, tanks, and one support building construction.

K.2.2 Explosives Training Range

The total size of the Explosives Training Range would be 2.5 acres. Minimal construction would be associated with this element and includes clearing vegetation, construction of a bunker and four monitoring wells.

K.2.3 North Field Improvements

The North Field improvements would include upgrades to the surface of Runway Baker, thinning of vegetation throughout, installation of unimproved roadways for access, and installation of arresting gear on Runway Baker.

K.2.4 Landing Zones

There would be 2 large (1,200 feet by 1,200 feet) Landing Zones and 11 small (600 feet by 600 feet) Landing Zones constructed. The work for Landing Zone establishment consists of site clearing only. New access roads would be constructed for Landing Zones not sited adjacent to existing infrastructure; the total length of these new roads is estimated at approximately 2,000 linear feet. These roadways are assumed to be 20 feet wide with gravel surfaces.

K.2.5 Base Camp

Building Reuse and Construction

Reuse of existing buildings is proposed for much of the footprint and no new construction activity is associated with reuse. However, there would be some new construction considered – one structure would be used as an aircraft shelter (16,200 square feet), and there would be new building construction for a range maintenance shop (1,260 square feet), communications node (2,700 square feet), a warehouse (36,000 square feet), a public works shop (8,700 square feet), electrical distribution building (900 square feet) and restrooms/showers (3,200 square feet). Functionally, it is assumed that the aircraft shelter would consist of a pre-engineered building erected on site, while the remaining structures are of similar nature that can be estimated as a simple prototype building and construction effort scaled to the listed size of the specific structures.

Construction would include foundation, single floor with roof enclosure, mechanical systems, heating, ventilation and air conditioning distribution, sprinkler system, interior finishes, and interior utility installation.

In addition to the building construction, some non-prototype items would be constructed including a potable water services and well field.

K.2.6 Site Work

Additional site disturbances would include various hardscape areas and other ground disturbances for construction-phase laydown areas, leach fields, etc. associated with the Base Camp, including the following:

- Utility line installations
- Communications tower and support infrastructure
- Concrete tent pads
- Camp and port biosecurity/wash rack
- Fueling pads
- Ammunition holding area
- Motor pool
- Hardscape construction
- Base Camp training parking
- Septic leach field
- Base camp fencing

Emission factors for all criteria pollutants and hazardous air pollutants from both construction equipment (non-road engines including cranes, forklifts, excavators, front end loaders, generators, and other construction equipment) and motor vehicles were derived from U.S. EPA's Motor Vehicle Emission Simulator Version 4 (MOVES 4) emission factor model (U.S. EPA 2023c), which is associated with the national default model database for both non-road equipment and on-road vehicle engines. The national default input parameters available for the Virgin Islands (the available data closest to the CNMI modeling conditions) were used in emission factor modeling, per prior U.S. EPA recommendations.

To calculate emission factors for the Proposed Action, model runs were conducted for an assumed construction start year of 2026 and project-level emission rate mode. Non-road emission factors from the MOVES 4 emission model are provided in units of grams per horsepower-hour), so emissions were estimated by multiplying the emission factor by the non-road engine's assumed horsepower rating, the total operating hours developed, and the load factor for each different type of equipment as applied in the MOVES 4 model. Emission factors for greenhouse gases, in terms of CO_2 and CH_4, were also predicted using the MOVES 4. Emissions for N_2O were prorated based on U.S. EPA emission factors for construction equipment (0.57 grams CH_4/gallon fuel and 0.26 grams N_2O/gallon fuel, respectively) (U.S. EPA 2016).

K.2.7 Nonroad Engines

An example of the calculation methodology for non-road engines using the MOVES 4 emission factors is as follows:

$$E = EF \times hp \times HR \times LF \times 1.10231E(-6)$$

Where:

E	=	non-road emissions per unit per duration (tons)
EF	=	non-road emission factor per unit type (grams per horsepower-hour)
HR	=	hours of operation per duration (hour)

LF = load factor
1.10231E(-6) = mass conversion factor (ton/gram)

For N_2O emissions, the following equation was applied:

$$E = \text{CH4}\ EF \times \frac{\text{N2O}}{\text{CH4}} conversion\ factor\ x\ PR \times HR \times LF \times 1.10231E(-6)$$

Where:

E = non-road emissions per unit per duration (tons)
EF = non-road emission factor per unit type (grams per horsepower-hour)
N_2O/CH_4 conversion factor = 0.26/0.57 = 0.45614
PR = power rating (horse power)
HR = total operating hours per duration (hour)
LF = load factor
1.10231E(-6) = mass conversion factor (ton/gram)

Typical load factors for various equipment types were based on Appendix A of the U.S. EPA's "Median Life, Annual Activity, and Load Factor Values for Non-road Engine Emissions Modeling" (U.S. EPA 2010).

K.2.8 On-Road Vehicles

On-road emission factors from the MOVES 4 are provided in grams per vehicle mile traveled for running operations, gram/hour for idling and gram/start for vehicle starts. Total emissions from on-road vehicles during construction were estimated based on running, idling, and starting operational modes.

The equation for emissions during running operations is the following:

$$E = EF \times VMT \times 1.10231E(-6)$$

Where:

E = on-road emissions per unit per duration (tons)
EF = on-road emission factor per vehicle type (gram/vehicle miles traveled)
VMT = vehicle miles traveled per duration
1.10231E(-6) = gram to ton conversion factor

Idling emissions were calculated by taking the MOVES 4–produced idle emission factor and multiplying by the number of hours (represented as a fraction) spent in idle mode. Idling time, 10 minutes per day, was estimated based on engineering judgement.

The equation for emissions during idle operations is the following:

$$E = EF \times HR \times 1.10231E(-6)$$

Where:

E = on-road emissions per unit (tons)
EF = on-road emission factor per idle time (gram/hour)
HR = total idling hours (hour)
1.10231E(-6) = mass conversion factor (ton/gram)

Emissions from starts were calculated by taking the MOVES 4 starts emission factor and multiplying by the number of starts, where two starts were assumed per day of use.

Equation for emissions during starts is the following:

$$E = EF \times ST \times 1.10231E(-6)$$

Where:

E	=	on-road emissions per unit (tons)
EF	=	on-road emission factor per starts (gram/start)
ST	=	total number of starts
1.10231E(-6)	=	mass conversion factor (ton/gram)

K.2.9 Fugitive Dust (Earth Disturbance)

In addition to engine emissions, fugitive dust emissions resulting from earth disturbance (e.g., excavation and transferring of excavated materials into dump trucks) were estimated with particulate emission factors from the Western Regional Air Partnership (WRAP) Fugitive Dust Handbook (WRAP 2006). The PM_{10} emission factor is the following:

$$PM_{10}\ emission\ factor\ (tons/acre - month) = 0.11$$

Where:

$PM_{2.5}$	=	PM_{10} emission factor × ratio [0.1 for construction and demolition activity]

Emissions were calculated using the following equation:

$$E = EF \times acres\ x\ months\ of\ activity$$

Where:

E	=	fugitive dust emissions (tons)
EF	=	emission factor (ton/acre-month

The amount of earth disturbed was based on square footage of land disturbed by new or modified buildings, other impervious surfaces, and other ground disturbances.

K.3 OPERATIONAL EMISSIONS

Operational emissions were calculated for the following sources:

- Road surface re-entrainment dust emissions
- On-road and off-road training personnel vehicles
- Fixed-wing and rotary-wing aircraft
- Ground-based training activities and support vehicles
- New stationary sources: electrical power generators and solid waste management

K.3.1 Ground Training Activities and Support Vehicles

Ground training activities would include operation of training vehicles (such as Assault Amphibious Vehicles, Light Armored Vehicles, and High Mobility Multipurpose Wheeled Vehicles) and supporting mobile and portable equipment (such as water and fuel trucks, forklifts, reverse osmosis water purification units, and generators).

Exhaust emissions from vehicles and supporting mobile and portable equipment were estimated with the same method used to estimate emissions from construction vehicles and MOVES 4 non-road vehicle module–predicted emission factors for such sources as off-highway tractors.

The amount of equipment and hours operating were based on the 2015 *Mariana Islands Training and Testing Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS)* scaled based on number of events proposed versus what was assumed for the previous studies.

In addition, because the training vehicles would maneuver on a mix of paved roads, unpaved roads, and military training trails with potential to generate fugitive dust, the U.S. EPA AP-42 was used to estimate roadway fugitive dust emissions from training vehicles. Given the lack of inputs to divide the time for training vehicles running on paved and unpaved roads, it was conservatively assumed that all roadway surface fugitive dust emissions (PM_{10} and $PM_{2.5}$) would be generated from unpaved roadways. Hours operated on roadways was also conservatively assumed to be the entire range time, while in reality vehicles would not be operating the full range hours.

For unpaved roads, the following equation was used (U.S. EPA 2006):

$$E = EF\left(\frac{lb}{VMT}\right) x \text{ VMT x } \frac{1 \text{ ton}}{2000 \text{ lb}}$$

$$EF\left(\frac{lb}{VMT}\right) = k \times (s/12)^\wedge a \times (W/3)^\wedge b \times [(365 - P)/365]$$

Where:

E	=	unpaved roads emissions per duration (tons)
EF (lb/VMT)	=	emission factor in units of pound/vehicle miles traveled
VMT	=	vehicle mile traveled
k	=	particulate size multiplier (pound/vehicle miles traveled) [1.5 for PM_{10} and 0.15 for $PM_{2.5}$]
s	=	surface material silt content (percent) [for purposes of these calculations, assumed default U.S. EPA AP-42 value of 8.5 percent for a construction site]
W	=	mean vehicle weight (tons) [based on average weights per vehicles type]
P	=	number of wet days in a year with at least 0.01 inches of precipitation
a	=	constant 0.9 for PM_{10} and $PM_{2.5}$
b	=	constant 0.45 for PM_{10} and $PM_{2.5}$

K.3.2 Airport/Airfields and Aircraft

Fixed-wing aircraft and helicopter engines would emit air emissions during operation. As with the previous studies for activities in the Mariana Islands Training and Testing Study Area, training and testing aircraft flights are assumed to originate offshore from aircraft carriers or other Department of the Navy (DON) vessels outfitted with flight decks or from Andersen Air Force Base in Guam. Except for helicopters, all aircraft are assumed to travel to and from training ranges at or above 3,000 feet above ground level.

The types of aircraft activity (e.g., flight characteristics for each training activity) were assumed to be similar to those that occur in the Mariana Islands Training and Testing Study Area, and number of sorties was scaled based on number of events proposed versus what was assumed for the previous studies. Changes were made to adjust for the current types of aircraft used for training and testing (such as the FA-18E/F and the F-35 B/C). Additionally, operations were added to account for the aircraft associated with Divert support activities at Francisco Manglona Borja / Tinian International Airport (U.S. Air Force 2016, 2020) and additional aircraft associated with supply transport to reflect current or baseline activities.

Criteria pollutant emission factors are typically provided as pound per hour of activity. Emission factors were taken from the 2015 *Mariana Islands Training and Testing EIS/OEIS* or, if they had been updated, from the 2020 *Mariana Islands Training and Testing Supplemental EIS/OEIS*. For most military engines, emissions factors were originally obtained from the DON Aircraft Environmental Support Office memoranda and previous DON EIS/OEIS documentation (primarily citing the Federal Aviation Administration's Emissions and Dispersion Modeling System model). Additional emission factors were taken from other aircraft-specific Aircraft Environmental Support Office memorandums and the June 2023 *Air Emissions Guide for Air Force Mobiles Sources: Methods for Estimating Emissions of Air Pollutants for Mobile Sources at United States Air Force Installations* (Air Force Civil Engineer Center [AFCEC] 2023). These emission factors were multiplied by total hours of flight activities per year per aircraft to calculate total emissions. Total hours per aircraft per testing and training activity were based on the number of sorties and the average of time on range per sortie. Time on range (activity duration) was based on the operational limit of the aircraft and is generally unchanged from what was considered in the 2015 *Mariana Islands Training and Testing EIS/OEI*S, except for additions of the new aircraft types/activities. To speciate emissions based on locations, the calculated hours were separated based on time spent overland through 3 nautical miles offshore, between 3 and 12 nautical miles from shore, and greater than 12 nautical miles from shore.

A simplified example equation for these calculations is the following:

$$E = EF \times \text{Hours of Activity} \times 1\ \text{ton}/2000\ \text{pounds}$$

Where:

E	=	aircraft emissions per unit per duration (tons)
EF	=	pounds per hour
Hours of Activity	=	hours of activity per location (overland through 3 nautical miles offshore, between 3 and 12 nautical miles overwater, greater than 12 nautical miles from shore)

Emissions for particulate matter are provided as total particulate matter. As was assumed for 2015 *Mariana Islands Training and Testing EIS/OEIS*, total particulate matter was conservatively assumed to be equivalent to PM_{10}. $PM_{2.5}$ was estimated by assuming 90 percent of PM_{10} is composed of $PM_{2.5}$. This ratio is included as approved estimation methodology within the June 2023 *Air Emissions Guide for Air Force Mobiles Sources: Methods for Estimating Emissions of Air Pollutants for Mobile Sources at United States Air Force Installations* (AFCEC 2023).

For hazardous air pollutants, emissions are based on calculated volatile organic compounds emissions and mass fractions of hazardous air pollutants within aircraft engine exhausts. The hazardous air pollutant mass fractions and methodology was taken from the June 2023 *Air Emissions Guide for Air Force Mobiles Sources: Methods for Estimating Emissions of Air Pollutants for Mobile Sources at United States Air Force Installations* (AFCEC 2023). The hazardous air pollutant mass fractions were sourced from *Recommended Best Practice for Quantifying Speciated Organic Gas Emissions from Aircraft Equipped with Turbofan, Turbojet, and Turboprop Engines* (U.S. EPA 2009). Emissions of each speciated hazardous air pollutant are calculated by converting the separately calculated volatile organic compounds emissions to total organic gases and multiplying the total organic gases by the hazardous air pollutant mass fraction.

$$E(HAP) = \frac{E\ (VOC)}{0.99}\ x\ MF(HAP) x\ \frac{1\ ton}{2000\ lb}$$

Where:

E (HAP)	=	emissions of speciated hazardous air pollutant (tons)
E (VOC)	=	emissions of total volatile organic compounds(pounds/year)
0.99	=	factor converting volatile organic compounds to total organic gases
MF (HAP)	=	mass fraction of speciated hazardous air pollutant

Greenhouse gas emission factors, in units of pound per 1,000 pounds of fuel (pounds/1,000 pounds) were taken from the June 2023 *"Air Emissions Guide for Air Force Mobiles Sources: Methods for Estimating Emissions of Air Pollutants for Mobile Sources at United States Air Force Installations"* (AFCEC 2023) when aircraft-specific factors were not available. Fuel used in aircraft was assumed to be jet fuel, and the fuel flow rate per aircraft was taken from the *2015 Mariana Islands Training and Testing EIS/OEIS* and the *2020 Mariana Islands Training and Testing Supplemental EIS/OEIS*. The following equation was used to calculate emissions:

$$E = EF\ x\ FF\ x\ HR\ x\ \frac{1}{1000}$$

Where:

E	=	emissions (tons)
EF	=	emission factor (pounds/1,000 pounds of fuel)
FF	=	fuel flow (pounds of fuel/hour)
HR	=	hours per duration
1/1000	=	conversion to 1,000 pound units

K.3.3 On-Road Vehicles

To support the training activities, material and personnel transport, vehicles traveling on paved roadways around the island would occur. The on-road vehicle emission factors were obtained from the MOVES 4, and the methodologies that were used are the same as those used for emissions from vehicles during the construction period, as described above. The number of personnel vehicles operating per year is conservatively assumed to be equivalent to the maximum number of personnel per training event (1,000 personnel per large training event, 250 personnel per medium training event and 100 personnel per small training event) and the maximum number of training events per year and their duration (three large training events per year operating four weeks per event, four medium training events per year operating two weeks per event, and four small training events per year operating two weeks per event). Based on engineering estimates, it was assumed each vehicle traveled 15 miles per day, idled 10 minutes a day, and had two startups per day of operation.

For fugitive dust from on-road vehicular traffic, emissions were calculated based on procedures detailed in U.S. EPA AP-42 Chapter 13.2. Paved road emissions used the following equation (U.S. EPA 2011):

$$E = EF\left(\frac{lb}{VMT}\right) \text{ x VMT x } \frac{1 \text{ ton}}{2000 \text{ lb}}$$

$$E\ (lb/VMT) = [k(sL\text{^}0.91 \times (W)\text{^}1.02](1 - P/4N)$$

Where:

E	=	paved road emissions per duration (tons)
EF (lb/VMT)	=	emission factor in units of pounds/vehicle mile traveled
VMT	=	vehicle miles traveled
K	=	particulate size multiplier (pounds/vehicle mile traveled) [0.0022 for PM_{10} and 0.00054 for $PM_{2.5}$]
sL	=	Silt Loading Value (grams/meters squared) [assumed a default U.S. EPA AP-42 value of 7.4 grams/meters squared]
W	=	mean vehicle weight (tons) [based on average weights per vehicle types]
P	=	number of wet days in a year with at least 0.01 inches of precipitation
N	=	number of days in averaging period (365 for annual)

For unpaved roads, the methodology used for calculations was the same as applied for ground training activities and support vehicle operations on unpaved roads.

K.3.4 New Stationary Sources: Electrical Power Generators and Solid Waste Management

Several emergency and back-up stationary generators would be installed at the Tinian Base Camp and mission-critical facilities for support during power outages:

- Two approximately 200 kilowatt (kW) diesel-fired generators at Base Camp;
- Four approximately 200 kW diesel-fired generators associated with communication towers; and
- Three approximately 50 kW diesel-fired generators associated with the surface radar sites.

U.S. EPA AP-42 emission factors, U.S. EPA Tier 2 standards and the anticipated diesel generator parameters considering number and size will be used to estimate emissions. A maximum of 500 hours of emergency operational capacity was assumed for each stationary generator to estimate emissions.

Generator emissions used the following equation per generator for pollutants using U.S. EPA emission factors (U.S. EPA 1996):

$$E = \text{EF x Heat Input Rate x } 500\frac{\text{hours}}{\text{year}}\, x\, \frac{1 \text{ ton}}{2000 \text{ lb}}$$

Where:

E	=	generator emissions per year (tons)
EF (lb/MMBtu)	=	emission factor in units of lb/MMBtu (fuel input)
Heat Input Rate	=	heat input rate in units of MMBtu/hr

For pollutants that used the U.S. EPA Tier 2 standards, the following equation was used:

$$E = \text{EF x power rating x } \frac{1\text{ lb}}{453.59\text{ grams}} \text{ x } 500\,\frac{\text{hours}}{\text{year}}\,x\,\frac{1\text{ ton}}{2000\text{ lb}}$$

Where:

E	=	generator emissions per year (tons)
EF	=	emission factor in units of g/kWh
Power Rating	=	kW

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