Missile Defense Agency

Guam Flight Test

Proposed Final Environmental Assessment/Overseas Environmental Assessment

May 2024

Department of Defense
Missile Defense Agency
5700 18th Street
Fort Belvoir, VA 22060-5573

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PROPOSED FINAL

ENVIRONMENTAL ASSESSMENT/
OVERSEAS ENVIRONMENTAL ASSESSMENT

For

GUAM FLIGHT TEST

At

ANDERSEN AIR FORCE BASE

May 2024

James Elliott
Missile Defense Agency
5700 18th Street, Fort Belvoir, VA 22060-5573

The Missile Defense Agency (MDA), in cooperation with the United States (U.S.) Air Force, U.S. Army, U.S. Navy, and U.S. Coast Guard has prepared this Environmental Assessment/Overseas Environmental Assessment in accordance with the National Environmental Policy Act (NEPA), as implemented by the Council on Environmental Quality Regulations and MDA, U.S. Air Force, U.S. Army, U.S. Navy, and U.S. Coast Guard regulations for implementing NEPA. The Proposed Action would include deploying and testing missile defense systems, including flight tests and tracking exercises from Andersen Air Force Base on Guam or at sea from a U.S. Navy Ship. Flight tests would begin in the first quarter of Fiscal Year 2025 and occur up to two times per year over a period of ten years.

PROPOSED FINDING OF NO SIGNIFICANT IMPACT

FOR GUAM FLIGHT TEST ENVIRONMENTAL ASSESSMENT/OVERSEAS ENVIRONMENTAL ASSESSMENT

AGENCY: Missile Defense Agency

ACTION: Finding of No Significant Impact (FONSI)

BACKGROUND:

Within the Department of Defense (DoD), the Missile Defense Agency (MDA) is responsible for developing, testing, and fielding a missile defense system to defend the United States (U.S.) and its deployed forces, allies, and friends against missile attacks in all phases of flight. A missile defense system provides a layered defense consisting of various land-, sea-, and air-based weapons; sensor and communications systems; and command and control platforms that are used to defeat incoming ballistic, cruise, and hypersonic missiles in all phases of flight.

This Environmental Assessment/Overseas Environmental Assessment (EA/OEA) has been prepared by MDA to analyze the impacts of deploying and testing missile defense systems from Andersen Air Force Base (AAFB) on Guam, or the Broad Ocean Area (BOA) of the western Pacific Ocean.

DESCRIPTION OF PROPOSED ACTION:

Deploy and test missile defense systems, including up to two flight tests or tracking exercises per year from AAFB or at sea from a U.S. Navy ship underway in the BOA of the western Pacific Ocean for a period of 10 years (Proposed Action). A flight test represents a target missile flight, an interceptor missile flight, an intercept of a target missile, or a test of sensors independent of missile flight. For a single flight test, multiple interceptors and targets may be utilized. A tracking exercise involves using sensors to scan and track a target with no interceptor.

The Proposed Action (PA) is expected to begin in the first quarter of Fiscal Year 2025 with Flight Experiment Mission (FEM)-02. FEM-02 would include launching a Standard Missile (SM)-3 (interceptor) against a medium-range ballistic missile (target). The target would be air-launched from a C-17 or similar aircraft at an altitude greater than 20,000 feet, at least 800 nautical miles (1,483 kilometers) east of Guam in the BOA of the western Pacific Ocean. The interceptor would launch from Northwest Field (NWF) on AAFB. The first stage booster would separate from the interceptor quickly after launch and would land on a remote, uninhabited area of AAFB. Intercept of the SM-3 and the target would occur in the exosphere (the outermost layer of Earth's atmosphere) above the BOA of the western Pacific Ocean greater than 200 nautical miles from Guam. Debris from the intercept and physical components from the target and interceptor (the pallet and parachutes used to air-launch the target, and expended booster stages) would fall to the surface of the ocean greater than 88 nautical miles from Guam and sink to the ocean floor.

Future MDA and U.S. Army flight tests and tracking exercises would be conducted in a similar manner. All land-based interceptor launches would take place from NWF on AAFB but may use different land-based defensive weapons systems than the Aegis Weapon System (AWS) being used for FEM-02, such as the Phased Array Tracking Radar to Intercept of Target (PATRIOT) Advanced Capability-Three (PAC-3) Missile Segment Enhanced (MSE) system or "PAC-3 MSE", Terminal High Altitude Area Defense (THAAD), or Indirect Fire Protection Capability (IFPC). Different radars and other systems could be used and would function similarly to the Army Navy/Transportable Radar Surveillance and Control-Series 6 (AN/TPY-6) that would be used for FEM-02. Each of these missiles, radars, and other systems would be similar to those used during FEM-02 in terms of function and environmental impacts. The number and types of sensors, interceptors, and targets used in a flight test or tracking exercise can be adjusted to create the desired test scenario.

Ship-based interceptor launches would also occur as described for FEM-02, except that no interceptor would be launched from land on Guam. During the sea-based flight test scenario, the interceptor would be launched from a U.S. Navy Aegis Cruiser or Destroyer at sea in the western Pacific Ocean. At-sea flight tests could include an SM-2 or SM-6, in addition to the SM-3.

Tracking exercises would not include an intercept. Tracking exercises could include the launch of an interceptor or target. If an interceptor or target were launched for a tracking exercise, it would follow its predetermined trajectory, eventually impacting the surface of the BOA in the western Pacific Ocean greater than 200 nautical miles from Guam and sinking to the ocean floor.

PURPOSE AND NEED:

The purpose of the PA is to validate the interoperability of multiple sensors and interceptor systems from MDA, the U.S. Navy, and the U.S. Army, that could become a part of the “system of systems” (or the backbone) of a missile defense system developed to protect Guam. These flight tests and tracking exercises are needed to facilitate research and increase the DoD’s understanding of the ability of a missile defense system, including the AWS, PATRIOT, THAAD, and IFPC system, and supporting sensors to counter the threat presented by short-, mid-, and long-range ballistic missiles, cruise missiles, and hypersonic missiles in a realistic environment. Further, this action is needed to significantly improve realistic Command and Control, Battle Management and Communications in multiple theaters around the world, as well as to increase ballistic missile, cruise missile, and hypersonic missile threat detection and defeat capabilities for Guam.

ALTERNATIVES CONSIDERED:

No Action Alternative: Under the No Action Alternative, no flight tests would occur from land- or sea-based launchers; no tracking exercises to test or calibrate the land-, airborne-, sea-, and space-based sensors would occur; and AAFB would continue with normal activities.

Alternative 1: Flight tests or tracking exercises utilizing land-based launch systems for interceptor launch with land-, airborne-, sea-, and space-based sensor integration.

Alternative 2: Flight tests or tracking exercises utilizing land- or sea-based launch systems for interceptor launch with land-, airborne-, sea-, and space-based sensor integration.

Alternative to be Implemented: Alternative 2 is the Preferred Alternative for implementation as it best meets the purpose of and need for the PA and would not result in significant impacts on the human and natural environment.

ALTERNATIVES CONSIDERED BUT NOT CARRIED FORWARD FOR ANALYSIS:

A second alternative launch location was considered for the flight tests of interceptor systems: Orote Point abandoned airfield, Naval Base Guam (NBG). Due to potential safety considerations, including the proximity to ammunition storage, impacts on airspace, and performance requirements, the launch location from the Orote Point abandoned airfield at NBG was not carried forward as an alternative site for analysis.

SUMMARY OF POTENTIAL ENVIRONMENTAL CONSEQUENCES:

Impacts on potentially affected resources were analyzed in detail in the EA/OEA, including direct, indirect, and cumulative impacts. Cumulative impacts were assessed as part of the EA/OEA's existing conditions, and in the direct and indirect impact analysis. No significant direct, indirect, or cumulative environmental impacts would occur from implementing the PA. A summary of the impacts associated with Alternative 2 (Preferred) is provided below.

Resource Area	**Alternative 2 (Preferred Alternative)**
Airspace Management	Close coordination by the MDA launch operations manager with the Federal Aviation Administration (FAA) (including the issuance of Notices to Air Missions [NOTAMs] and establishment of a temporary flight restriction), Guam Center Radar Approach Control, and Guam International and AAFB Air Traffic Control Towers would minimize the potential for any adverse impacts on airspace use in the vicinity of the launch site and planned missile downrange profile. And because sea-based flight tests or tracking exercises would take place far from land and populated areas, the analysis conclusions for airspace management are consistent with a minor determination as and therefore would result in a less than significant impact on airspace management.
Air Quality	Due to the expected dispersion and transport of pollutant plumes from intermittent and low rates of emissions, under local meteorological conditions, and infrequent public exposure impacts are not expected to interfere with the attainment of Ambient Air Quality Standards or contribute to human health risks from hazardous air pollutant (HAP) exposure in areas where the public may be present. Additional vessel activities would mainly occur in distances

Resource Area	Alternative 2 (Preferred Alternative)
	well beyond 12 nautical miles from Guam. The expected dispersion and transport of pollutant plumes from these intermittent emissions in the broad ocean area are not expected to significantly increase concentrations of criteria pollutants or HAPs or have an impact on human health. For this reason the analysis conclusions for air quality under Alternative 2 (Preferred Alternative) are consistent with a minor determination and would result in a less than significant impact on air quality.
Climate Change and Greenhouse Gases	Expected greenhouse gas (GHG) emissions are relatively minor and make up a negligible percentage of the global GHG emissions. The analysis conclusions for climate change and greenhouse gases are consistent with a minor determination and therefore would result in a less than significant impact on climate change and greenhouse gases.
Terrestrial Biological Resources	Wildlife could be exposed to increased noise levels; however, noise impacts on wildlife would likely be limited to short-term, minor disturbances. The potential for physical disturbance or strike of wildlife or Endangered Species Act (ESA)-listed plant species would be from the expended first stage booster. Given the size of the booster and infrequent nature of the flight tests, it is unlikely the falling booster would result in a direct strike on wildlife or ESA-listed species. If the booster did damage an ESA-listed plant, the number of individuals affected would be small (less than 6 plants) and would not cause long-term effects to the populations or species. The potential for the physical presence of flight test personnel in the proximity of wildlife is during the recovery of the first booster. Personnel presence during recovery could result in a startle response, resulting in nearby wildlife fleeing the area. However, these impacts would be short term and not result in any long-term behavioral impacts. Radar use is expected to have no effect on biological resources due to the radar operations, flight behavior, and ecology of birds and bats, and lack of roost habitat near the sensors field of regard. Lastly, due to the presence of humans, man-made structures, vehicles, and lighting within the project area, as well as the location of the radar, it is unlikely that birds would come within proximity of the radar. The analysis conclusions for terrestrial biological resources are considered moderate and therefore would result in a less than significant impact on terrestrial biological resources.

Resource Area	Alternative 2 (Preferred Alternative)
	Sea-based flight tests or tracking exercises would occur far from land and have no impact on terrestrial biological resources and, therefore, would result in a less than significant impact on terrestrial biological resources.
Marine Biological Resources	Military expended material from interception debris, parachutes, and expended stages would be introduced into the marine environment. Debris resulting from successful interception would have the greatest potential to strike marine biological resources. Due to the low densities of marine biological resources within the potential flight test debris zone, the potential for debris to strike mobile marine biological resources would be extremely low. All debris associated with the flight tests would sink to the seafloor. Flight tests and subsequent debris would be infrequent (twice annually or less). The likelihood of any fish, sea turtle, marine mammal, or seabird being in the exact location of debris suspended in the water column and ingesting it is extremely low. Risk for entanglement would be present while parachutes are suspended in the water column, which would be a relatively short period of time. Once expended parachutes have reached the seafloor, they would pose no risk for entanglement. Impacts on marine biological resources from noise from splashdown of missile components have the potential to affect the behavior and hearing sensitivity in birds, marine mammals, sea turtles, and fish. However, the probability of marine biological resources being in the impacted area and at the ocean surface is low; therefore, the risk of potential impacts from noise is low. The analysis conclusions for marine biological resources are consistent with a minor determination and therefore would result in a less than significant impact on marine biological resources.
Cultural Resources	There are no identified historic properties within the launch area or potential booster drop area at AAFB. Additionally, no historic properties have been identified within the relevant portions of the potential flight test debris area. Debris falling to the seafloor is not likely to impact any unidentified historic properties that may exist due to dispersion of debris through the water column. Sea-based flight tests or tracking exercises would occur far from land. The analysis conclusions for cultural resources and historic properties are consistent with a negligible determination and would result in a less than significant impact on cultural resources and historic properties.
Environmental Justice and	Potential impacts on air quality, climate change and greenhouse gases, and public health and safety from land-based flight tests or tracking exercises

Resource Area	**Alternative 2 (Preferred Alternative)**
Children's Environmental Health and Safety Risk	would be minor. In addition, there are no anticipated impacts on socioeconomic resources. Therefore, there would be no disproportionately high impacts on or adverse effects to any low-income or minority populations in the vicinity of AAFB. The policies and procedures that protect the health and safety of the public and workers also protect children. Thus, Alternative 2 would not disproportionately expose children to environmental health or safety risks. Sea-based flight tests would occur far from land or populated areas. The analysis conclusions for environmental justice under Alternative 2 are consistent with a minor determination and therefore would result in a less than significant impact on environmental justice.
Public Health and Safety	Adherence to the policies and procedures protects the health and safety of the public and workers. These and other procedures ensure ground safety, flight safety, range clearance and surveillance, sea-surface area clearance and surveillance, and control of commercial air traffic. These procedures include coordination with the FAA and U.S. Coast Guard and publishing Notices to Mariners and NOTAMs. The FAA would also establish a Temporary Flight Restriction to protect military and civilian aircraft from the non-ionizing High-intensity Radiated Field of the TPY-6 radar when active. To further ensure public health and safety, roadblocks, access control, restricted access, and security sweeps would occur at AAFB, and land restrictions would be put in place for public and private lands in the vicinity of the launch area outside of AAFB. Sea-based flight tests and tracking exercises would occur far from land and populated areas. The analysis conclusions for public health and safety are consistent with a minor determination and therefore would result in a less than significant impact on public health and safety.
Noise	Land-based flight tests and tracking exercises could result in sound levels characterized as very loud near the launch pad. However, flight tests and tracking exercises would occur infrequently, be short in duration, and have a minute effect on the overall sound in the area. Given the sound environment at the launch area, launch noise would be higher than typical ambient levels, but would be comparable to a large truck or airplane overflight. Any sonic boom would be typically audible for only a few milliseconds and would be of less intensity than larger rockets which have been considered by the U.S. Fish and Wildlife Service to be less than significant to marine species. Sea-based launches would occur far from sensitive receptors. The analysis conclusions

Resource Area	**Alternative 2 (Preferred Alternative)**
	for noise are consistent with a minor determination and therefore would result in a less than significant impact on noise.

ENVIRONMENTAL MANAGEMENT AND MONITORING ACTIONS:

NEPA requires federal agencies to consider appropriate mitigation measures to avoid, minimize, or compensate for specific impacts. MDA and the services are taking steps to avoid and minimize impacts from the PA and identify potential mitigation measures for consideration to further minimize or offset remaining adverse environmental impacts from the PA. Biological Resources consultation is underway. MDA and the services will abide by mitigation measures outlined in the Biological Evaluation of the PA at the consultation conclusion.

Best Management Practices and Conservation Measures

DoD personnel would implement the following efforts as best management practices to avoid and minimize impacts from the PA.

BMP	Description
Air Quality	Construction activities would mitigate emissions from fugitive dust and burning of fossil fuels by complying with Guam Air Pollution Control Standards.
Biosecurity Outreach and Education	The DoD will implement a natural resources education program to ensure all military and contractor personnel are informed of the biological resources in the project area, including invasive species, special-status species, avoidance measures, and reporting requirements in the project area.
Brown Treesnake Interdiction	Joint Region Marianas has established a comprehensive brown treesnake interdiction program to ensure that military activities, including the transport of civilian and military personnel and equipment to and from Guam, do not contribute to the spread of the brown treesnake to other islands or regions. Brown treesnake interdiction requirements are specified in DoD instructions (i.e., 36 Wing Instruction 32-7004, Brown Tree Snake Control Plan and Commander Navy Region Marianas Instruction 5090.10A, Brown Tree Snake Control and Interdiction Plan). The PA would comply with these established procedures.

BMP	Description
Biological Monitor	A qualified biological monitor must be present and monitor all booster recovery activities. This includes ensuring that no unnecessary vegetation, particularly ESA-listed species, is disturbed or damaged while accessing the site of the expended booster, while preparing the booster for extraction, and when exiting the recovery area. The biomonitor will flag ESA-listed species for avoidance during the ingress and egress of the recovery area and during the preparation and retrieval of the booster.

Other Avoidance, Minimization, and Mitigation Measures

The following measures to avoid, minimize, or mitigate environmental impacts associated with the PA are included in this EA/OEA:

- After the conclusion of FEM-02, a helicopter would be used to retrieve the interceptor's first booster stage.
- Undeveloped areas would not be used for placement, storage, or launch of flight test or tracking exercise components.

No other measures to avoid, minimize, or mitigate environmental impacts associated with the PA are included in this EA/OEA.

PUBLIC REVIEW AND COMMENT:

A Notice of Availability of the Proposed Final EA/OEA and unsigned Proposed FONSI for public review and comment was published in local newspapers. Hard copies of the documents were made available at local libraries on Guam, and downloadable versions were posted to the MDA public website.

CONCLUSION:

The analysis of the PA to deploy and test missile defense systems, including up to two flight tests or tracking exercises per year from AAFB or at sea from a U.S. Navy ship underway in the BOA of the western Pacific Ocean for a period of 10 years, concluded that its implementation would not have a significant environmental impact on the human and natural environment, either by itself or cumulatively with other actions. After thoroughly considering the facts herein, the undersigned finds that the PA is consistent with existing environmental policies and objectives set forth in the National Environmental Policy Act and its implementing regulations. Therefore, an Environmental Impact Statement is not required.

APPROVE:

______________________________ **DATE:** ____________________

LAURA M. DESIMONE
Executive Director
Missile Defense Agency

______________________________ **DATE:** ____________________

Name
Title
Joint Region Marianas

Abstract

Designation:	Environmental Assessment/Overseas Environmental Assessment
Title of Proposed Action:	Guam Flight Test
Project Location:	Andersen Air Force Base
Lead Agency for the EA:	Missile Defense Agency
Cooperating Agency:	United States Department of the Navy, United States Department of the Air Force, United States Department of the Army, and United States Coast Guard
Affected Region:	Guam/Western Pacific Broad Ocean Area
Action Proponent:	Missile Defense Agency
Point of Contact:	James Elliott Missile Defense Agency 5700 18th Street Fort Belvoir, VA 22060-5573 james.elliott@mda.mil
Date:	May 2024

The Missile Defense Agency, in cooperation with the United States (U.S.) Air Force, U.S. Army, U.S. Navy, and U.S. Coast Guard has prepared this Environmental Assessment/Overseas Environmental Assessment in accordance with the National Environmental Policy Act, as implemented by Council on Environmental Quality Regulations and Missile Defense Agency, U.S. Air Force, U.S. Army, U.S. Navy, and U.S. Coast Guard regulations for implementing the National Environmental Policy Act. The Proposed Action would include deploying and testing missile defense systems, including flight tests and tracking exercises from Andersen Air Force Base or at sea from a U.S. Navy ship. Flight tests would begin in the first quarter of Fiscal Year 2025 and occur up to two times per year over a period of ten years.

The Missile Defense Agency evaluated the potential environmental impacts associated with three alternatives:

- No Action Alternative, under which no flight tests would occur from land- or sea-based launchers; no tracking exercises to test or calibrate the land-, airborne-, sea-, and space-based sensors would occur; and Andersen Air Force Base would continue with current activities. This alternative does not meet the purpose of and need for the Proposed Action.
- Alternative 1 includes flight tests or tracking exercises utilizing land-based launch systems for interceptor launch with land-, airborne-, sea-, and space-based sensor integration.

- Alternative 2 (Preferred Alternative) includes flight tests or tracking exercises utilizing land- or sea-based launch systems for interceptor launch with land-, airborne-, sea-, and space-based sensor integration.

A thorough analysis of environmental resource areas determined that implementation of any of the alternatives would not result in significant impacts on the following resource areas: airspace management; air quality; climate change and greenhouse gases; terrestrial biological resources; marine biological resources; cultural resources; environmental justice and children's environmental health and safety risk; public health and safety; and noise.

EXECUTIVE SUMMARY

ES.1 Proposed Action

The Missile Defense Agency (MDA), in cooperation with the United States (U.S.) Air Force, U.S. Army, U.S. Navy, and U.S. Coast Guard, has prepared this Environmental Assessment/Overseas Environmental Assessment (EA/OEA) to evaluate the potential environmental impacts from conducting up to two proposed missile defense flight tests (hereinafter referred to as “flight tests”) or target tracking exercises (hereinafter referred to as “tracking exercises”) from a location on Guam or at sea in the western Pacific Ocean per year for a period of ten years (Proposed Action).

Flight tests would begin in the first quarter of Fiscal Year 2025 with Flight Experiment Aegis Weapon System (FEM)-02. During FEM-02, a target Medium Range Ballistic Missile (target) would be air-launched from a C-17 or similar aircraft. The aircraft would be more than 800 nautical miles from Guam at an altitude greater than 20,000 feet. The target would separate from the extraction pallet and parachutes and begin following its pre-determined trajectory. The extraction pallet and parachutes would stay connected, fall to the surface of the ocean outside of the U.S.’s Exclusive Economic Zone outside of the territory of Guam, and sink to the seafloor. The target would have two booster stages which would also fall to the surface of the ocean outside of the U.S.’s Exclusive Economic Zone outside of the territory of Guam and sink to the seafloor. The booster stages are anticipated to remain in one piece, with all solid propellant consumed. No hazardous material leaks would be expected.

Land-based assets at Andersen Air Force Base (AAFB) would begin tracking the target after it is launched from the aircraft. A Standard Missile (SM)-3 interceptor missile (interceptor) would then launch from Northwest Field at AAFB. The three stage interceptor would have two booster stages. The first stage booster would fall to the ground east of the launch area within AAFB boundaries shortly after launch. The interceptor’s second stage booster would fall to the surface of the ocean outside of the U.S.’s Exclusive Economic Zone outside of the territory of Guam and sink to the seafloor. Both interceptor booster stages are anticipated to remain in one piece, with all solid propellant consumed. No hazardous material leaks would be expected. The interceptor would travel on its trajectory into the exosphere (the outermost region of Earth’s atmosphere) where it would intercept the target by force of impact, resulting in debris. Most of the debris would burn up upon reentry, however some pieces of debris may fall to the surface of the ocean no closer than 88 nautical miles from Guam and sink to the seafloor.

MDA is the lead agency for this EA/OEA pursuant to the National Environmental Policy Act (42 United States Code 4321, et. seq) section 107(a) and 40 Code of Federal Regulations section 1501.7. The U.S. Air Force, U.S. Army, U.S. Navy, and U.S. Coast Guard were invited to participate as cooperating agencies pursuant to National Environmental Policy Act section

107(a)(3), as amended by the Fiscal Responsibility Act of 2023, and 40 Code of Federal Regulations section 1501.8.

ES.2 Purpose of and Need for the Proposed Action

The purpose of the Proposed Action is to validate the interoperability of multiple sensors and interceptor systems from the Services that could become a part of the "system of systems" (or the backbone) of a missile defense system developed to protect Guam. The need for the Proposed Action is to facilitate research and increase the Department of Defense's understanding of the ability of a missile defense system — including the Terminal High Altitude Area Defense (THAAD) system, Aegis Weapon System, Phased Array Tracking Radar to Intercept of Target (PATRIOT) Advanced Capability-Three (PAC-3) Missile Segment Enhanced (MSE) system, Indirect Fire Protection Capability system, and supporting sensors — to counter the threat presented by short-, mid-, and long-range ballistic missiles, cruise missiles, and hypersonic missiles in a realistic environment.

ES.3 Alternatives Considered

MDA is considering two action alternatives that meet the purpose of and need for the Proposed Action, and a No Action Alternative. Alternative 1 includes flight tests or tracking exercises utilizing land-based launch systems for interceptor launch with land-, airborne-, sea-, and space-based sensor integration. Alternative 2 (Preferred Alternative) includes flight tests or tracking exercises utilizing land- <u>or sea-based launch systems</u> for interceptor launch with land-, airborne-, sea-, and space-based sensor integration. The No Action Alternative does not include flight tests from land- or sea-based launchers; tracking exercises to test or calibrate the land-, airborne-, sea-, and space-based sensors would not occur; and AAFB would continue with current activities.

ES.4 Summary of Environmental Resources Evaluated in the EA

Council on Environmental Quality regulations, National Environmental Policy Act, and MDA instructions for implementing the National Environmental Policy Act, specify that an EA should address those resource areas potentially subject to impacts from proposed actions. In addition, the level of analysis should be commensurate with the anticipated level of environmental impact.

The following resource areas have been addressed in this EA/OEA: airspace management; air quality; climate change and greenhouse gases; terrestrial biological resources; marine biological resources; cultural resources and historic properties; environmental justice and children's environmental health and safety risk; public health and safety; and noise. MDA did not analyze potential impacts on the following resource areas, as they were determined to be negligible, nonexistent, or not significant: geology and soils; hazardous materials and waste management; infrastructure (utilities); land use; socioeconomics; transportation; water resources; wetlands; and visual resources/aesthetics.

ES.5 Summary of Potential Environmental Consequences of the Alternatives and Major Mitigating Actions

Table ES-1 provides a summary of the potential impacts on resource areas from each of the alternatives analyzed.

Table ES-1: Summary of Potential Impacts on Resource Areas

Resource Area	No Action Alternative	Alternative 1	Alternative 2 (Preferred Alternative)
Airspace Management	Under the No Action Alternative, the Proposed Action would not occur and there would be no impact on airspace management.	Under Alternative 1, close coordination by the MDA launch operations manager with the Federal Aviation Administration (FAA) (including the issuance of Notices to Air Missions [NOTAMs] and establishment of a temporary flight restriction), Guam Center Radar Approach Control, and Guam International and AAFB Air Traffic Control Towers would minimize the potential for any adverse impacts on airspace use in the vicinity of the launch site and planned missile downrange profile. The analysis conclusions for airspace management under Alternative 1 are consistent with a minor determination as described in Table 4.2-1 and therefore would result in a less than significant impact on airspace management.	For the same reasons stated under Alternative 1, and because sea-based flight tests or tracking exercises would take place far from land and populated areas, the analysis conclusions for airspace management under Alternative 2 (Preferred Alternative) are consistent with a minor determination as described in Table 4.2-1 and therefore would result in a less than significant impact on airspace management.
Air Quality	Under the No Action Alternative, the Proposed Action would not occur and there would be no impact on air quality.	Due to the expected dispersion and transport of pollutant plumes from intermittent and low rates of emissions, under local meteorological conditions, and infrequent public exposure, Alternative 1 impacts are not expected to interfere with the attainment of Ambient Air Quality Standards or contribute to human health risks from hazardous air pollutant (HAP) exposure in areas where the public may be present. The analysis conclusions for air quality under Alternative 1 are consistent with a minor determination, as described in Table 4.3-1, and therefore would result in a less than significant	Under Alternative 2 (Preferred Alternative) additional vessel activities would mainly occur in distances well beyond 12 nautical miles from Guam. The expected dispersion and transport of pollutant plumes from these intermittent emissions in the broad ocean area are not expected to significantly increase concentrations of criteria pollutants or HAPs or have an impact on human health. For this reason, and the reasons stated under Alternative 1, the analysis

Resource Area	No Action Alternative	Alternative 1	Alternative 2 (Preferred Alternative)
		impact on air quality.	conclusions for air quality under Alternative 2 (Preferred Alternative) are consistent with a minor determination, as described in Table 4.3-1, and therefore would result in a less than significant impact on air quality.
Climate Change and Greenhouse Gases	Under the No Action Alternative, the Proposed Action would not occur and there would be no impact on climate change and greenhouse gases.	Under Alternative 1, expected greenhouse gas (GHG) emissions are relatively minor and make up a negligible percentage of the global GHG emissions. The analysis conclusions for climate change and greenhouse gases under Alternative 1 are consistent with a minor determination, as described in Table 4.4-1, and therefore would result in a less than significant impact on climate change and greenhouse gases.	For the same reasons stated under Alternative 1, the analysis conclusions for climate change and greenhouse gases under Alternative 2 (Preferred Alternative) are consistent with a minor determination, as described in Table 4.4-1, and therefore would result in a less than significant impact on climate change and greenhouse gases.
Terrestrial Biological Resources	Under the No Action Alternative, the Proposed Action would not occur and there would be no impact on terrestrial biological resources.	Under Alternative 1, wildlife could be exposed to increased noise levels; however, noise impacts on wildlife would likely be limited to short-term, minor disturbances. The potential for physical disturbance or strike of wildlife or Endangered Species Act (ESA)-listed plant species under Alternative 1 would be from the expended first stage booster. Given the size of the booster and infrequent nature of the flight tests, it is unlikely the falling booster would result in a direct strike on wildlife or ESA-listed species. If the booster did damage an ESA-listed plant, the number of individuals affected would be small (less than 6 plants) and would not cause long-term effects to the populations or species. The potential for the physical presence of flight test personnel in the proximity of wildlife is during the recovery of the first booster. Personnel presence during recovery	For the same reasons stated under Alternative 1, the analysis conclusions for terrestrial biological resources under Alternative 2 (Preferred Alternative) are consistent with a moderate determination, as described in Table 4.5-1. Sea-based flight tests or tracking exercises would occur far from land and have no impact on terrestrial biological resources and, therefore, would result in a less than significant impact on terrestrial biological resources.

Resource Area	No Action Alternative	Alternative 1	Alternative 2 (Preferred Alternative)
		could result in a startle response, resulting in nearby wildlife fleeing the area. However, these impacts would be short term and not result in any long-term behavioral impacts. Radar use is expected to have no effect on biological resources due to the radar operations, flight behavior and ecology of birds and bats, and lack of roost habitat near the sensors field of regard. Lastly, due to the presence of humans, man-made structures, vehicles, and lighting within the project area, as well as the location of the radar, it is unlikely that birds would come within proximity of the radar. The analysis conclusions for terrestrial biological resources under Alternative 1 are considered moderate, as described in Table 4.5-1, and therefore would result in a less than significant impact on terrestrial biological resources.	
Marine Biological Resources	Under the No Action Alternative, the Proposed Action would not occur and there would be no impact on marine biological resources.	Under Alternative 1, military expended material from interception debris, parachutes, and expended stages would be introduced into the marine environment. Debris resulting from successful interception would have the greatest potential to strike marine biological resources. Due to the low densities of marine biological resources within the potential flight test debris zone, the potential for debris to strike mobile marine biological resources would be extremely low. All debris associated with the flight tests would sink to the seafloor. Flight tests and subsequent debris would be infrequent (twice annually or less). The likelihood of any fish, sea turtle, marine mammal, or seabird being in the exact location of debris suspended in the water	For the same reasons stated under Alternative 1, the analysis conclusions for marine biological resources under Alternative 2 (Preferred Alternative) are consistent with a minor determination, as described in Table 4.6-1, and therefore would result in a less than significant impact on marine biological resources.

Resource Area	No Action Alternative	Alternative 1	Alternative 2 (Preferred Alternative)
		column and ingesting it is extremely low. Risk for entanglement would be present while parachutes are suspended in the water column, which would be a relatively short period of time. Once expended parachutes have reached the seafloor, they would pose no risk for entanglement. Impacts on marine biological resources from noise from splashdown of missile components have the potential to affect the behavior and hearing sensitivity in birds, marine mammals, sea turtles, and fish. However, the probability of marine biological resources being in the impacted area and at the ocean surface is low; therefore, the risk of potential impacts from noise is low. The analysis conclusions for marine biological resources under Alternative 1 are consistent with a minor determination, as described in Table 4.6-1, and therefore would result in a less than significant impact on marine biological resources.	
Cultural Resources	Under the No Action Alternative, the Proposed Action would not occur and there would be no impact on cultural resources and historic properties.	There are no direct or indirect impacts to known cultural resources or historic properties on AAFB. The likelihood of impacting unknown cultural resources or historic properties on AAFB is very low. Debris falling to the seafloor is not likely to impact known or unknown cultural resources due to low site distribution and high dispersal/low density of debris. In the statically improbable instance that debris did strike a cultural resource, attenuated velocity would prevent the debris from causing damage. The analysis conclusions for cultural resources and historic properties under Alternative 1 are consistent with a minor determination, as described in	Under Alternative 2 (Preferred Alternative), sea-based flight tests or tracking exercises would occur far from land. For this reason and those stated under Alternative 1, the analysis conclusions for cultural resources and historic properties under Alternative 2 (Preferred Alternative) are consistent with a minor determination, as described in Table 4.7-1, and therefore would result in a less than significant impact on cultural resources and historic properties.

Resource Area	No Action Alternative	Alternative 1	Alternative 2 (Preferred Alternative)
		Table 4.7-1, and would result in a less than significant impact on cultural resources and historic properties.	
Environmental Justice and Children's Environmental Health and Safety Risk	Under the No Action Alternative, the Proposed Action would not occur and there would be no impact on environmental justice and children's health and safety risk.	Under Alternative 1, potential impacts on air quality, climate change and greenhouse gases, and public health and safety from land-based flight tests or tracking exercises would be minor. In addition, there are no anticipated impacts on socioeconomic resources. Therefore, there would be no disproportionately high impacts on or adverse effects to any low-income or minority populations in the vicinity of AAFB. The policies and procedures that protect the health and safety of the public and workers also protect children. Thus, Alternative 1 would not disproportionately expose children to environmental health or safety risks. The analysis conclusions for environmental justice under Alternative 1 are consistent with a minor determination, as described in Table 4.8-1, and therefore would result in a less than significant impact on environmental justice.	Under Alternative 2 (Preferred Alternative), sea-based flight tests would occur far from land or populated areas. For this reason and the reasons stated under Alternative 1, the analysis conclusions for environmental justice under Alternative 2 (Preferred Alternative) are consistent with a minor determination, as described in Table 4.8-1, and therefore would result in a less than significant impact on environmental justice.
Public Health and Safety	Under the No Action Alternative, the Proposed Action would not occur and there would be no impact on public health and safety.	Under Alternative 1, adherence to the policies and procedures identified in Sections 2.1.1 (Flight Test and Tracking Process and Equipment) and 3.9.2 (Public Health and Safety Affected Environment) protects the health and safety of the public and workers. These and other procedures ensure ground safety, flight safety, range clearance and surveillance, sea-surface area clearance and surveillance, and control of commercial air traffic. These procedures include coordination with the FAA and U.S. Coast Guard and publishing	Under Alternative 2 (Preferred Alternative), sea-based flight tests and tracking exercises would occur far from land and populated areas. For this reason, and the same reasons as stated under Alternative 1, the analysis conclusions for public health and safety under Alternative 2 (Preferred Alternative) are consistent with a minor determination, as described in Table 4.9-1, and therefore would result in a

Resource Area	No Action Alternative	Alternative 1	Alternative 2 (Preferred Alternative)
		Notices to Mariners and NOTAMs. The FAA would also establish a Temporary Flight Restriction to protect military and civilian aircraft from the non-ionizing High-intensity Radiated Field of the TPY-6 radar when active. To further ensure public health and safety, roadblocks, access control, restricted access, and security sweeps would occur at AAFB, and land restrictions would be put in place for public and private lands in the vicinity of the launch area outside of AAFB. The analysis conclusions for public health and safety under Alternative 1 are consistent with a minor determination, as described in Table 4.9-1, and therefore would result in a less than significant impact on public health and safety.	less than significant impact on public health and safety.
Noise	Under the No Action Alternative, the Proposed Action would not occur and there would be no impact from noise.	Under Alternative 1, land-based flight tests and tracking exercises could result in sound levels characterized as very loud near the launch pad. However, flight tests and tracking exercises would occur infrequently, be short in duration, and have a minute effect on the overall sound in the area. Given the sound environment at the launch area, launch noise would be higher than typical ambient levels, but would be comparable to a large truck or airplane overflight. Any sonic boom would be typically audible for only a few milliseconds and would be of less intensity than larger rockets which have been considered by the U.S. Fish and Wildlife Service to be less than significant to marine species. The analysis conclusions for noise under Alternative 1 are consistent with a minor determination, as described in Table 4.10-1, and therefore would result in a less than significant impact on noise.	Under Alternative 2 (Preferred Alternative), sea-based launches would occur far from sensitive receptors. For this reason, and the reasons stated under Alternative 1, the analysis conclusions for noise under Alternative 2 (Preferred Alternative) are consistent with a minor determination, as described in Table 4.10-1, and therefore would result in a less than significant impact on noise.

ES.6 Public Involvement

MDA is providing a 30-day public review and comment period following publication of the Proposed Final EA/OEA and Proposed Finding of No Significant Impact (FONSI) Notice of Availability. Notification of the availability of these documents and opportunities for public comment will be published three times in the Pacific Daily News and Guam Daily Post on Guam. Printed copies of the Proposed Final EA/OEA and Proposed FONSI are available at the Dededo Public Library and the Nieves M. Flores Memorial Library. The Proposed Final EA/OEA and Proposed FONSI are also available for download at https://www.mda.mil/system/guamft/.

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Acronyms and Abbreviations

AAFB	Andersen Air Force Base
AAQS	Ambient Air Quality Standards
AWS	Aegis Weapon System
BMD	Ballistic Missile Defense
BOA	Broad Ocean Area
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CERAP	Center Radar Approach Control
CFR	Code of Federal Regulations
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
CWA	Clean Water Act
dB	Decibel
dBA	A-weighted Decibels
DNL	Day-Night Average Sound Level
DoD	Department of Defense
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EIAMD	Enhanced Integrated Air and Missile Defense
EIS	Environmental Impact Statement
ELTS	Early Launch Tracking System
EME	Electromagnetic Energy
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FEM	Flight Experiment Aegis Weapon System
FONSI	Finding of No Significant Impact
FR	Federal Register
GHG	Greenhouse Gas
GWP	Global Warming Potential
HAP	Hazardous Air Pollutant
HIRF	High-Intensity Radiated Field
H.R.	House of Representatives
IFPC	Indirect Fire Protection Capability
INRMP	Integrated Natural Resources Management Plan
JO	Job Order
LHA	Launch Hazard Area
L_{max}	Maximum Sound Level
MBTA	Migratory Bird Treaty Act
MDA	Missile Defense Agency
MITT	Mariana Islands Training and Testing
MMPA	Marine Mammal Protection Act
MSA	Munitions Storage Area
MSL	Mean Sea Level
MT	Metric Ton
N_2O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NAVFAC	Naval Facilities Engineering Command
NBG	Naval Base Guam
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOTAM	Notice to Air Missions
NOTMAR	Notice to Mariners
NO_x	Nitrogen oxides
NRHP	National Register of Historic Places
NWF	Northwest Field
O_3	Ozone
OEA	Overseas Environmental Assessment
OEIS	Overseas Environmental Impact Statement
PAC-3 MSE	Phased Array Tracking Radar to Intercept of Target Advanced Capability-Three Missile Segment Enhanced
$PM_{2.5}$	Particulate matter less than or equal to 2.5 microns
PM_{10}	Particulate matter less than or equal to 10 microns
RCC	Range Commanders Council
ROI	Region of Influence
SIP	State Implementation Plan
SM	Standard Missile
SO_2	Sulfur Dioxide
SPCS	Space Control Squadron
TFR	Temporary Flight Restriction
THAAD	Terminal High Altitude Area Defense
TTS	Transportable Telemetry System
U.S.	United States
U.S.C.	United States Code
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VOC	Volatile Organic Compounds

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1.0 Purpose of and Need for the Proposed Action

1.1 Introduction

The Missile Defense Agency (MDA), in cooperation with the United States (U.S.) Air Force, U.S. Army, U.S. Navy, and U.S. Coast Guard has prepared this Environmental Assessment/Overseas Environmental Assessment (EA/OEA) to evaluate the potential environmental impacts from proposed missile defense flight tests (hereinafter referred to as "flight tests"), or target tracking exercises (hereinafter referred to as "tracking exercises") conducted from a location on Guam or at sea in the western Pacific Ocean.

This EA/OEA has been prepared in accordance with the following:

The National Environmental Policy Act of 1969 (NEPA), as amended (42 U.S. Code [U.S.C.] section 4321 et seq.)

- The President's Council on Environmental Quality (CEQ) 2022 Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR] parts 1500–1508)
- Executive Order (EO) 12114, *Environmental Effects Abroad of Major Federal Actions*
- MDA's NEPA Implementing Procedures (79 Federal Register [FR] 46410)
- U.S. Department of the Air Force's Environmental Impact Analysis Process (32 CFR part 989)
- U.S. Army NEPA Implementing Procedures (32 CFR part 651, Environmental Analysis of Army Actions)
- U.S. Navy Procedures for Implementing NEPA (32 CFR part 775) and Chief of Naval Operations Instruction 5090.1E, *Environmental Readiness Program*
- U.S. Coast Guard Environmental Planning Policy (Commandant Instruction M5092.1)

This EA/OEA considers the potential environmental impacts of conducting up to two flight tests or tracking exercises per year over a 10-year period from Andersen Air Force Base (AAFB) on Guam or from a U.S. Navy surface ship underway in the broad ocean area (BOA) of the western Pacific Ocean to validate the interoperability of multiple sensors and interceptor systems from MDA, U.S. Army, and U.S. Navy (the Services) that could comprise portions of a missile defense system developed to protect Guam.

The BOA is defined as the open ocean area beyond 12 nautical miles offshore from land, and typically encompasses the Pacific, Atlantic, and Indian oceans for NEPA analysis.

This EA/OEA discusses and analyzes the potential environmental impacts of the first flight test, the Flight Experiment Aegis Weapon System (FEM)-02, in detail. Future flight tests are discussed and analyzed programmatically. As details for future flight tests and tracking exercises are further developed, additional NEPA documentation may be required.

A detailed description of the Proposed Action (PA) is provided in Chapter 2.0 (Description of the Proposed Action and Alternatives).

Background

Guam is a U.S. territory and a key strategic location for sustaining and maintaining U.S. influence, deterring adversaries, and responding to crises across the Pacific theater. Commander of the U.S. Indo-Pacific Command assesses that its posture in Guam requires modernization and enhancement to provide an operationally resilient and sustainable force that aligns with national guidance and enables the implementation of international agreements. Current forces are capable of defending Guam against today's regional ballistic missile threats. However, the regional threats to Guam continue to increase and improve technologically. Therefore, U.S. Indo-Pacific Command has identified a requirement for a more robust missile defense system as soon as possible to address the rapid evolution of adversary threats.

Within the Department of Defense (DoD), MDA is responsible for developing, testing, and fielding a missile defense system to defend the U.S. and its deployed forces, allies, and friends against missile attacks in all phases of flight. A missile defense system provides a layered defense consisting of various land-, sea-, and air-based weapons; sensor and communications systems; and command and control platforms that are used to defeat incoming ballistic, cruise, and hypersonic missiles in all phases of flight. The layered missile defense technology being developed, tested, and deployed by the U.S. is designed to counter missiles in all phases of flight.

1.2 Purpose of and Need for the Proposed Action

MDA proposes to deploy and test missile defense systems, including flight tests or tracking exercises, from a location on Guam or at sea from a U.S. Navy ship (Proposed Action). The purpose of the PA is to validate the interoperability of multiple sensors and interceptor systems from the Services that could become a part of the "system of systems" (or the backbone) of a missile defense system developed to protect Guam. These flight tests and tracking exercises are needed to facilitate research and increase the DoD's understanding of the ability of a missile defense system, including the Terminal High Altitude Area Defense (THAAD), Aegis Weapon System (AWS), Phased Array Tracking Radar to Intercept of Target (PATRIOT) Advanced Capability-Three (PAC-3) Missile Segment Enhanced (MSE) system, Indirect Fire Protection Capability (IFPC) system, and supporting sensors to counter the threat presented by short-, mid-, and long-range ballistic missiles, cruise missiles, and hypersonic missiles in a realistic environment. Further, this action is needed to significantly improve realistic Command and Control, Battle Management and Communications in multiple theaters around the world, as well as to increase ballistic missile, cruise missile, and hypersonic missile threat detection and defeat capabilities for Guam.

1.3 Decisions to Be Made

The decision to be made is whether to deploy, test, and conduct up to two flight tests or tracking exercises per year utilizing land-based launch systems for interceptor launch with land-, airborne-, sea-, and space-based sensor integration; or up to two flight tests or tracking exercises per year utilizing land- or sea-based launch systems for interceptor launch with land-, airborne-, sea-, and space-based sensor integration. This EA/OEA also considers and evaluates a No Action Alternative. A decision, if made, would be based on the analysis of the potential threats to Guam, system performance, and potential environmental impacts. Other decisions to be made associated with the PA include the decisions to be made by the Federal Aviation Administration (FAA) and U.S. Coast Guard to issue Notice to Air Missions and Notice to Mariners.

1.4 Scope of the Environmental Assessment

This EA/OEA identifies, evaluates, and documents the reasonably foreseeable environmental effects that would occur from conducting up to two proposed flight tests or tracking exercises per year over a 10-year period from a location on Guam or the western Pacific Ocean. Activities associated with the proposed flight tests and tracking exercises are also assessed in this EA/OEA.

This EA/OEA discusses and analyzes the potential environmental impacts of the first flight test, FEM-02, in detail. Future flight tests are discussed and analyzed programmatically. As details for future flight tests and tracking exercises are further developed, additional NEPA documentation may be required. The resources analyzed in this EA/OEA, and those considered but excluded from further analysis, are listed in Chapter 2.0 (Description of the Proposed Action and Alternatives).

Prior to this EA/OEA, MDA developed and began deploying the Initial Deployment Operational Concept on Guam to address the rapid evolution of adversary threats. The Initial Deployment is deployed at the same location as the PA, to validate the operational concept necessary to test the operability of MDA components in a realistic environment. The activities evaluated included the feasibility of expeditionary deployment and site preparation techniques in harsh environments (including typhoon weather conditions), operational procedures, installation, checkout, and maintenance. It was determined that the Initial Deployment Operational Concept is a categorically excluded action that will not significantly impact the quality of the human environment, and thus does not require further analysis.

1.5 Cooperating Agencies

MDA is the lead agency for this EA/OEA, and the U.S. Air Force, U.S. Army, U.S. Navy, and U.S. Coast Guard have been invited to participate as cooperating agencies for consultation, review, and comment on this EA/OEA, as defined in 40 CFR section 1501.8 Cooperating Agencies or 40 CFR section 1501.7 Lead Agencies.

1.6 Federal Environmental Requirements

The PA constitutes a federal action subject to the requirements of NEPA. The CEQ issued regulations (40 CFR 1500–1508) to implement NEPA that include provisions for both the content and procedural aspects of the required environmental analysis. Accordingly, MDA prepared this EA/OEA through adherence to all applicable procedures (see Section 1.1, Introduction) to evaluate alternatives, identify and evaluate potential environmental impacts, describe any mitigation measures or commitments required, and to communicate its findings to agency decision makers and the public. The scope of analysis presented in this EA/OEA is defined by the potential range of environmental impacts that would result from implementation of the PA.

Related Environmental Documentation

This EA/OEA incorporates by reference applicable environmental impact analyses from previously completed NEPA documents, including those listed below. A complete list of documents used to prepare this EA/OEA is provided in Chapter 5.0 (References).

- 2000 Ballistic Missile Defense Organization Cooperative-Engagement-Capability/PATRIOT (CEC/PATRIOT) Interoperability Test Environmental Assessment
- 2003 Ground-Based Midcourse Defense (GMD) Extended Test Range (ETR) Final Environmental Impact Statement
- 2007 Ballistic Missile Defense System Programmatic Environmental Assessment
- 2007 Flexible Target Family Environmental Assessment
- 2015 Integrated Flight Tests at Wake Atoll Final Environmental Assessment
- 2017 Terminal High-Altitude Area Defense (THAAD) Permanent Stationing in Guam Environmental Assessment
- 2020 Terminal High-Altitude Area Defense (THAAD) Additional Facilities and Infrastructure Supplemental Environmental Assessment
- 2020 Mariana Islands Training and Testing (MITT) Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS)

1.7 Interagency and Intergovernmental Coordination and Consultations

Interagency and intergovernmental coordination is an integral part of EA preparation. As part of early coordination and consultations, MDA notified and consulted with relevant federal and local agencies on the PA and alternatives to identify potential environmental issues and regulatory requirements associated with implementation of the PA. By and through the U.S. Navy, and along with cooperating federal agencies, and as part of this EA/OEA process, MDA is consulting with the agencies presented in Table 1.7-1.

Table 1.7-1: Agencies Currently Being Consulted with Under This EA/OEA

Agency	Statute
National Marine Fisheries Service	Endangered Species Act and the Magnuson-Stevens Fishery Conservation and Management Act
U.S. Fish and Wildlife Service	Endangered Species Act
Guam State Historic Preservation Office	National Historic Preservation Act
Guam Bureau of Statistics and Plans	Coastal Zone Management Act

Appendix B (Correspondence) contains the list of agencies consulted during this EA/OEA. The correspondence(s) with each entity, responses, and concurrences (as applicable) are also included in Appendix B.

1.8 Summary of Public Participation

As part of the NEPA process for this EA/OEA, public participation is encouraged. A 30-day public comment period will begin following publication of the Proposed Final EA/OEA and Proposed Finding of No Significant Impact (FONSI) Notice of Availability. Notification of the availability of these documents and opportunities for public comment will be published in the Pacific Daily News and Guam Daily Post on Guam, and hard copies of the Proposed Final EA/OEA and Proposed FONSI are available at the Dededo Public Library and the Nieves M. Flores Memorial Library. The Proposed Final EA/OEA and Proposed FONSI are also available for download at https://www.mda.mil/system/guamft/.

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2.0 Description of the Proposed Action and Alternatives

2.1 Proposed Action

The PA is to deploy, test, and conduct up to two flight tests or tracking exercises per year over a 10-year period from a location on Guam or from a U.S. Navy ship underway in the BOA of the western Pacific Ocean. A flight test represents a target missile flight, an interceptor missile flight, or an intercept of a target missile, or a test of sensors independent of missile flight. For a single flight test, multiple interceptors and targets may be utilized. A tracking exercise involves using sensors to scan and track a target with no intercept. The interceptor for flight tests would launch from Northwest Field (NWF), AAFB on Guam (Figure 2.1-1), or from a U.S. Navy ship underway in the western Pacific Ocean. Tracking exercises could include both land- and sea-based sensors. Figure 2.1-2 provides an overview of NWF and the layout of flight test components.

The target would be released from a C-17 or similar aircraft at an altitude greater than 20,000 feet, at least 800 nautical miles (1,483 kilometers) from Guam. Once the interceptor leaves Guam, all flight paths and target interception would be over the BOA. The debris that would result from an exospheric interception would impact water more than 88 nautical miles from Guam. All intercepts would be programmed to land in predetermined areas and verified clear areas of the BOA.

Figure 2.1-1: Project Area Overview

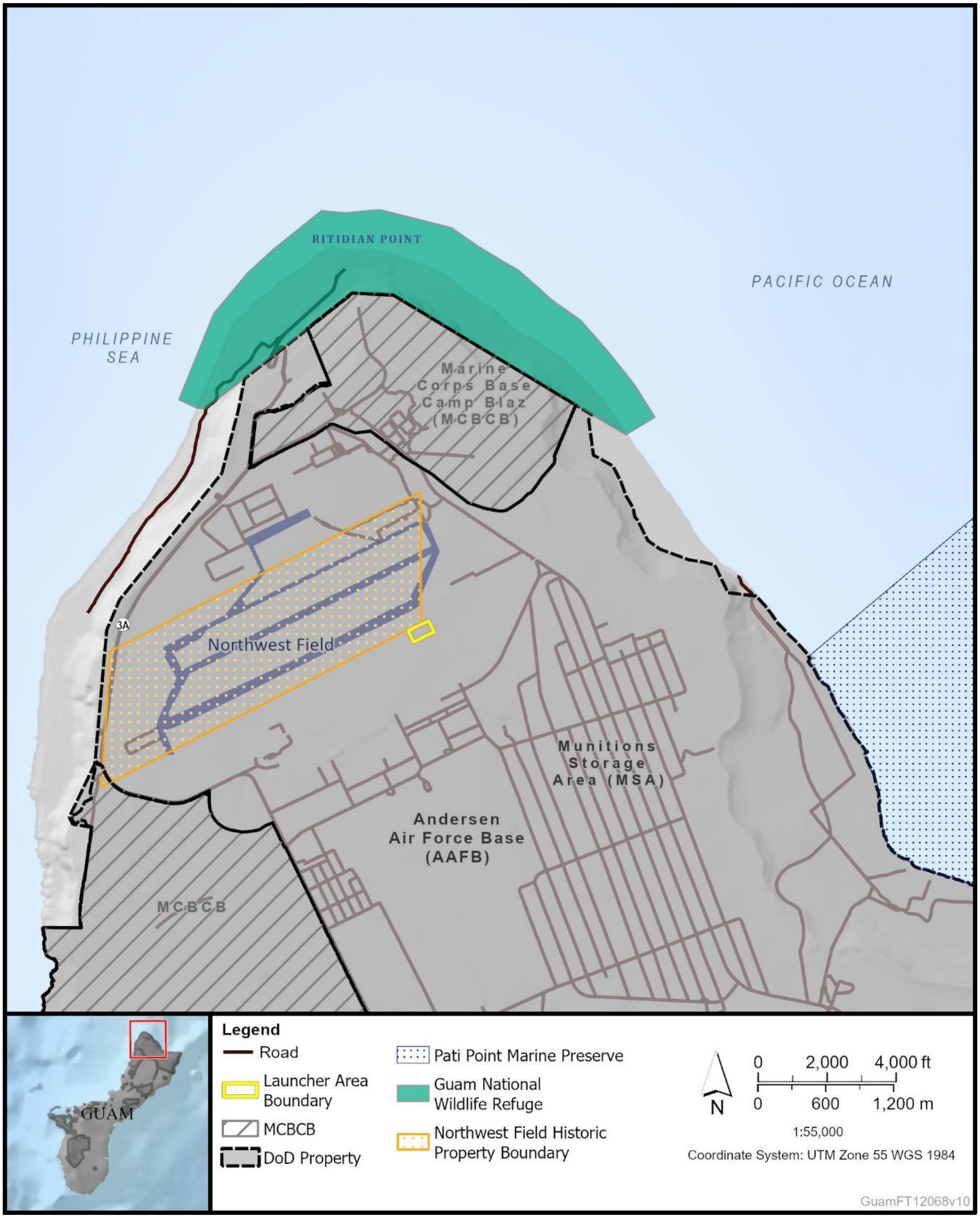


Figure 2.1-2: Overview of Northwest Field, AAFB, and Flight Test Components

Flight tests are expected to begin in the first quarter of Fiscal Year 2025, starting with FEM-02. FEM-02 could include the activities presented in Table 2.1-1.

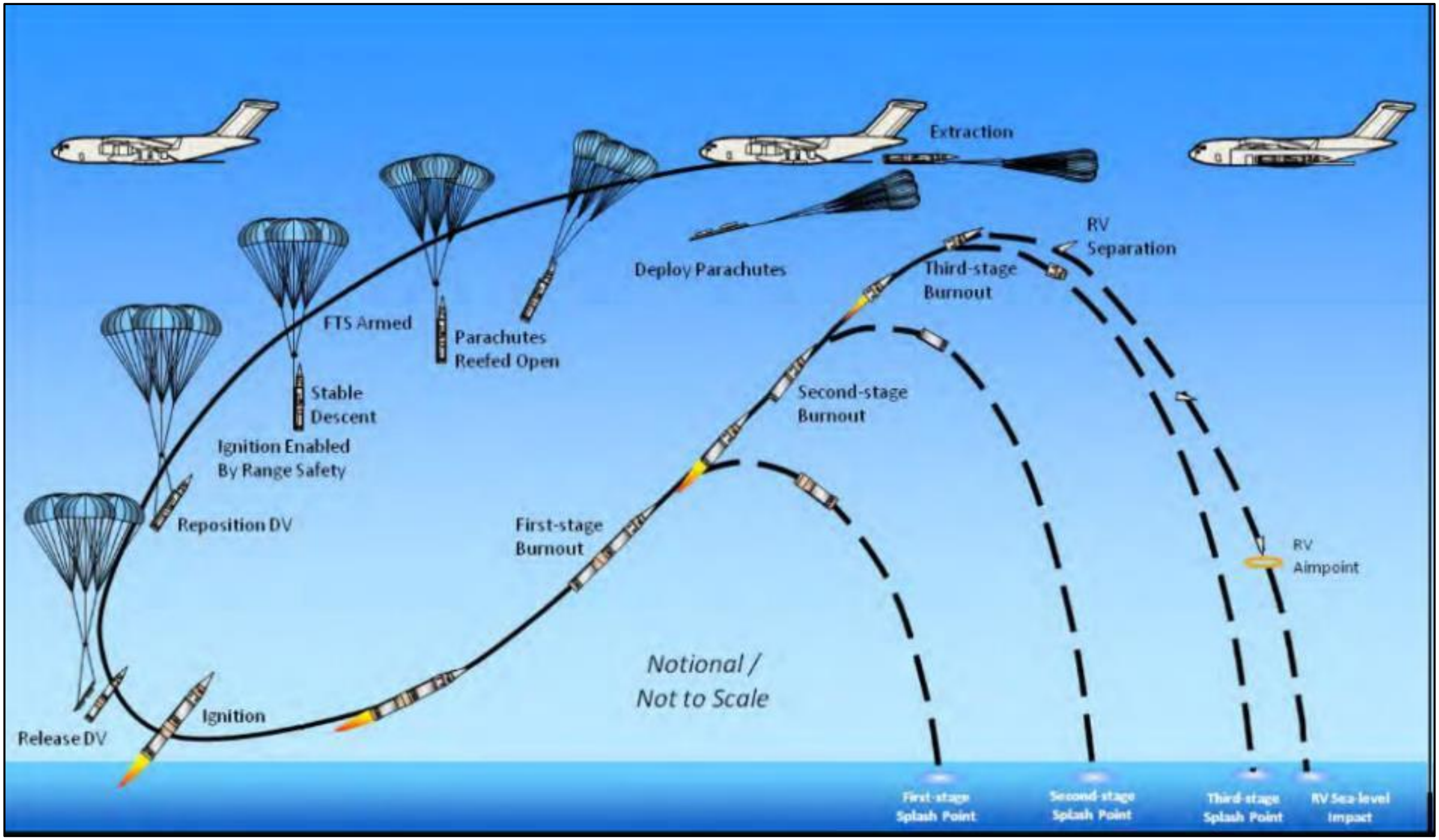
Table 2.1-1: FEM-02 Activities by Phase

FEM-02 Phase	Activity
Pre-Flight Test	Transportation, storage, and placement of interceptor in the launcher in previously disturbed areas
	Integration, checkout, and calibration of range safety and test assets (checkout and calibration activities would include observation of targets of opportunity that may occur on the range and observation of existing overhead satellites, expected to require several hours per day)
	Transportation of target to AAFB and target staging for air launch
Flight Test	Execution of flight tests, which could include the air launch of a target; range safety, air-, land-, or space-based sensors tracking the target; an interceptor launch (land-based); and use of test assets to monitor all aspects of test flight activities, including launch, flight, booster drops, interception, and debris fall
Post-Flight Test	Interceptor's first stage booster recovery
	Shipment of the launcher and range safety equipment back to the mainland U.S.

FEM-02 would include launching a Standard Missile-3 (SM-3) against a medium-range ballistic missile target. As part of the single FEM-02 flight test event, an interceptor would launch from AAFB, Guam, to intercept an air-dropped target outside of the U.S.'s Exclusive Economic Zone (EEZ) outside of the territory of Guam in the exosphere (the outermost region of Earth's atmosphere which begins approximately 375 miles above Earth's surface). The target would be released from a C-17 or similar aircraft (Figure 2.1-3) at an altitude greater than 20,000 feet, 800 nautical miles (1,483 kilometers) east of Guam in the BOA of the western Pacific Ocean.

The target is initially powered and guided into the exosphere but falls under gravity toward the point of intercept, typically following a high, arching trajectory. The midcourse phase begins when the target's booster burns out and it begins coasting in space towards its target. The target would have two booster-stages, both of which would fall into the BOA of the western Pacific Ocean greater than 200 nautical miles from Guam and sink to the sea floor. The intercept would occur in the exosphere. The intercept would result in the destruction of both the interceptor and the target and much of the remaining debris would burn up as it enters the atmosphere. Some of the debris would descend through the atmosphere, land on the ocean surface, and sink to the sea floor. Missile debris would mostly be made up of small pieces (less than 10 grams) but could include medium and larger pieces (tens of kilograms). The debris field that would result from the exospheric intercept would impact water no closer than 88 nautical miles from Guam over depths of water ranging from 10 meters to 9,600 meters.

Figure 2.1-3: Notional Target Launch from an Aircraft



Notes: FTS = Flight Termination System, DV = Delivery Vehicle, RV = Reentry Vehicle

The SM-3 interceptor used during FEM-02 would have two booster stages. The first stage interceptor booster is anticipated to fall on land east of the launch site inside the AAFB installation boundary. Out of an abundance of caution, the Department may request some landowners on the boundaries of AAFB remain away from their properties during test events to ensure their safety. Affected landowners will be contacted by the U.S. Navy Joint Region Marianas to obtain landowner consent. The second stage interceptor booster would fall into the BOA of the western Pacific Ocean greater than 200 nautical miles from Guam and sink to the sea floor.

Future MDA and Army flight tests following FEM-02 would be conducted in a similar manner, but may also include transportation, setup, and checkout of range safety assets, test assets, and support equipment (including personnel trailers and stationary diesel-fueled generators) in previously disturbed areas. All land-based interceptor launches would take place from NWF on AAFB but may use different land-based defensive weapons systems than the AWS being used for FEM-02, such as the PAC-3 MSE, THAAD, or IFPC. Different radars and other systems could be used and would function similarly to the Army Navy/Transportable Radar Surveillance and Control-Series 6 (AN/TPY-6) that would be for FEM-02. Each of these missiles, radars, and other systems would be similar to those used during FEM-02 in terms of function and environmental impacts. The number and types of sensors, interceptors, and targets used in a flight test or tracking exercise can be adjusted to create the desired test scenario.

Ship-based interceptor launches would also occur as described for FEM-02, except that no interceptor would be launched from land on Guam. During the sea-based flight test scenario, the interceptor would be launched from a U.S. Navy Aegis Cruiser or Destroyer at sea in the western Pacific Ocean. At-sea flight tests could include an SM-2 or SM-6, in addition to the SM-3.

Tracking exercises would not include an intercept. Tracking exercises could include the launch of an interceptor or target. If an interceptor or target were launched for a tracking exercise, it would follow its predetermined trajectory, eventually impacting the surface of the BOA in the western Pacific Ocean and sinking to the sea floor.

2.1.1 Flight Test and Tracking Process and Equipment

2.1.1.1 Flight Test Safety

Once a test event is scheduled, there would be a standard sequence of notification and coordination procedures between the Range Safety Office and the agencies that would enforce the clearance of land, air, and sea areas. Reagan Ballistic Missile Defense Test Site would be in charge of range safety for FEM-02.

Flight safety includes analysis of missile performance capabilities and limitations and test mishap termination procedures. It also includes computation and review of missile trajectories, launch azimuths, kinetic energy intercept debris impact areas, and ground hazard areas, review and approval of destruct systems, and preparation of safety plans. Prior to each flight test, the Flight Safety Analyst would define which airspace areas would be affected and the Chief of Range Operations would coordinate with the FAA and the U.S. Coast Guard to address any issues of concern. Air traffic would be rerouted from debris impact areas and expended booster drop zones or rescheduled during the launch window. Local Notices to Mariners (NOTMAR) and Notices to Air Missions (NOTAM) would be issued in the region of the flight test. Flight Test Operators would adhere to health and safety standard operating procedures for the launch. Areas such as shipping lanes would be cleared in accordance with existing standard operating procedures.

Based on the planned launch trajectory ground hazard area, the range safety procedures could require the temporary closure of the Guam National Wildlife Refuge located at the northern tip of the island, as well as temporary restriction of access to other public and private lands located to the north, east, and west of NWF on AAFB. Notification of closures of public and private land would be provided well in advance of any flight test. Agreements between the DoD will be executed with landowners prior to any closures. A NOTMAR and NOTAM would be issued in the day(s) leading up to the launch. AAFB would also coordinate and monitor any traffic passing through the installation, as well as close roads in the vicinity of the proposed launch location on mission day.

2.1.1.2 Test Site Preparations

The PA would require the use of existing facilities and placement of range safety and test assets on previously disturbed areas at or adjacent to NWF at AAFB.

The test site would not be connected to existing base utilities for sanitary sewer, water, communications, or power. Sanitary sewer systems and water for up to 180 test personnel would be provided using portable facilities. Communication lines (e.g., fiber or copper wires) would be laid on the ground and protected by either flexible armor or concrete wire ducts; no trenching would be required. Electrical power would be provided using diesel-fueled generators that are periodically refueled using tank trucks or portable fuel pods or bladders.

2.1.1.3 Range Safety Assets

Range safety equipment includes radars, telemetry collection devices, and flight termination systems to track the launch of an interceptor through fly-out from AAFB to the BOA of the western Pacific Ocean. Radars would be used to detect and track the interceptor and the target, which ensure the interceptor is launched on a path to intercept the target. The test range equipment to be used for FEM-02 would include the Range Safety and Telemetry System; Early Launch Tracking System; and land-, airborne-, sea-, and space-based sensors. In addition, cameras would be used at the launch site as part of range safety. A description of these range safety assets is provided in Appendix D (Range Safety Asset Descriptions).

The range safety equipment would be transported from White Sands Missile Range, New Mexico, or other test ranges, to AAFB via C-17 or other cargo planes, or via sea shipment and transported by truck to the range safety area located adjacent to NWF and the test launcher.

Range safety equipment and support trailers would be anchored to the ground using steel cable and concrete anchor blocks; screw-in or sunken anchors would not be used in order to eliminate the need to drill into the underlying ground. Temporary lighting, security barriers (e.g., fences or concrete jersey walls), and lightning protection poles would be erected; and grounding rods would be installed at select locations. Care would be taken to ensure light fixtures are hooded or directed downwards to minimize impact on wildlife. All equipment except grounding rods would be installed above ground and would not require ground disturbance.

2.1.1.4 Land-Based Interceptor Systems

The flight tests could utilize several target interceptor systems, including the Aegis Guam System, the THAAD Interceptor System, the PAC-3 MSE system, and the IFPC Increment 2-Intercept (IFPC Inc 2-I) System. These tactical systems would be transported from Redstone Arsenal, Alabama, via C-17 or other cargo planes to AAFB, or cargo ships to the Port of Guam, and driven to the proposed interceptor launch location adjacent to NWF. A description of these interceptor (or weapon) systems and their interceptors is provided in Appendix E (Interceptor and Target Weapon System Descriptions).

The interceptor systems would either be anchored to a temporary concrete pad or parked on a crushed gravel pad. Temporary lighting, security barrier, and lightning protection precautions would be taken as described above for range safety assets. Interceptors would be stored in a climate-controlled magazine on either AAFB or Naval Base Guam (NBG). The interceptor would be transported to the launch site in the days leading up to a flight test.

For FEM-02, MDA proposes to use the Aegis Guam System anchored to a temporary concrete pad. Figure 2.1-2 presents the FEM-02 interceptor launcher layout, and interceptor system layouts would be similar for future flight tests.

MDA interceptors that would be used during flight tests under this analysis use hit-to-kill technology whereby kinetic energy destroys the incoming warhead. No nuclear or conventional explosive warheads would be used. For FEM-02, MDA proposes to use the SM-3, which is a three-stage-two-booster solid-propellant, vertically launched interceptor designed to intercept ballistic missiles above the atmosphere (i.e., exo-atmospheric intercept) in the midcourse phase of an enemy ballistic missile’s path. The SM-3 interceptor would be transported from Redstone Arsenal, Alabama, to Guam. Future flight tests would have similar transportation requirements.

Once the interceptor arrived on Guam, all movement of the interceptor and its components would be pre-coordinated and approved by flight test personnel, U.S. Navy personnel, U.S. Army personnel, and AAFB personnel. Applicable safety regulations would be followed in the transport, receipt, storage, and handling of hazardous materials, which includes the interceptor's solid propellant, and components which include lithium and other types of batteries. Appendix E (Interceptor and Target Weapon System Descriptions) provides more detail on the SM-3 and other interceptors that may potentially be used in future flight tests.

2.1.1.5 Ship-Based Intercepts in the Western Pacific BOA

The Aegis ballistic missile defense (BMD) program, which is carried out by the MDA and the U.S. Navy, enables the Aegis System to counter ballistic threats. The Aegis System is a centralized, automated, command-and-control and weapons control system that was designed as a total weapon system, from detection to kill. The heart of the system is the AN/SPY, an advanced, automatic detect and track, multi-function phased-array radar. This high-powered radar is able to perform search, track and missile guidance functions simultaneously, with a track capacity of more than 100 targets.

There are currently 88 U.S. Navy ships in service with the AWS installed: 13 Cruisers and 75 Destroyers. Aegis ships are given the capability to conduct BMD operations by incorporating changes to the Aegis system's computers and software, and by arming the ships with BMD interceptors. The BMD interceptors used by Aegis ships are the SM-3, the SM-2 Block IV, and the SM-6.

2.1.1.6 Integration and Checkout Activities

Once the range safety equipment and test assets are emplaced adjacent to the NWF area and communications and electrical power connections are made, the MDA would conduct a wide range of checkout activities to ensure the equipment is functioning properly and communicating via the following range safety equipment: Battle Management Command, Control, and Communications System; and the fire-control system. Radars, sensors, and telemetry equipment would be calibrated using calibration towers, drones, or overhead satellites. The equipment would likely be operated several hours per day but could occasionally run up to 24 hours per day, especially leading up to the day(s) before an actual test. The typical duration for MDA and Army test events to setup, calibrate, and execute is 45 days.

2.1.1.7 Targets

Flight tests and tracking exercises could use several different targets launched from airborne platforms over the BOA of the western Pacific Ocean, including the Medium Range Ballistic Missile, Short Range Air Launched Target, the Air Launched Intermediate Range Ballistic Missile, and hypersonic missile.

These targets consist of common target components, typically one or more rocket motors and the front section. Adapters (or interstages) separate the individual motors from the front section of the target. The front section components would include reentry vehicles, avionics control modules, and payload deployment modules. Targets could house optical sensors, guidance and control electronics, radio transmitters and receivers, and a power supply (possibly lithium, nickel-cadmium, or other types of batteries). Common payload deployment modules could contain sensors, countermeasures, and simulants. An analysis of these types of targets can be found in the Flexible Target Family EA (U.S. Department of Defense Missile Defense Agency, 2007). No air launches of liquid propellant targets would occur. Table E-1 in Appendix E (Interceptor and Target Weapon System Descriptions) provides more information about the targets under consideration in this EA/OEA.

All movement of the target and its components would be pre-coordinated and approved by flight test personnel, U.S. Navy personnel, and AAFB personnel. Applicable safety regulations would be followed in the transport, receipt, storage, and handling of hazardous materials, which includes the interceptor’s solid propellant, and components which include lithium and other types of batteries.

2.1.1.8 FEM-02

Flight tests would begin with FEM-02 in the first quarter of fiscal year 2025. Test duration could last up to 8 hours, and the typical duration for MDA and Army test events to setup, calibrate, and execute is 45 days. Up to 350 personnel could be needed for FEM-02; however, 350 personnel would not be on-site all at once.

2.1.1.8.1 Pre-Flight Activities

FEM-02 would use a Medium Range Ballistic Missile target shipped via air from Cape Canaveral, Florida, with a refueling stop at either Hill Air Force Base, Utah; Joint Base Pearl Harbor-Hickam (JBPHH) or Edwards Air Force Base, California. The target would be staged in a C-17 parked at an ordnance holding pad on AAFB for 10-15 days before the flight test. The C-17 would be climate controlled using two diesel-fueled air conditioning units until the test event. Applicable safety regulations would be followed in the transport and handling of hazardous materials.

An appropriate explosive safety quantity distance zone would be established and maintained around facilities where missiles or other ordnance are stored or handled in accordance with all applicable federal, state, local, and U.S. Air Force regulations. Figure 2.1-4 presents the explosive safety quantity distance for FEM-02.

U.S. Army, U.S. Air Force, or U.S. Navy personnel would conduct a comprehensive safety analysis to determine specific launch and flight hazards for each flight test. A standard dispersion computer model for both normal and aborted launch scenarios would be run by installation safety personnel. As part of the analysis, risks to off-installation areas and non-participating aircraft, sea vessels, and personnel would be determined. The results of the analysis would then be used to identify the launch hazard area, expended booster drop zones, debris impact areas, and flight termination boundary.

Ground Hazard Area

Before a flight test launch, the Range Safety Officer would determine if the intercept could be safely launched from the proposed location. To do this, the Range Safety Officer develops a Ground Hazard Area around the proposed launch site. The Ground Hazard Area is the area that could be affected by pieces of interceptor debris should a malfunction occur just above the launch pad or if the interceptor's flight must be terminated in the early flight phase. All launch systems included in this analysis are mature systems, and explosions above the launch pad or early termination of the interceptor's flight are not anticipated.

The Ground Hazard Area would be cleared of all but mission-essential test personnel during launch operations. In addition, a launch caution corridor, which is an area limited to essential personnel; and an impact line, demarcating the protection line for all non-mission-essential personnel, would be established. To ensure public safety, access to select private properties on the boundary of AAFB would be restricted.

Interceptor First Stage Booster Drop Zone

The interceptor's first stage booster drop area on AAFB is the area where the expended first stage booster from the interceptor would fall to the ground soon after launch. The approximate 197-acre (1,975-foot wide x 5,500-foot long) potential booster drop area for FEM 02 would be wholly contained within the AAFB installation boundary east of the FEM-02 launch site (Figure 2.1-5). The interceptor's first stage booster, which is 6 feet long by 2 feet in diameter, is expected to remain in one piece and all solid propellant would be consumed prior to impact. The maximum expected area of disturbance would be less than 500 square feet within this area.

Figure 2.1-4: FEM-02 Explosive Safety Quantity Distance

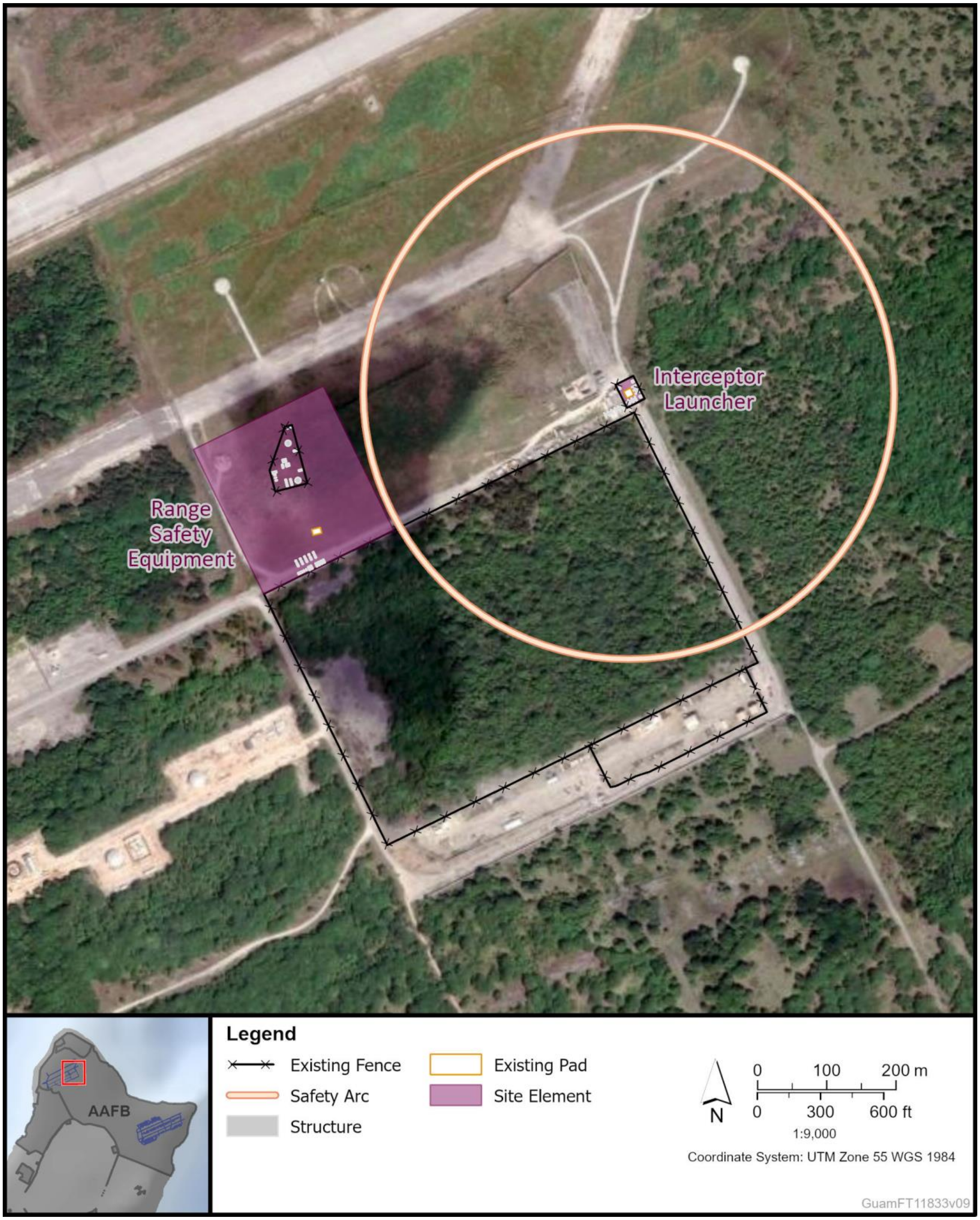
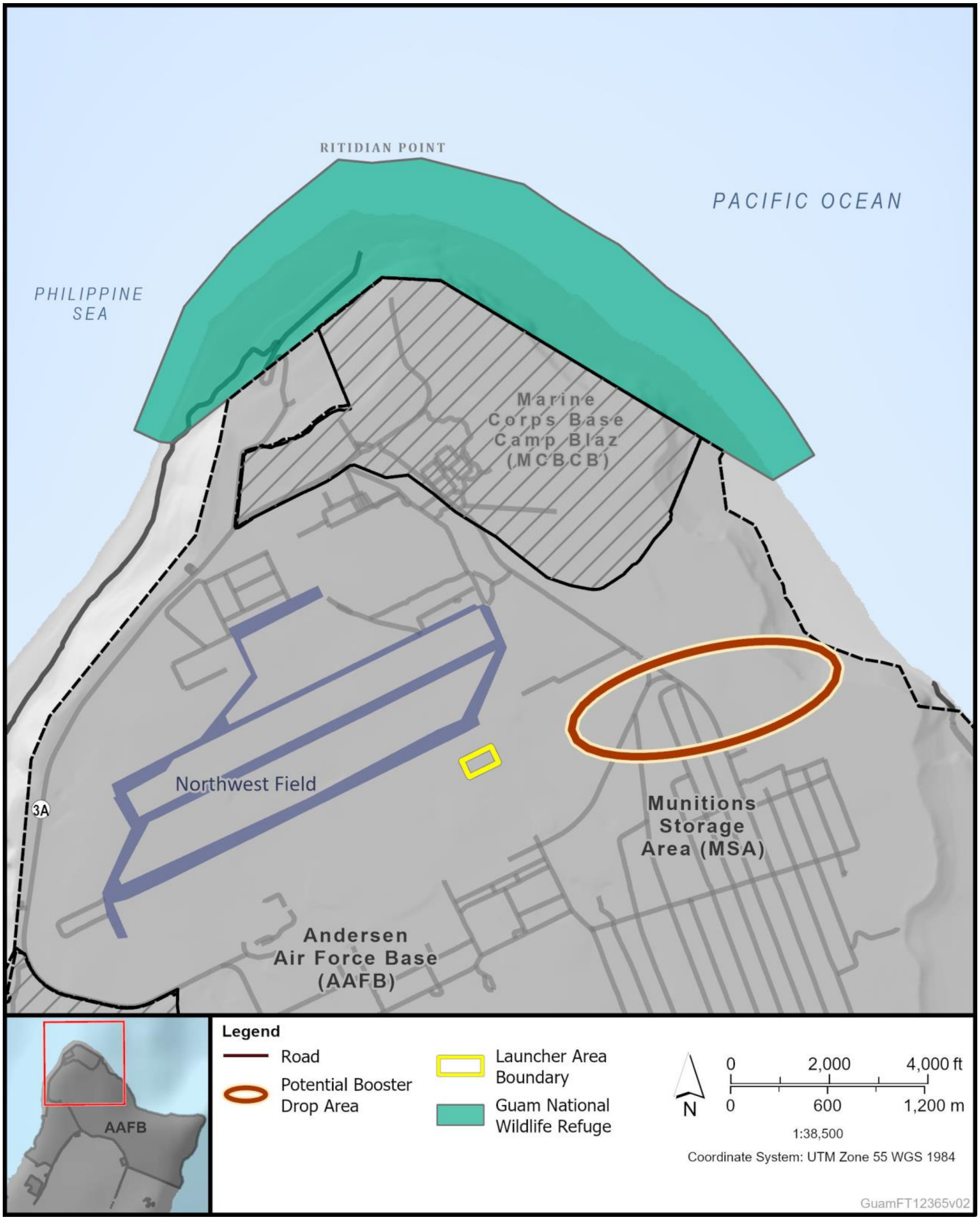


Figure 2.1-5: FEM-02 Interceptor First Stage Booster Drop Zone



Potential Flight Test Debris Zone

For FEM-02, the potential flight test debris zone (Figure 2.1-6), where target and interceptor intercept debris, expended booster stages, and the extraction pallet and up to five parachutes used to air-launch the target is located, is approximately 259,219 square nautical miles; however, the entire area would not be impacted. The potential area of ocean surface and sea floor impact would only consist of the area within the potential flight test debris zone where the extraction pallet and parachutes, expended booster stages, and target intercept debris fall to the surface of the ocean and sink to the sea floor. The actual area impacted within the potential flight test debris zone would be much smaller than the entire area, but it is unknown where exactly the impact area would be within the potential flight test debris zone.

Of the 259,219 square nautical miles that make up the potential flight test debris zone, approximately 10.5 percent (27,217 square nautical miles) is within the U.S.'s EEZ outside of the territory east of Guam. The portion of the potential flight test debris zone inside of the U.S.'s EEZ is at least 88 nautical miles to Guam ensuring there would be no impacts on nearshore areas.

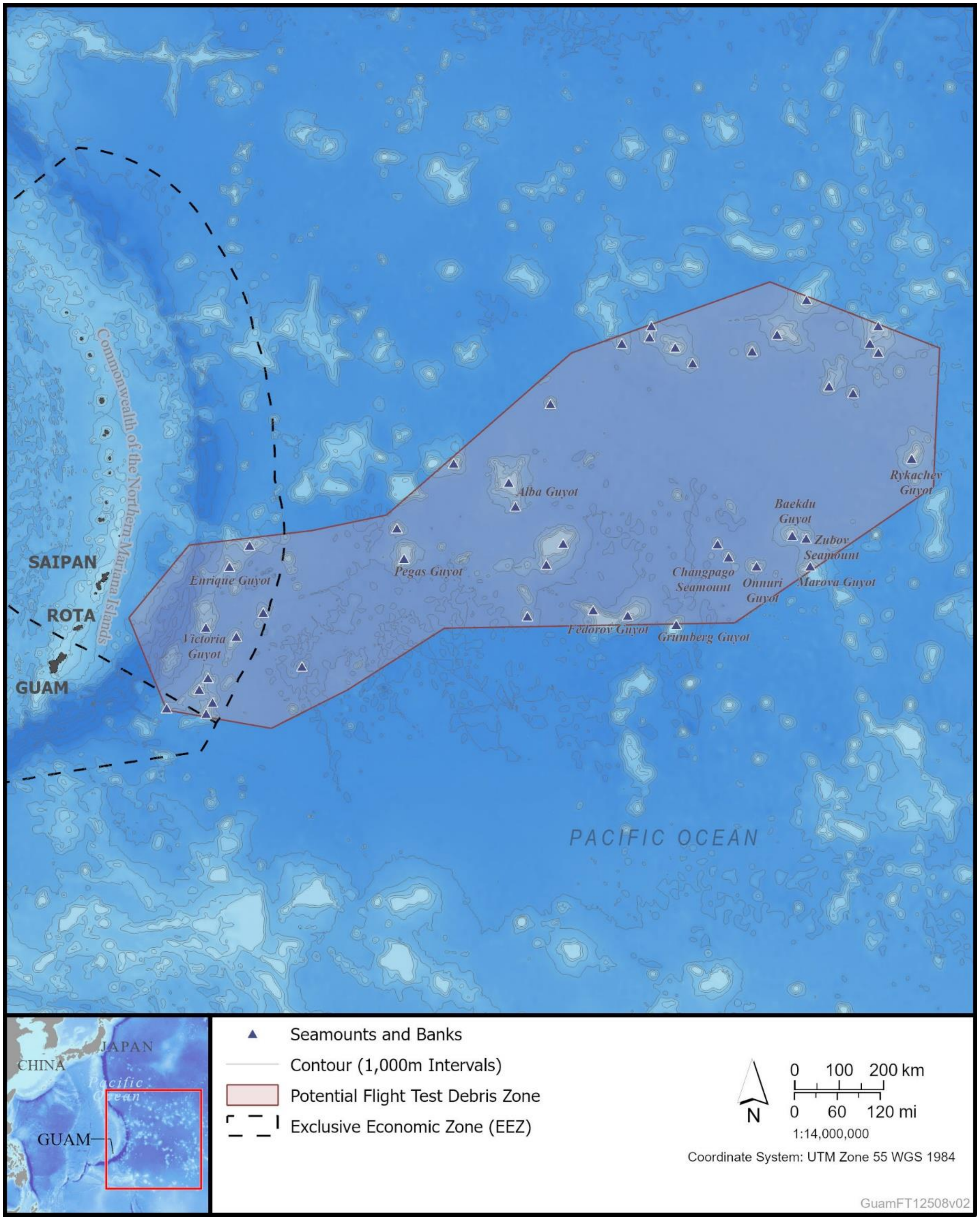
Debris resulting from the target intercept could potentially fall in the portion of the potential flight test debris zone inside of the U.S.'s EEZ outside of the territory of Guam. The interceptor's second-stage booster, all target booster stages, and the extraction pallet and parachutes used to air-launch the target would fall in the potential flight test debris zone beyond the EEZ of Guam in international waters.

The majority of the potential flight test debris zone is deep ocean. Most of the seafloor depths within the potential flight test debris zone range from 2,000 to 9,600 meters. However, there are several seamounts and banks present in the area with depths ranging from 32 to more than 2,000 meters.

Flight Termination Boundary

Another component of flight safety is based on the possibility of a flight termination after the interceptor has exited the vicinity of the launch pad. A flight termination boundary along the interceptor's flight path would be predetermined, should a launch malfunction or a flight termination action occur. The flight termination boundary defines the limits at which command flight termination would be initiated to contain the interceptor and its debris within predetermined hazard and warning areas, thus minimizing the risk to test support personnel and the general public. All launch systems included in this analysis are mature systems, and a launch malfunction or flight termination action is not anticipated.

Figure 2.1-6: FEM-02 Potential Flight Test Debris Zone

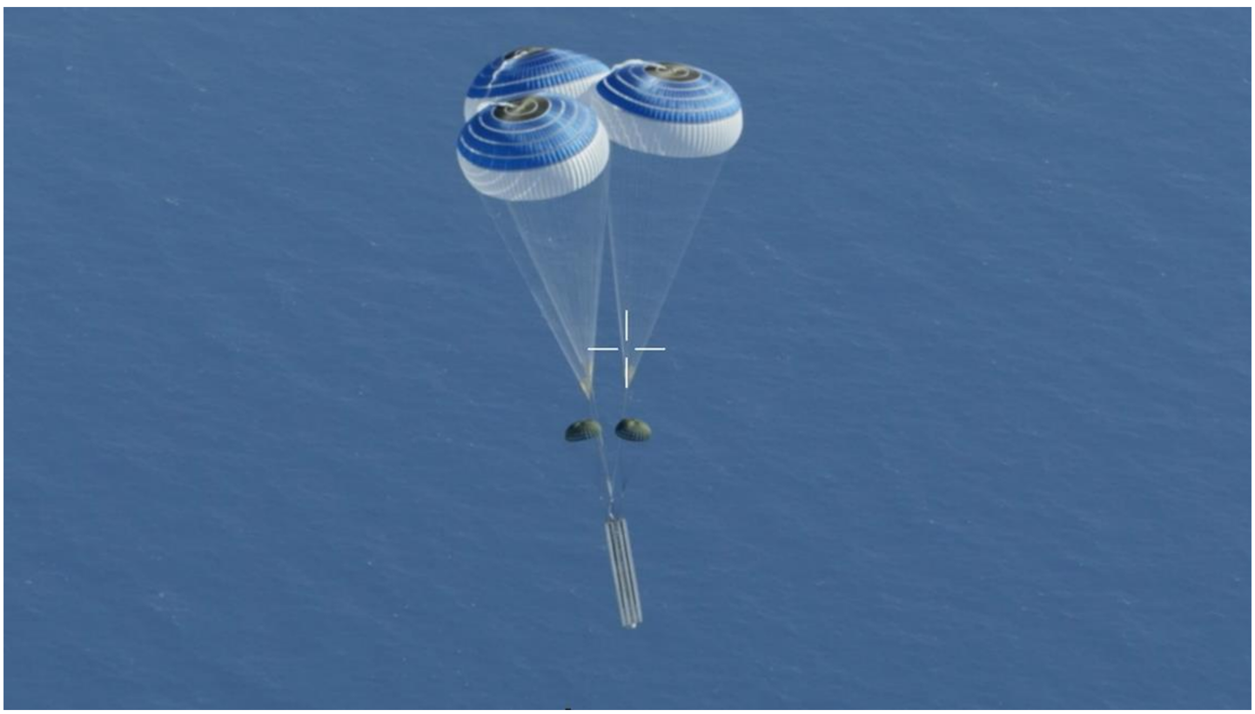


2.1.1.8.2 Test Launches

The duration of a typical flight test would be approximately 8 hours. Airspace surveillance procedures would last as little as 45 minutes, or as long as 3.5 hours if the test were delayed, after which it would be rescheduled.

For FEM-02, the target would be air-launched from an Air Force C-17 Globemaster or similar aircraft over the BOA of the western Pacific Ocean on an inbound trajectory northeast of Guam. The C-17 would leave from AAFB and fly to the designated target drop zone, where the extraction pallet would be pulled from the aircraft by parachute and descend toward the ocean surface (Figure 2.1-7). A total of up to 5 parachutes would be used to deploy the target from the aircraft in preparation for the actual launch. The parachutes may use a ring-slot design with multiple panel openings, or a ribbon parachute made of a nylon/Kevlar composition. They would range from 15 to 94 feet in diameter.

Figure 2.1-7: Extraction Pallet and Parachutes



The target would contain ordnance in the form of solid-rocket motor propellant, parachute reefing cutters, flight termination system, and detonation cord. The target would be secured to the carriage extraction system with “blankets” made of nylon or similar material, or with steel straps. The blankets would be stitched together with detonation cord. When the detonation cord is exploded, the blankets would release the target from the pallet. The pallet and parachutes, which are weighted, would then fall to the ocean surface and sink relatively quickly.

At an altitude greater than 20,000 feet, the target would be released from the extraction pallet and parachutes using the small explosive charges described above. The first booster stage would ignite, and the target would travel on a set trajectory. The target would have two booster stages and both would fall to the surface of the BOA of the western Pacific Ocean greater than 200 nautical miles from Guam and sink to the sea floor. Tracking radar would acquire and track the target, while the command-and-control system would compute the best time to launch the interceptor.

The land-based interceptor would be launched from AAFB towards the target. The interceptor would gain speed in the first few seconds of flight, then rapidly accelerate out of sight and earshot. The first expended booster stage from the interceptor would separate shortly after launch and fall to the ground to the east of the launch site in a pre-determined area within the installation boundary of AAFB (see Figure 2.1-5). The first stage interceptor booster is approximately 6 feet long and 2 feet in diameter, weighing approximately 500 pounds. The booster stages are anticipated to remain in one piece, with all solid propellant having been consumed. No hazardous material leaks would be expected based on previous flight tests at White Sands Missile Range, New Mexico, and the area of impact would be approximately 300–500 square feet. The first stage interceptor booster would be recovered after the flight test. The second stage expended booster would separate over the BOA of the western Pacific Ocean greater than 200 nautical miles from Guam, falling to the ocean surface and sinking to the sea floor. The interceptor would then intercept and destroy the target by force of impact.

Intercept debris is the result of the collision between the target and interceptor. After the successful intercept of the target in the exosphere, much of the debris would burn up upon reentry in the atmosphere. The remaining inert debris would impact the ocean’s surface and sink to the sea floor within the modeled debris field as depicted in Figure 2.1-6. Based on prior flight tests, the anticipated outcome of a successful intercept would be a few large pieces (tens of kilograms), more medium size pieces (less than a kilogram), and mostly small pieces of missile debris (less than 10 grams). Following a successful intercept, debris would not normally be recovered from the ocean. If the intercept is not successful, both the target and interceptor would be terminated and impact the ocean’s surface, presenting no risk to Guam, and sink to the sea floor.

Hazardous materials associated with preparation, maintenance, and execution of FEM-02 would include cleaners, solvents, lubricants, motor fuel, and diesel, and would be disposed of as hazardous waste, according to AAFB installation procedures.

2.1.1.8.3 Post-Flight Activities

The interceptor’s first stage booster would be recovered from AAFB. Should the booster fall in a wooded area, a small team would locate the booster on foot and prepare it for airlifted removal. Once the team is ready for the booster to be airlifted, an MH-60S Seahawk or similar helicopter would fly to the location of the first stage booster. The helicopter would hover over the booster approximately 80–100 feet above ground level and, utilizing its cargo hook capacity of 6,000 pounds, would extract the booster and airlift it back to AAFB. Once the booster is recovered, it would be disposed of according to U.S. Air Force and MDA regulations.

Total flight time of the MH-60S or similar helicopter would be approximately 20 minutes, including no more than 5 minutes of hovering over the booster. Flight time includes engine start, plane captain checks, taxi, flight from AAFB to the recovery area, hover, return flight from the recovery area to AAFB, taxi, and shutdown.

If the booster lands within a previously developed or disturbed area, or maintained/landscaped area (e.g., grassland), then the recovery team would approach the booster with a flatbed truck and a backhoe. The backhoe would be used to lift the booster onto the truck and then would be driven to the appropriate location on AAFB, where it would be disposed of according to Air Force and MDA standard protocols.

At the conclusion of the FEM-02 flight test, the launcher would be shipped back to the mainland U.S. by barge in a total of three Container Express (commonly known as CONEX) boxes. They would enter through the Port of Los Angeles and be shipped by truck to Minnesota for refurbishment. The AN/TPY-6 radar would stay on site for two years.

2.2 Alternatives

Alternatives have been identified and are considered in this EA/OEA. The alternatives include the following:

- **No Action Alternative** – No flight tests would occur from land- or sea-based launchers; no tracking exercises to test or calibrate the land-, airborne-, sea-, and space-based sensors would occur; and AAFB would continue with normal activities.
- **Alternative 1** – Flight tests or tracking exercises utilizing land-based launch systems for interceptor launch with land-, airborne-, sea-, and space-based sensor integration.
- **Alternative 2 (Preferred Alternative)** – Flight tests or tracking exercises utilizing land- or sea-based launch systems for interceptor launch with land-, airborne-, sea-, and space-based sensor integration.

2.3 No Action Alternative

By choosing the No Action Alternative, MDA would not validate the interoperability of multiple sensors and interceptor systems. The No Action Alternative would not meet the purpose of and need for the PA; however, as required by NEPA, the No Action Alternative is carried forward for analysis. The No Action Alternative is used to analyze the consequences of not undertaking the PA, not simply conclude no impact, and serves to establish a comparative baseline for analysis.

2.4 Alternatives Considered but Not Carried Forward for Analysis

A second alternative launch location was considered for the flight tests of interceptor systems: Orote Point abandoned airfield, NBG. Due to potential safety considerations including the proximity to ammunition storage, impacts on airspace, and performance requirements, the launch location from the Orote Point abandoned airfield at NBG was not carried forward as an alternative site for analysis.

2.5 Environmental Resources

Table 2.5-1 presents both the resources analyzed in detail in this EA/OEA, as well and those resources eliminated from detailed analysis. The resources eliminated from detailed analysis are summarized in Appendix A (Environmental Resources Eliminated from Further Detailed Analysis) and are not considered further in this EA/OEA because negligible impacts were anticipated due to the implementation of the PA.

The resources analyzed in detail in this EA/OEA were derived from the potential for impacts based on an understanding of local conditions and the nature of the proposed work. Nine broad resource areas of environmental consideration were analyzed to provide a context for understanding the potential effects of the PA, and to provide a basis for assessing the severity of potential impacts.

Table 2.5-1: Resources Analyzed and Resources Eliminated from Analysis

Resources Analyzed in Detail	Resources Eliminated from Detailed Analysis
Airspace Management	Geology and Soils
Air Quality	Hazardous Materials and Waste Management
Climate Change and Greenhouse Gases	Infrastructure (Utilities)
Terrestrial Biological Resources	Land Use
Marine Biological Resources	Socioeconomics
Cultural Resources	Transportation
Environmental Justice and Children's Environmental Health and Safety Risk	Water Resources
Public Health and Safety	Wetlands
Noise	Visual Resources/Aesthetics

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3.0 Affected Environment

3.1 Introduction

This chapter describes the environmental resources that may be affected by the PA. The information and data presented are commensurate with the importance of the potential impacts in order to provide the proper context for evaluating such impacts. Available reference materials, including EISs, EAs, and related environmental studies were reviewed.

3.2 Airspace Management

The objective of military airspace management is to meet operational requirements through the safe and efficient use of available navigable airspace in a peacetime environment, while minimizing the impact on other aviation users and the public. Airspace is the space above a nation, which is under its jurisdiction. Airspace is defined vertically, laterally, and temporally for aviation purposes. The categories of airspace include controlled and uncontrolled airspace, special use airspace, and other airspace. These categories are defined by the FAA based on the complexity or density of aircraft movements, the nature of operations within the airspace, the level of safety required, and national and public interest in the airspace.

3.2.1 Regulatory Setting

Under the Federal Aviation Act of 1958, Public Law 85-726, the FAA is charged with the safe and efficient use of our nation’s airspace and has established certain criteria and limits to its use. The method used to provide this service is the National Airspace System. This system is “a common network of U.S. airspace; air navigation facilities, equipment and services, airports or landing areas; aeronautical charts, information and services; rules, regulations and procedures, technical information and manpower and material.”

Airspace over the United States out to the 3-mile limit offshore defines the National Airspace System. Airspace outside of the 12 nautical mile limit is international airspace governed by the rules of the International Civil Aviation Organization. The International Civil Aviation Organization has designated administration of much of the airspace offshore to the United States through international agreements. The FAA, as the functional level of the United States Government, administers such airspace similar to the National Airspace System.

The National Airspace System airspace environment is described in terms of its principal attributes, namely controlled and uncontrolled airspace, special use airspace, and airways, described below.

Controlled Airspace. Controlled airspace is a generic term that encompasses the different classifications (Class A, B, C, D, and E) of airspace and defines dimensions within which Air Traffic Control service is provided to flights under instrument meteorological conditions, and to flights under visual meteorological conditions. All military and civilian aircraft are subject to FAA Regulations.

Uncontrolled Airspace. Uncontrolled or Class G airspace is the portion of airspace that has not been designated as Class A, B, C, D, or E. It is therefore designated uncontrolled airspace. Class G airspace extends from the surface to the base of the overlying Class E airspace.

Special Use Airspace. Special Use Airspace consists of airspace within which specific activities must be confined, or wherein limitations are imposed on aircraft not participating in those activities. Special use airspace usually consists of prohibited areas, restricted areas, warning areas, military operations areas, alert areas, and controlled firing areas.

Airways. An airway is a legally defined corridor that connects one specified location to another at a specified altitude, along which an aircraft capable of meeting the performance and navigation requirements of the airway may be flown. Airways are defined with segments within a specific altitude block or corridor width between fixed geographic coordinates for satellite navigation systems, or between ground-based radio transmitter navigational aids or the intersection of specific radials of two navigational aids. There are two types of airways: (1) Victor Airways are low-altitude airways established in the United States by the FAA for flights below 18,000 feet mean sea level (MSL), and (2) Jet Routes are designed to serve aircraft operations from 18,000 feet MSL and above. The FAA has also instituted procedures whereby aircraft can fly direct from one location to another using internal navigation.

3.2.2 Affected Environment

Region of Influence (ROI). The ROI for land-based launches of the interceptor includes the airspace over Guam, the launch pad and radar transmitting areas, extending downrange throughout the interceptor’s flight path to intercept of the airborne target in the BOA of the western Pacific Ocean. For sea launches of the interceptor, the ROI would include the launch location in the BOA of the western Pacific Ocean and extending downrange from it throughout its flight path to intercept of the airborne target. For target air launches from a C-17, the ROI includes the staging location from which the launch aircraft would fly to the launch location, the location from which the launch aircraft would release the target, and the areas covered by the aircraft and target flights.

Airports. Two airports are operated on Guam: Guam International Airport. (A.B. Won Pat International Airport) and AAFB.

Guam International Airport is a primary public regional airport serving passenger and cargo needs between Guam, the continental United States, Asia, Australia and various islands in the Pacific region. The airport is open 7 days a week, 24 hours a day.

Guam International Airport has Class D Airspace, which only surrounds airports that have an operational control tower. Class D airspace is also tailored to meet the needs of the airport. The Guam International Airport Class D airspace extends from the surface upward to and including 2,600 feet MSL within a 4.3-mile radius of Guam International Airport.

Guam International Airport Class E Airspace includes that airspace extending upward from the surface within 2 miles on each side of the Nimitz very high frequency omni-directional range 245° radial, extending from the 4.3-mile radius of Guam International Airport to 5 miles southwest of the Nimitz Very High Frequency Omni-directional Range/Tactical Air Navigation.

Guam International Airport has 12 terminal instrument procedures used for the orderly transfer of an aircraft under Instrument Flight Rules to initiate an approach to the airport to a landing, or to a point from which a landing may be made visually.

AAFB provides basing and support to military aircraft. The airfield is open 7 days a week, 24 hours a day.

AAFB has Class D Airspace that extends from the surface up to and including 2,600 feet MSL within a 4.3-mile radius of AAFB.

For AAFB, Class E includes that airspace extending upward from the surface within 3 miles on each side of the 065° bearing from AAFB extending from the 4.3-mile radius of AAFB to 8.5 miles northeast and that airspace within 2 miles north of and 3.5 miles south of the 245° bearing from AAFB, extending from the 4.3-mile radius of the airport to 7.5 miles southwest of AAFB, excluding the Guam International Airport Class D airspace.

Airspace. In addition to the airspace associated with the two airports on Guam, there are two FAA-published Temporary Flight Restrictions (TFRs) over Guam (Figure 3.2-1); both are for special security reasons. The smaller red polygon depicts airspace from the surface to 6,000 feet MSL where aircraft are not allowed to operate. This airspace contains continuous military activity which creates a serious hazard to aviation. Aircraft flying within the airspace would be exposed to direct radiation, which may produce harmful effects to personnel and equipment. The larger area depicted in Figure 3.2-2 exists from 2,600 feet MSL to 20,000 feet MSL. All aircraft entering this area must remain in two-way radio communications with air traffic control and be transmitting a discrete transponder code as assigned by air traffic control.

The published airways within the ROI that may be affected by the PA (missile test launch from land) include jet routes A450, W21, A337, B452, and G223 (Figure 4.2-1).

Existing Flight Activity. Flight tracking data within 20 nautical miles of Guam were downloaded from the FAA's Traffic Flow Management System Counts, which provided number of flights arriving into and departing from Guam International Airport and AAFB, categorized by user class (air carrier, air taxi, general aviation, or military). The 30 days of track data reflect a balance of runway use at Guam International Airport and AAFB (Runways 6 and 24 at both airports), days of the week, and month of the year. These days were selected to provide a representative sample of flight tracks and to account for variations in flight operations due to changes in weather, time of day, day of the week, and seasonal demand. Flight operations data were categorized according to user class: air carrier, air taxi, general aviation, military, or transient, and are described in Table 3.2-1.

Table 3.2-1: Airspace User Class Descriptions

User Class	Description
Commercial (Air Carrier and Air Taxi) Flights	Scheduled commercial airline passenger flights are categorized as air taxi (aircraft with 60 or fewer seats) and air carrier (aircraft with more than 60 seats).
General Aviation Flights	General aviation flight tracks include all non-military, non-commercial flight operations.
Military Flights	Military flights into or departing from AAFB.
Transient Flights	Transient flights are aircraft flights that transit through Guam airspace but neither takeoff nor land on Guam. Transient flights are typically flying above flight level 340.

3.2.2.1 Notice to Air Missions

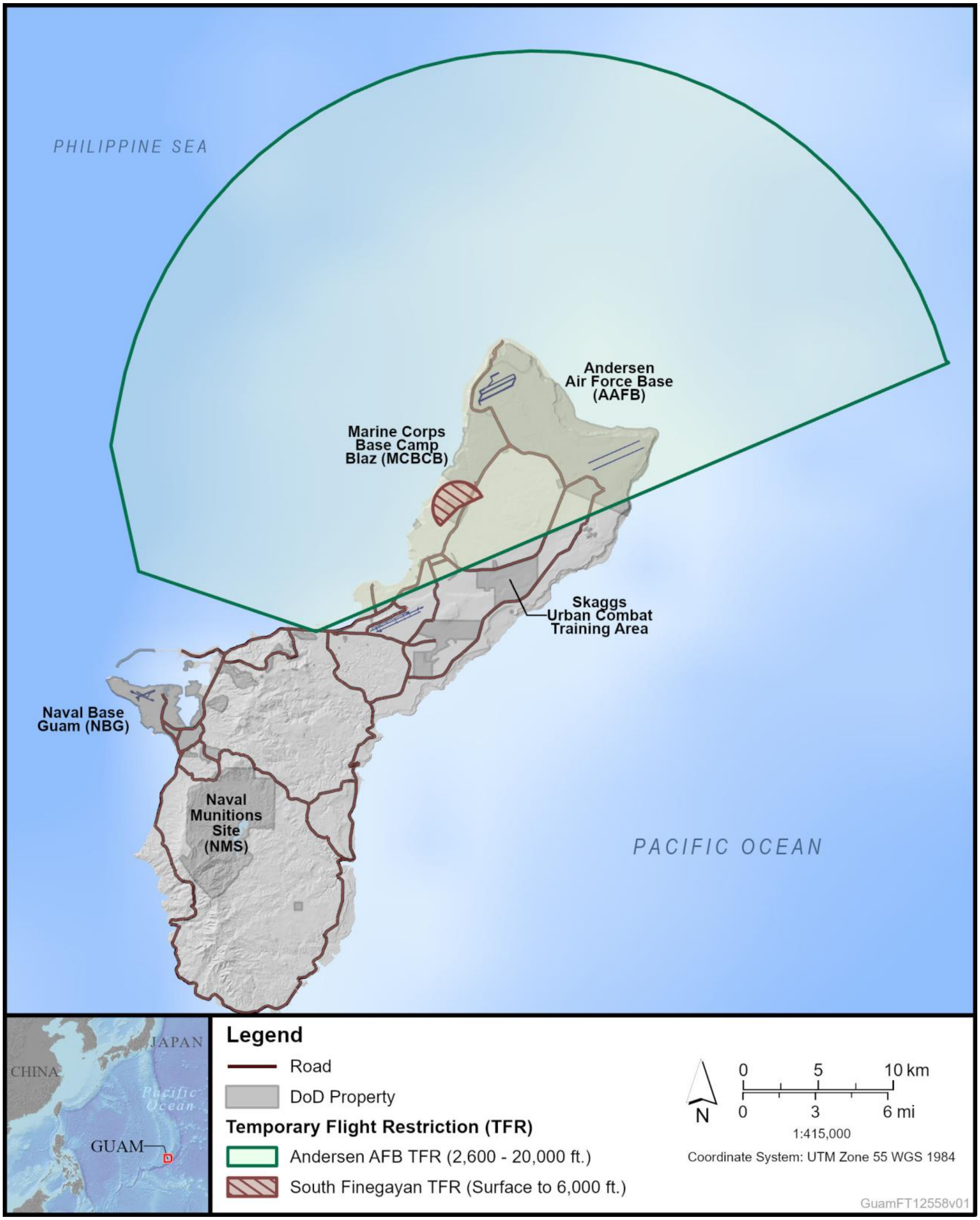
Prior to each launch, the airspace that must be temporarily closed would be defined and published through a NOTAM. Specific launch trajectories (including latitude and longitude coordinates) for interceptor flight test operations would be based on mission-specific needs as described in Chapter 2.0 (Description of the Proposed Action and Alternatives). The specific launch trajectory and associated Aircraft Hazard Areas or Launch Hazard Area would be provided in MDA's Range Safety Annex and submitted to the FAA in advance of radar testing and interceptor flight test operations. This information would be used to determine the necessary airspace closures provided in the NOTAM.

3.2.2.2 Altitude Reservation

Airspace controlled by the FAA may be restricted specifically through activation of an Altitude Reservation. The FAA generally uses Altitude Reservations to protect oceanic airspace. The NOTAM specifying an Altitude Reservation would establish a closure window that is intended to warn aircraft to keep out of a specific region throughout the time that a hazard may exist. The length of the window is primarily intended to account for the time needed for the operator to meet its mission objectives. The location and size of the closure area is defined to protect the public. For a launch, typically the closure must begin at the time of launch and must end when any potential debris, including items that are planned to be jettisoned (e.g., stages or fairings) and any debris generated by a failure, has reached the bottom of the affected airspace.

Altitude Reservations are immediately released once the mission has successfully cleared the area and all planned jettisoned items no longer impose a risk to the public. The actual duration of airspace closure is normally much less than the original planned closure, especially if the launch window is relatively long and the launch occurs at the beginning of the window. The FAA typically begins to clear airspace and reroute aircraft in advance of a launch and directs aircraft back into the released airspace after the launch to recover to normal flow and volume.

Figure 3.2-1: Temporary Flight Restrictions – Guam



3.2.2.3 Temporary Flight Restrictions

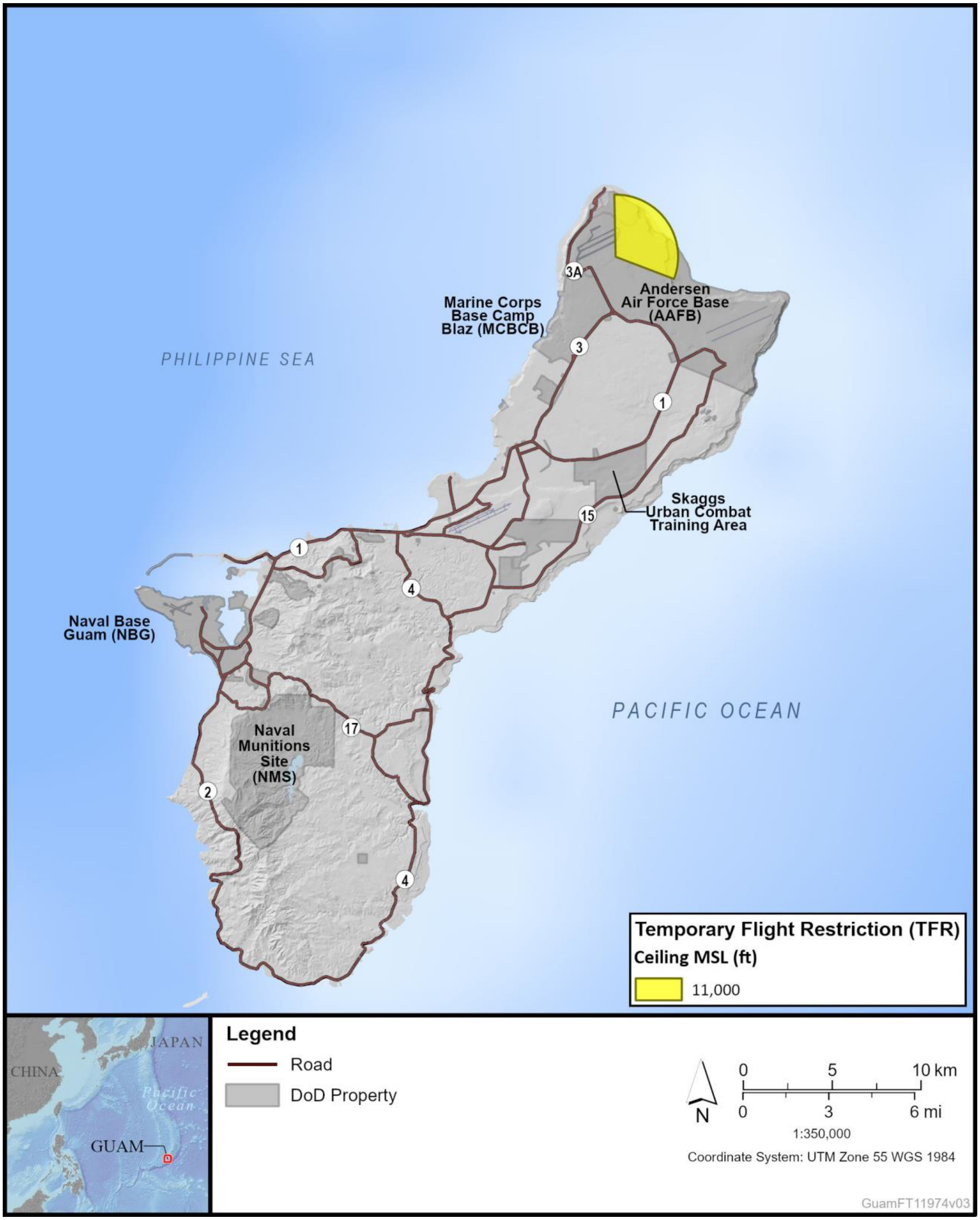
Flight tests would include the use of high-energy, non-ionizing radiation radars. Because of the potential hazard to personnel and aircraft operations from electromagnetic energy emitted by these radars, the MDA is proposing to the FAA to establish a TFR above and around radar locations. A TFR, when activated, is airspace where aircraft operations are prohibited to prevent aircraft from being exposed to radar-generated high-intensity radiated field (HIRF) at levels exceeding FAA certification standards for aircraft electrical and electronic systems unless otherwise coordinated with and permitted by the appropriate Controlling or Using agencies. The anticipated TFR for the FEM-02 flight test is depicted in Figure 3.2-2. This TFR will already be in place for the Initial Deployment discussed in Section 1.5 (Scope of the Environmental Assessment).

The requirement for safe separation of aircraft from HIRF is defined by standards FAA 14 CFR 25.1317 (*High-Intensity Radiated Fields [HIRF] Protection*) certification levels, Institute of Electrical and Electronics Engineers C95.1-2019 (*Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz*), American Society for Testing and Materials F3236-21a (*Standard Specification For High Intensity Radiated Field [HIRF] Protection In Small Aircraft*), and DoD Military Standard-464D (*Electromagnetic Environmental Effects Requirements for Systems*). In accordance with the preceding HIRF publications, the following three sub-standards must be addressed:

1. Maximum allowable HIRF exposure to the people within the aircraft
2. Maximum allowable HIRF exposure to an aircraft’s electrical or electronic system that performs a function whose failure would prevent the continued safe flight and landing of the aircraft
3. Maximum allowable HIRF exposure to electrical or electronic system that performs a function whose failure would significantly reduce the capability of the aircraft or the ability of the flight crew to respond to an adverse operating condition

Of the three sub-standards, sub-standard 3 is the most restrictive and thus sets HIRF safety requirements.

Figure 3.2-2: Guam Flight Test TFR



3.3 Air Quality

This section describes the air quality in the Study Area. The detailed Air Quality Impact Study is included in Appendix H (Air Quality Impact Study). Air pollution can damage the health of people, plants, animals, and water bodies as well as the exteriors of buildings, monuments, and statues. It also creates haze or smog that reduces visibility and interferes with aviation. A region's air quality is influenced by many factors, including the type and amount of pollutants emitted into the atmosphere, the size and topography of the air basin, and the local meteorological conditions. Ambient air quality is reported as the atmospheric concentrations of specific air pollutants at a particular time and location. The units of measure are expressed as a mass per unit volume (e.g., micrograms per cubic meter of air) or as a volume fraction (e.g., parts per million by volume). The ambient air pollutant concentrations measured at a particular location are determined by the pollutant emissions rate, local meteorology, and atmospheric chemistry. Wind speed and direction, the vertical temperature gradient of the atmosphere, and precipitation patterns affect the dispersion dilution, and removal of air pollutant emissions from the atmosphere.

3.3.1 Analysis Framework

The Air Quality Impact Study (Appendix H) comprises three analyses: (1) the Clean Air Act (CAA) General Conformity Analysis; (2) an analysis under NEPA; and (3) an analysis under EO 12114. The generated air emissions would be evaluated in one or more of the three identified analysis categories, based on the geographical and spatial locations where emissions occur and CAA air quality status (nonattainment, maintenance, or attainment) of those respective locations, as well as pollutants emitted, type of emission source, and levels of emissions. Most of the air emissions associated with the PA are expected to occur at distances less than 12 nautical miles from the shore.

3.3.1.1 General Conformity Evaluation

General Conformity evaluation encompasses the entire process from the applicability analysis through the conformity determination. The applicability analysis determines whether the PA can be exempt from completing a conformity determination. A conformity determination is required for each criteria pollutant or precursor where the net change of direct and indirect emissions of the criteria pollutant or precursor in a nonattainment or maintenance area caused by a federal action would equal or exceed any of the emissions thresholds called *de minimis* levels. If the emissions are below *de minimis* thresholds, then a conformity determination is not required, and the federal action conforms to the applicable implementation plan and meets the requirements of 40 CFR Part 93, subpart B.

3.3.1.2 National Environmental Policy Act

Analysis of health-based air quality impacts under NEPA includes estimates of total direct and indirect criteria air pollutants and Hazardous Air Pollutant (HAP) emissions released at or below 3,000 feet above ground/mean sea level within 12 nautical miles of U.S. coastline from all activities, including aircraft, vessels, missiles, and targets. Total direct and indirect emissions consider all emission increases and decreases that are reasonably foreseeable and are possibly controllable. The analysis considers the future emissions in the area with the action versus the future emissions without the action (i.e., the Baseline Condition/Affected Environment).

The air quality impact analysis presents a summary of emissions estimated for each alternative and provides a qualitative discussion of short-term and long-term impacts of the emissions to air quality and how these impacts affect attainment with CAA Ambient Air Quality Standards (AAQS) and contribution to human health risk from HAP exposure. The location and initial dispersion of emissions, duration of exposure, meteorological conditions, wind patterns, buoyancy of pollutants, and other relevant factors are considered and discussed as part of the analysis.

3.3.1.3 EO 12114 Environmental Effects Abroad of Major Federal Actions

The analysis of health-based air quality impacts under EO 12114 includes emissions released at or below 3,000 feet above MSL and beyond 12 nautical miles of the U.S. coastline from all activities, including aircraft, vessels, missiles, and targets; and a qualitative discussion of impacts of the emissions to air quality and how these impacts affect attainment with AAQS and contribution to human health risk from HAP exposure.

3.3.2 Affected Environment

3.3.2.1 Region of Influence

The ROI for air quality depends on the type of pollutant, emission rates of the pollutant source, proximity to other emission sources, and local and regional meteorology. For photochemical pollutants (i.e., made, or changed by exposure to sunlight) such as ozone, the impact area may extend much farther (e.g., miles) downwind. The maximum effect of precursors on ozone levels tends to occur several hours after the time of emission during periods of high solar load (i.e., sunlight) and may occur many miles from the source. Ozone and ozone precursors transported from other regions can also combine with local emissions to produce high local ozone concentrations.

The ROI for the PA includes the areas within and the area surrounding AAFB and the BOA of the western Pacific Ocean.

AAFB is located in Yigo at the northern tip of Guam and covers approximately 15,400 acres. The main operations area of the Base is in the eastern third of the Installation. This area includes the main active airfield and an array of operations, maintenance, and community support facilities. The central third of the Installation is a Munitions Storage Area. The western third is NWF, which is used for helicopter training and various field exercises. No publicly accessible areas are near the NWF, including two active hunting areas located south of NWF. AAFB tenant commands that are not associated with the PA are located approximately 0.3 mile to the west of NWF.

AAFB currently operates under Title V Permit No. FO-001R1, issued by Guam EPA. The stationary sources covered by the Title V Permit include internal and external combustion engines, landfill emissions, field operations, fuel storage and transfers, and an asphalt batch plant.

3.3.2.2 Existing Conditions

Guam is in attainment with all National Ambient Air Quality Standards (NAAQS), except areas near Piti and Tanguisson power plants are in nonattainment for the 1971 sulfur dioxide NAAQS (U.S. Environmental Protection Agency, 2023d), and the Piti-Cabras area is in nonattainment for the 2010 sulfur dioxide NAAQS (U.S. Environmental Protection Agency, 2023d). Although no recent ambient air quality data are available for Guam, the island is expected to have the same attainment/nonattainment status for Guam's AAQS as for the NAAQS for the same pollutant. The ROI for the PA includes the sulfur dioxide (SO_2) nonattainment areas where, following each flight test, assets are transported via a truck from NWF to the Port of Guam.

Currently, there are no air monitoring stations operating on Guam, and ambient air quality data has not been collected for the island since 1991. However, a conservative indication of expected air quality conditions on Guam is to consider observations on a more populated island, Oahu, Hawaii, which operates six monitoring stations to monitor concentrations of criteria pollutants. The 2021 monitoring data show no violation of the particulate matter less than or equal to 10 microns (PM_{10}), particulate matter less than or equal to 2.5 microns ($PM_{2.5}$), ozone (O_3), carbon monoxide (CO), or SO_2 NAAQS on Oahu (Hawaii Department of Health, 2022). It is expected that air quality on Guam would also have concentrations of criteria pollutants that are well below the applicable standards. Guam EPA is in the process of developing an annual emissions inventory for Guam; currently, no air emissions inventory information is available for the island.

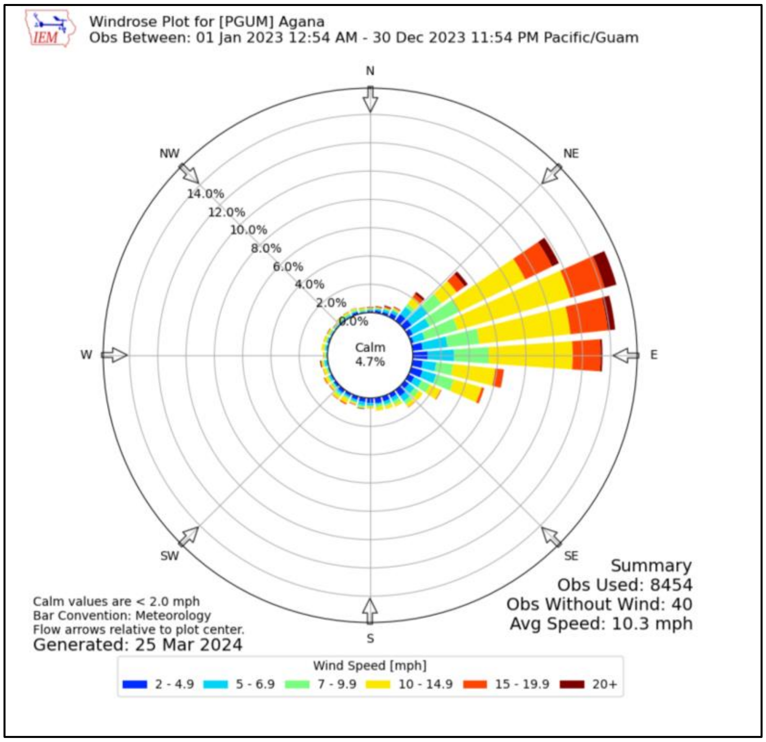
The U.S. Environmental Protection Agency's (USEPA's) 2019 Air Toxics Screening Assessment (AirToxScreen) provides emissions, ambient concentrations, and exposure estimates for 181 HAPs plus diesel particulate matter. For HAP/air toxics with health data based on long-term exposure, the assessment estimates cancer risks, the potential for noncancer health effects, or both, including noncancer health effects for diesel particulate matter. The AirToxScreen assessment is not currently available for Guam. However, the assessment for Hawaii can be used as an indication of potential HAPs of concern on Guam. The 2019 AirToxScreen data for Hawaii show that the top contributors to cancer risk are formaldehyde, carbon tetrachloride, acetaldehyde, benzene, 1,3-butadiene, naphthalene, ethylbenzene, chromium vi (hexavalent), and nickel compounds.

Ambient air quality conditions where AAFB is located are affected by a combination of on-base mobile sources including aircraft and aircraft ground support equipment; on-road and non-road vehicles; construction equipment; and stationary sources, such as internal combustion engines. According to the 2022 Annual Air Emissions and Fee Report, submitted by AAFB to Guam EPA, in 2022, AAFB emitted a total of 14 tons of criteria pollutants and 0.177 tons of HAPs. Most of the emissions were from emergency engines and fuel storage and transfer activities.

Ambient air quality conditions in the BOA of the western Pacific Ocean are affected by the transport of emissions from the islands in the BOA and movement of commercial ships and aircraft in the area.

Meteorological conditions affect the dispersion and transport of air pollutants and the resulting air quality. The climate of Guam is influenced by its location in the western Pacific Ocean. The climate is tropical marine, characterized by warm temperatures, high humidity, and distinct wet and dry seasons. The dry season typically begins in December and extends through June. The rainy season falls within the remaining months. Temperatures in Guam are generally warm and consistent throughout the year. Average temperatures range from around 77°F (25°C) in the cooler months to 86°F (30°C) in the warmer months. During the dry season, the prevailing winds (tradewinds) from the east and northeast intensify and tend to transport pollutants released from the west shoreline toward the ocean. During the warmest months from March through August, the tradewinds still blow steadily from the east or northeast. Figure 3.3-1 depicts wind rose data, for the January 2019 to December 2023 period, collected by the weather station (PGUM) located at Antonio B. Won Pat International Airport. The wind rose represents the directions around a compass, and the length of the petal or spoke indicates wind direction and frequency toward the center point. Individual segments of the spoke represent the frequency of winds for defined wind speed categories, with the slowest winds closest to and the fastest winds furthest from the center of the diagram. The average hourly wind speed in Guam has significant seasonal variation over the course of the year.

Figure 3.3-1: Guam Wind Rose



3.3.2.3 Sources of Emissions

The air quality impact study analyzes direct and indirect criteria pollutants and HAP emissions associated with the PA. Direct emissions are those emissions caused by the PA and that occur at the same time and place as the action. This includes emissions from all mobile, area and stationary sources. Indirect emissions are those emissions that are caused by the PA, but that may occur later in time or may be farther removed in distance from the action itself but that are still reasonably foreseeable. No construction activities are planned as part of the PA. Personnel commute to the site is anticipated to be the only source of indirect emissions. Personnel who may travel to Guam in support of the PA are expected to arrive via regular commercial flights or accompany equipment that is flown onto the island. Therefore, emissions due to personnel travel to Guam are not separately analyzed. The shipment of the launcher and range safety equipment at the conclusion of the flight test, from the island to the Port of Los Angeles, would occur via commercial carriers that would regularly complete this trip. Therefore, emissions from this activity are not analyzed.

The following activities would generate criteria pollutants and HAP emissions, primarily generated by the combustion of fuel.

- Aircraft emissions from the following: (1) transport of the range safety equipment from White Sands Missile Range, New Mexico, or other test ranges, to AAFB; (2) transport of the interceptor systems from Redstone Arsenal, Alabama, to AAFB; (3) transport of the target missiles from Cape Canaveral, FL, to AAFB; (4) transport of SM-3 interceptor missile from Redstone Arsenal, Alabama, to Guam, (5) flight activities in support of target launches; and (6) helicopter flight in support of post-launch activities. The aircraft activities occur under both alternatives. Emissions from the associated C-17 flights ground support equipment are also included. For the purposes of assessing air quality effects under NEPA, all activities involving the use of aircraft at or below the 3,000 feet above ground level limit were included in the emissions estimates, in accordance with USEPA guidance (U.S. Environmental Protection Agency, 1992). Per 40 CFR 93.153(c)(2), 3,000 feet above ground level is the default mixing height above which emissions would not affect the ambient air quality.

- Vessel emissions associated with the sea-based interceptor launch: The only vessel activity near Guam would be when a Navy ship is involved with the at-sea interceptor launch. A vessel in the area would travel to NBG specifically for the Flight Test crew to conduct a mission brief with the MDA team prior to and potentially after the test. No loitering, maneuvering, or operations within 12 nautical miles are anticipated. The rest of the vessel activities occur beyond 12 nautical miles by a vessel that is already in the area, during the test event, which is expected to take approximately 8 hours. This activity is anticipated to occur once per year.
- Truck emissions from the following: (1) transportation of the safety assets to a location adjacent to AAFB NWF and test launcher, (2) transportation of the interceptor systems to a location adjacent to AAFB NWF and test launcher, (3) transportation and staging of target missiles, (4) post-launch travel to the booster drop zone; (5) fuel delivery to the site for the generators to be used during the flight test, (6) retrieval and transportation of the first stage booster if it falls on existing developed area, and (7) shipment of the launcher and range safety equipment, at the conclusion of the flight test, by three trucks from a port of landing to Minnesota for refurbishment. These activities occur under both alternatives. Estimated emissions include dust generated from vehicle travel on paved and unpaved roads.
- Emissions from diesel-fueled generator sets that provide electrical power in support of range safety and flight test operations.
- Emissions from diesel-fueled air conditioning units to be used for aircraft climate control while parked at an ordnance holding pad on AAFB until the flight test event begins.
- Emissions due to launch of the interceptor missile. Emissions due to the target launch occur in elevations greater than 3,000 feet above MSL and are not included in the air quality analysis.
- Emissions due to up to 350 personnel commuting to the site.

3.4 Climate Change and Greenhouse Gases

This section evaluates potential effects on climate change and global GHG emissions that could result from implementation of the PA.

3.4.1 Regulatory Setting

The USEPA specifically identified carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride as GHGs (U.S. Environmental Protection Agency, 2009) (74 FR 66496). These gases influence global climate by trapping heat in the atmosphere that would otherwise escape to space. Increased concentrations of these gases due to human activities is the primary cause of global warming observed over the last 70 years and contributes significantly to climate change (National Academy of Sciences, 2020). GHGs have varying global warming potential (GWP). GWP is a measure of how much energy the emissions of 1 ton of a gas absorb over a given period of time (usually 100 years), relative to the emissions of 1 ton of CO_2 (U.S. Environmental Protection Agency, 2023c). The reference gas for GWP is CO_2; therefore, CO_2 has a GWP of 1. Other common GHGs that result from human activity include CH_4, which is estimated to have a GWP of 27–30 over 100 years; and N_2O, which has a GWP of 273. CO_2, and to a lesser extent, CH_4 and N_2O, are products of combustion and are generated from stationary combustion sources as well as vehicles, aircraft, and vessels. High GWP gases include GHGs that are used in refrigeration/cooling systems, such as chlorofluorocarbons and hydrofluorocarbons.

Currently, there are no regulatory thresholds of significance for GHG emissions; however, the CEQ has released interim guidance on when and how federal agencies should consider GHG emissions and climate change in NEPA analyses (Council on Environmental Quality, 2023). The guidance emphasizes when conducting climate change analyses in NEPA reviews, agencies should consider the following: (1) the potential effects of a PA on climate change, including by assessing both GHG emissions and reductions from the PA; and (2) the effects of climate change on a PA and its environmental impacts.

The guidance states that federal agencies should quantify the reasonably foreseeable direct and indirect GHG emissions of their PAs and reasonable alternatives (as well as the no action alternative). The guidance also recommends that “agencies provide additional context for GHG emissions, including through the use of the best available social cost of GHG estimates, to translate climate impacts into the more accessible metric of dollars, allow decision makers and the public to make comparisons, help evaluate the significance of an action’s climate change effects, and better understand the tradeoffs associated with an action and its alternatives.” (Council on Environmental Quality, 2023).

3.4.2 Analysis Framework

The PA is anticipated to release GHGs into the atmosphere. These emissions are quantified for each alternative and compared to the No Action Alternative.

3.4.3 Affected Environment

3.4.3.1 Region of Influence

The ROI for GHG is the global atmosphere, since climate change is a global issue.

3.4.3.2 Existing Conditions

Global GHG in 2022 reached a high of 54.59 billion metric tons (MT) of carbon dioxide equivalent (CO_2e) (Ritchie et al., 2020). CO_2e is a measurement of the total greenhouse gases emitted, expressed in terms of the equivalent measurement of carbon dioxide. As shown in Table 3.4-1, in 2021, the U.S. emitted over 6,300 million MT of CO_2e.

Table 3.4-1: Trends U.S. Greenhouse Gas Emissions, Million MT CO_2e

Economic Sector	2017	2018	2019	2020	2021
Industry	1,973.9	2,033.2	2,011.2	1,852.9	1,909.2
Transportation	1,846.0	1,876.2	1,879.2	1,629.2	1,809.5
Commercial	1,060.4	1,074.5	1,029.7	930.5	972.2
Residential	962.3	1,034.9	982.0	918.3	953.8
Agricultural	693.0	709.8	690.7	671.5	671.5
U.S. Territories	26.3	26.3	25.1	23.6	24.1
Total	6,561.8	6,754.8	6,617.9	6,026.0	6,340.2

Source: U.S. Environmental Protection Agency (2023e)

On Guam, the primary GHGs emitted are CO_2, CH_4, and NO_x from combustion of fuel (U.S. Environmental Protection Agency, 2024). Table 3.4-2 presents the 2022 reported GHG emissions for large emitting facilities on Guam. These facilities are required to submit data to the USEPA's Greenhouse Gas Reporting Program. AAFB is not among the large emitting facilities that are subject to USEPA GHG reporting.

Table 3.4-2: Facilities GHG Emissions – 2022, MT CO_2e

Facility Name	City	GHG Emissions
Dededo Combustion Turbine Generating Facility	Dededo	116,446
Guam Power Authority - Cabras Power Plant	PITI	509,941
Layon Municipal Solid Waste Landfill	Inarajan	57,575
Macheche Combustion Turbine	Dededo	35,806
Marianas Energy Company	Piti	282,195
Piti 7 Combustion Turbine	Piti	158,737
Tenjo Vista Power Plant	Piti	6,505
Yigo Combustion Turbine	Yigo	86,779
Yigo Diesels	Yigo	54,234
Total GHG Emissions from Large Emitting Facilities -2022		**1,308,218**

Source: U.S. Environmental Protection Agency (2023a)

3.4.3.3 Sources of Emissions

The following activities would generate GHG emissions, primarily by the combustion of fuel. The 3,000 feet above ground level limit, which is the default mixing height above which criteria pollutants and HAPs emissions would not affect the ambient air quality, does not apply to GHG. Therefore, GHG emissions were calculated for all altitudes. Personnel who may travel to Guam in support of the PA are expected to arrive via regular commercial flights or accompany equipment that is flown onto the island. Therefore, GHG emissions due to personnel travel to Guam are not separately analyzed. The shipment of the launcher and range safety equipment at the conclusion of the flight test, from the island to the Port of Los Angeles, would occur via commercial carriers that would regularly complete this trip. Therefore, GHG emissions from this activity are not analyzed. GHG emissions due to operating a backhoe, that would be used to retrieve the booster if it lands within a previously developed or disturbed area, were estimated and deemed to be negligible.

- Aircraft emissions from the following: (1) transport of the range safety equipment from White Sands Missile Range, New Mexico, or other test ranges, to AAFB; (2) transport of the interceptor systems from Redstone Arsenal, Alabama, to AAFB; (3) transport of the target missiles from Cape Canaveral, FL, to AAFB; (4) transport of SM-3 interceptor missile from Redstone Arsenal, Alabama, to Guam; (5) flight activities in support of target launches; and (6) helicopter flight in support of post-launch activities. Aircraft GHG emissions from landing and takeoff at the initial departure locations and from the refueling stop for the transport of the target missiles from Cape Canaveral, FL, to AAFB are included. The aircraft activities occur under both alternatives. Emissions from the associated C-17 flights ground support equipment are also included.
- Vessel emissions associated with the sea-based interceptor launch. The only vessel activity near Guam would be when a Navy ship in the area is involved with the at-sea

interceptor launch. A vessel would pull into NBG for the crew to conduct a mission brief with the flight test team prior to and potentially after the test. No loitering, maneuvering, or operations within 12 nautical miles are anticipated. The rest of the vessel activities occur beyond 12 nautical miles, during the test event, which is expected to take approximately 8 hours. This activity is anticipated to occur once per year.

- Truck emissions from the following: (1) transportation of the safety assets to a location adjacent to AAFB NWF and test launcher, (2) transportation of the interceptor systems to a location adjacent to AAFB NWF and test launcher, (3) transportation and staging of target missiles, (4) post-launch travel to the booster drop zone, (5) fuel delivery to the site for the generators to be used during the flight test, (6) retrieval and transportation of the first stage booster if it falls on existing developed area, (7) transport of the launcher and range safety equipment, at the conclusion of the flight test, by three trucks, from NWF to the Port of Guam, and (8) shipment of the launcher and range safety equipment, at the conclusion of the flight test, by three trucks to Minnesota for refurbishment. These activities occur under both alternatives.
- Emissions from diesel-fueled generator sets that provide electrical power in support of range safety and flight test operations.
- Emissions from two diesel-fueled air conditioning units to be used for aircraft climate control while parked at an ordnance holding pad on AAFB until the flight test event begins.
- Emissions due to launches of interceptor and target missiles.
- Emissions due to up to 350 personnel commuting to the site.

3.5 Terrestrial Biological Resources

3.5.1 Regulatory Setting

Native or naturalized vegetation, wildlife, special-status plant and animal species, and the habitats in which they occur, are collectively referred to as biological resources. Special-status species include species classified as endangered, threatened, proposed, or candidates under the federal ESA.

Under the ESA, an endangered species is defined as any species that is in danger of extinction throughout all or a significant portion of its range. A threatened species is defined as any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Federal actions near the U.S. Territory of Guam are subject to ESA requirements for consultation. When the action of a Federal agency may affect an ESA-listed species, that agency (i.e., the “action” agency) is required to consult with either NMFS or the U.S. Fish and Wildlife Service (USFWS), depending upon the protected species or critical habitat that may be affected. Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species (50 CFR 402.02 rev. 27 Aug 2019). Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action but that are not part of the action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action. (89 FR 24268, April 5, 2024). The Consultation Handbook on Procedures for Consultation and Conference Activities Under Section 7 of the Endangered Species Acts notes that “may affect” is the “appropriate conclusion when a proposed action may pose any effects on listed species or designated critical habitat. When a Federal agency proposing the action determines that a ‘may affect’ situation exists, then they must either initiate formal consultation or seek written concurrence from the Services that the action ‘is not likely to adversely affect’ listed species.” “Not likely to adversely affect” is further defined as “the appropriate conclusion when the effects on listed species are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those that are extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur (U.S. Fish and Wildlife Service & National Marine Fisheries Service, 1998).

Consultation would be reinitiated under the ESA if 1) take occurs, 2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered, 3) the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered, or 4) a new species is listed or critical habitat designated that may be affected by the identified action.

Both migratory and most native resident bird species are protected under the Migratory Bird Treaty Act, and their conservation by federal agencies is mandated by EO 13186 (Migratory Bird Conservation). Under the Migratory Bird Treaty Act, it is unlawful by any means or in any manner, to pursue, hunt, take, capture, kill, attempt to take, capture, or kill, [or] possess migratory birds or any part, nest, or eggs of any such bird at any time, unless permitted by regulation.

3.5.2 Affected Environment

3.5.2.1 Region of Influence

For the purposes of this EA/OEA, based upon the types of effects from proposed activities, there are three areas that would be subject to potential impacts. The overall ROI is northern Guam and is defined as the terrestrial area that may be impacted by noise from the launch of the interceptor missile (Figure 3.5-1). The ROI includes two “sub-areas,” which are described in Table 3.5-1.

Figure 3.5-1: ROI Based upon the Modeled Received Sound Levels from a Proposed Interceptor Launch

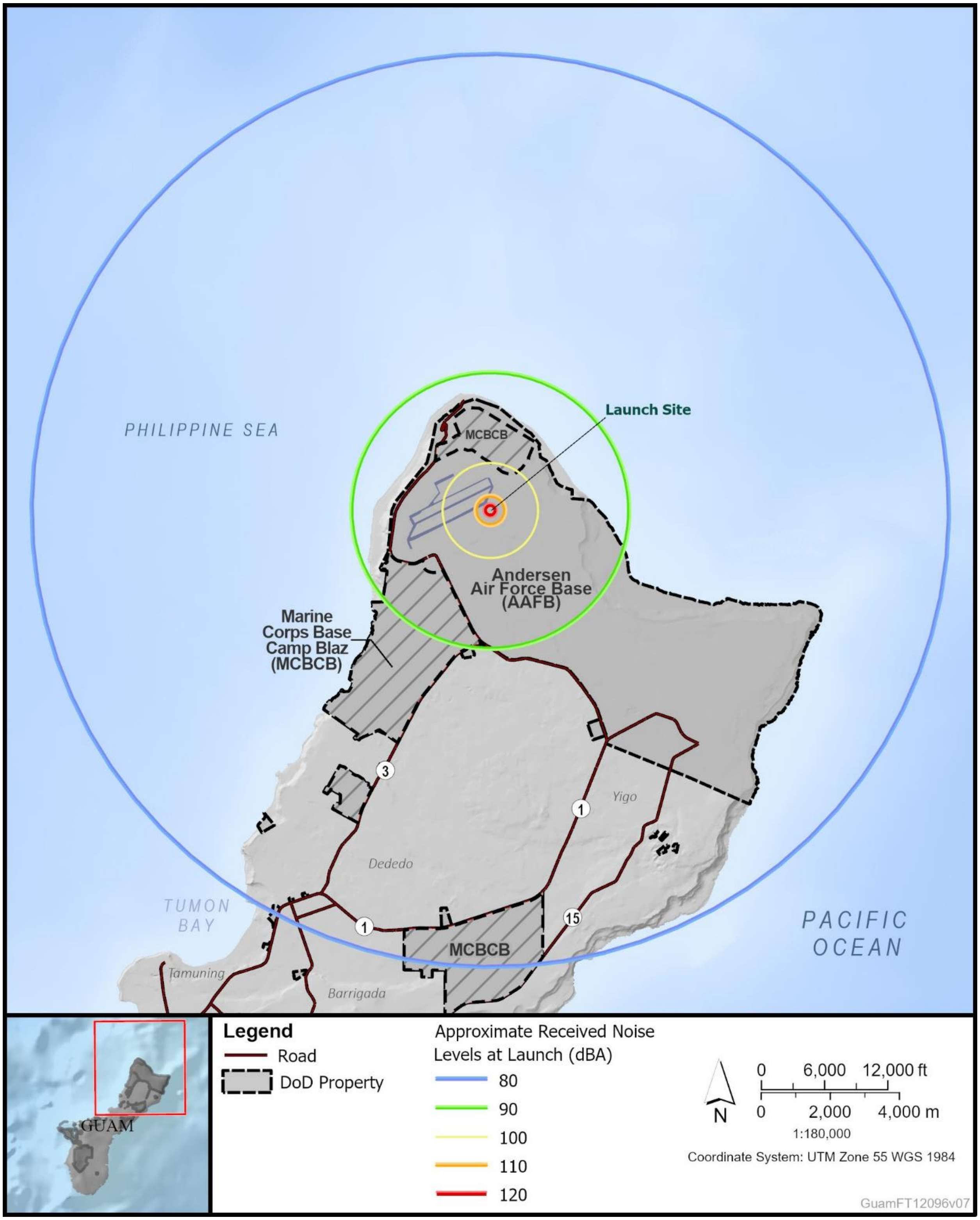


Table 3.5-1: ROI Sub-Area Descriptions

ROI Sub-Areas	Description
Launch Site Area	In addition to the potential effects from launch noise, the ROI also includes the 5.5-acre launch site area where pre-launch, launch, and post-launch activities may impact immediately adjacent areas.
Booster Drop Area	The 197-acre area where the expended first stage booster would land is the only area within the ROI where physical impacts of the ground and vegetation would occur.

Vegetation

The proposed launch site area is comprised mostly of developed land. The placement of proposed facilities, assets, and infrastructure within the project area would occur on developed areas or previously disturbed and maintained shrub/grassland areas (Figure 3.5-2).

The majority (approximately 155 acres; 79 percent) of the approximate 197-acre expended booster drop area consists of limestone native or degraded forest (Table 3.5-2 and Figure 3.5-3).

Table 3.5-2: Acreage of Vegetation Communities within the Expended Booster Drop Area

Vegetation Community	Area (acres)	Proportion
Developed	23.3	11.8%
Limestone Coastal Scrub	5.5	2.8%
Limestone Degraded Forest	73.7	37.5%
Limestone Native Forest	81.4	41.4%
Shrub/Grassland	12.8	6.5%
Total	**196.7**	

Source: U.S. Department of the Navy (2022b)

Special status species within the ROI are discussed in detail in Section 3.5.2.3 (Special Status Species).

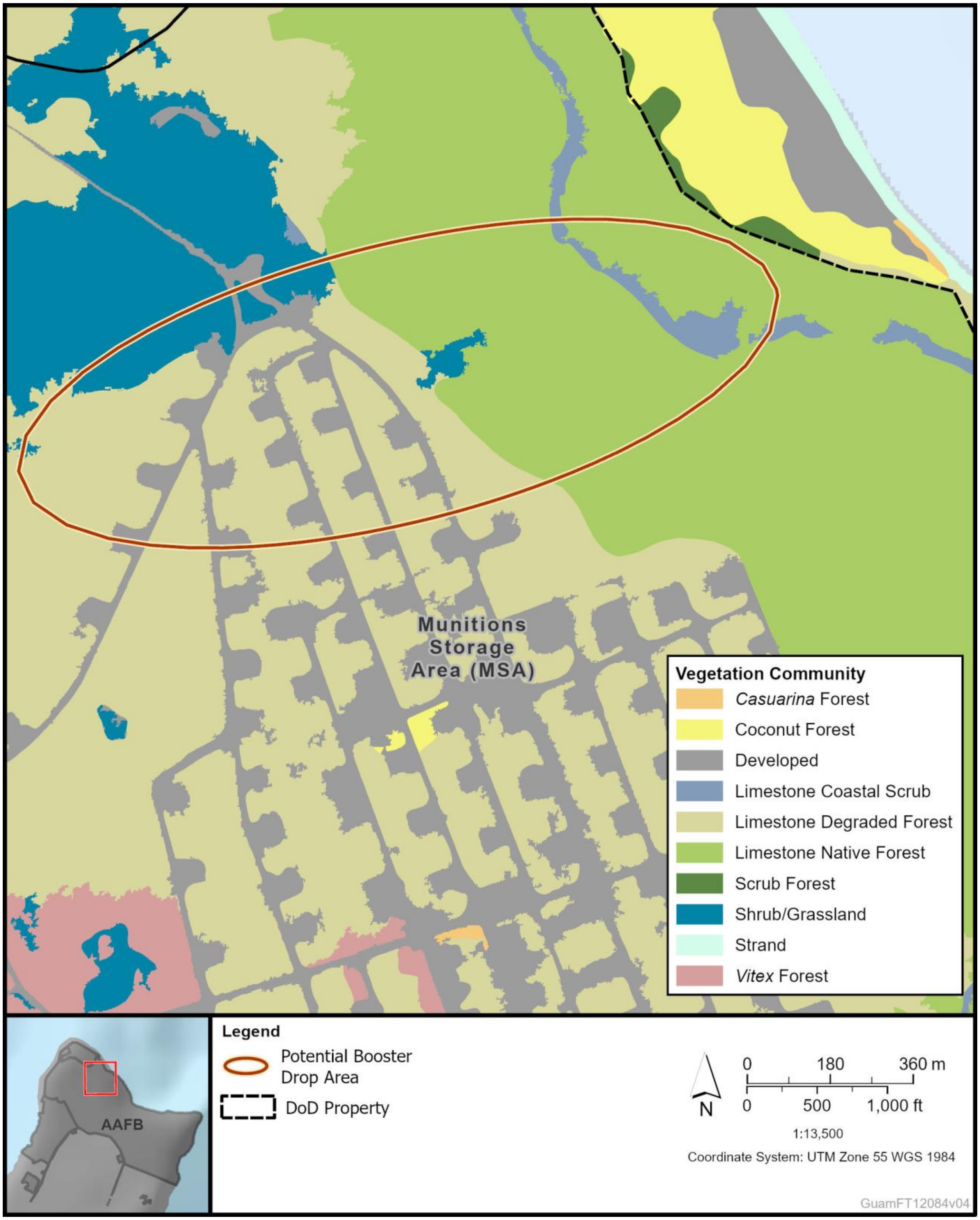
3.5.2.2 Wildlife

Given the recent surveys in 2020 and 2023, except for ESA-listed sea turtles (addressed below in Section 3.5.2.3, Special Status Species), there are no native reptiles or amphibians in the ROI (EA Engineering Science & Technology Inc. PBC, 2020). The invasive brown treesnake (*Boiga irregularis*) continues to be widespread throughout Guam and is a threat to native species (U.S. Department of the Navy, 2019a). As no native reptiles or amphibians have been observed in the ROI, they are not analyzed further in this EA/OEA.

Figure 3.5-2: Overview of Flight Test Components at Northwest Field, AAFB

Figure 3.5-3: Vegetation Communities Within the Potential Booster Drop Area

Source: U.S. Department of the Navy (2022b)



Twenty-one species of birds have been recorded on AAFB (U.S. Department of the Navy, 2019a). Most avian species on AAFB are native to the region; however, many are seasonal visitors that use coastal, grassy, or other open habitats to forage during their annual migration. Migratory birds either spend the winter on Guam or migrate through during the spring and fall to breeding areas to the north and south (U.S. Department of the Navy, 2019a).

Non-native mammals present at AAFB include rats (*Rattus spp.*), house mouse (*Mus musculus*), and musk shrew (*Suncus murinus*) (Wiewel et al., 2009). Feral populations of dogs (*Canis lupus familiaris*), cats (*Felis catus*), Philippine deer (*Cervus mariannus*), and pigs (*Sus scrofa*) pose threats to native wildlife populations (U.S. Department of the Navy, 2019a). The only native mammal on Guam is the Mariana fruit bat (*Pteropus mariannus mariannus*), which is described further in Section 3.5.2.3 (Special Status Species).

3.5.2.3 Special Status Species

To support the preparation of an EIS for the proposed Enhanced Integrated Air and Missile Defense (EIAMD) System on Guam, ESA-listed species surveys were conducted in September and October 2023 within the Munitions Storage Area, which included the majority of the potential expended booster drop area. Additional surveys were conducted by AAFB in 2022 within the eastern portion of the booster drop area. Figure 3.5-4 depicts the results of the 2022 and 2023 surveys as well as surveys from 2010 through 2018. Table 3.5-3 provides a summary of the number of occurrences of ESA-listed species within the booster drop area based on all surveys conducted from 2010 through 2023. In addition to those ESA-listed species that may be impacted within the booster drop area, the only ESA-listed species within the ROI that may be impacted by noise from the proposed launch activities is the Mariana fruit bat.

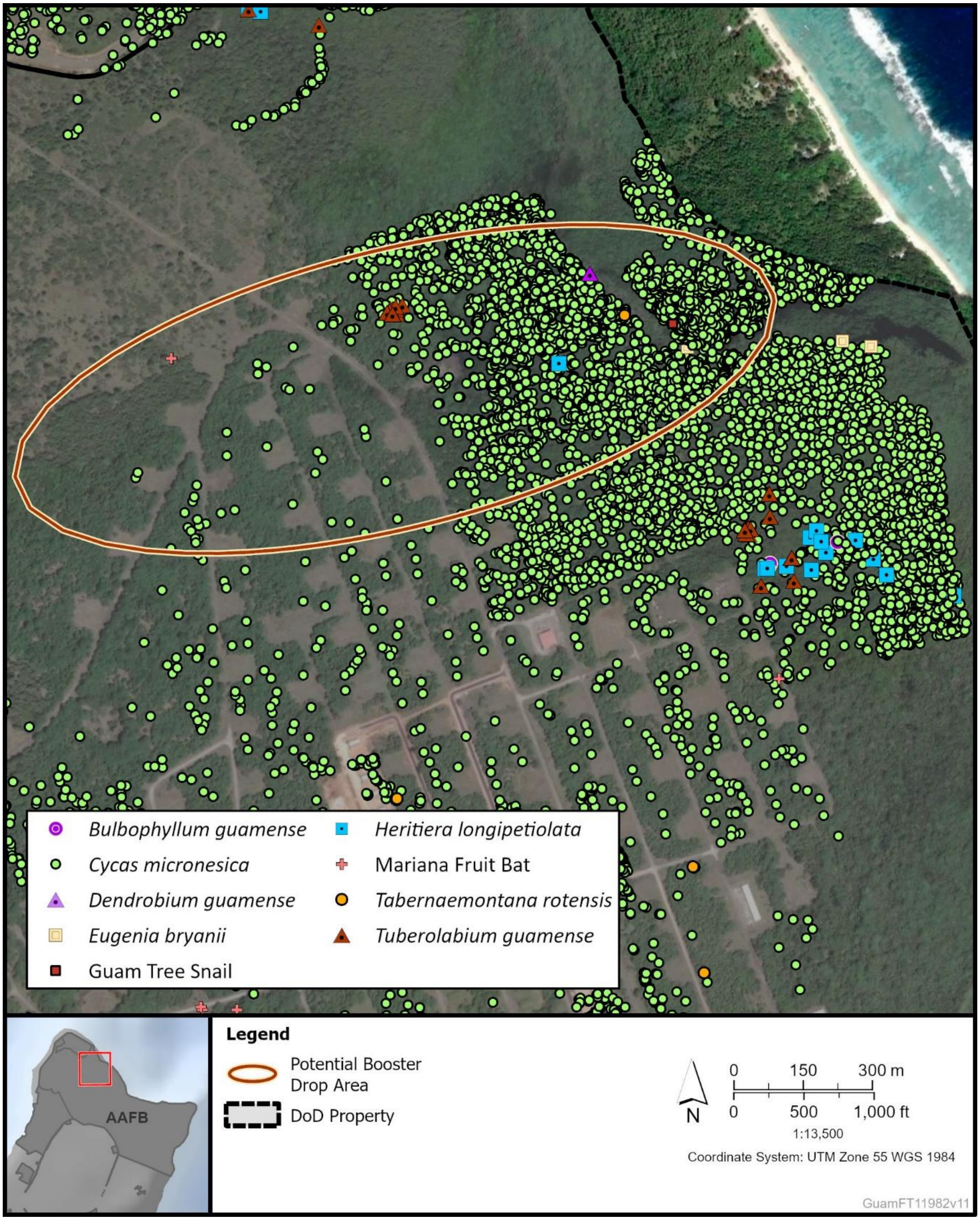
Table 3.5-3: Summary of Occurrences of Federal ESA-Listed Species within the Booster Drop Area

Species (*Scientific Name*)	ESA Status	Number of Individuals within the Booster Drop Area†
Mammals		
Mariana fruit bat (*Pteropus mariannus mariannus*)	Threatened	1
Invertebrates		
Guam tree snail (*Partula radiolata*)	Endangered	1
Plants		
Dendrobium guamense	Threatened	1
Tuberolabium guamense	Threatened	7
Cycas micronesica	Threatened	2,514
Eugenia bryanii	Endangered	1
Heritiera longipetiolata	Endangered	1
Tabernaemontana rotensis	Threatened	1

Note: †See Figure 3.5-3.
Sources: 2023 surveys for the EIAMDS EIS; unpublished NAVFAC Marianas 2023 GIS data.

Figure 3.5-4: Occurrences of ESA-listed Species Within and Adjacent to the Potential Expended Booster Drop Area

Sources: Data from 2023 EIAMDS EIS Surveys; unpublished NAVFAC Marianas 2023 GIS data



3.5.2.3.1 Mariana Fruit Bat

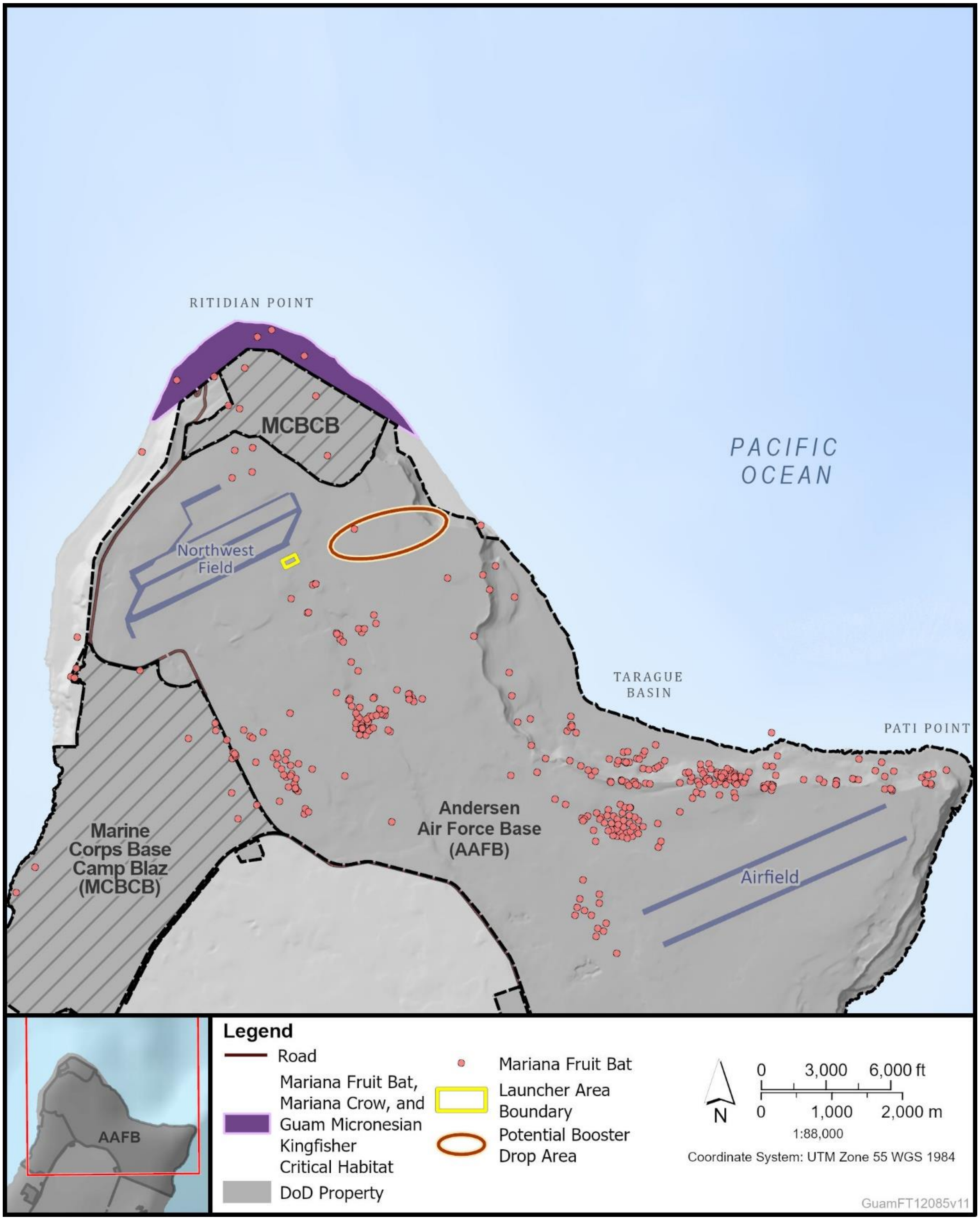
The Mariana fruit bat is listed as endangered under the federal ESA. They feed on a variety of plant material, but fruit makes up majority of their diet. Recent surveys in 2020, 2021, and 2022 estimate a population size on AAFB of 73, 108, and 104 individuals, respectively (Naval Facilities Engineering Command Marianas, 2020, 2022, 2023). Surveys of AAFB since 2010 show that while fruit bats can be found throughout AAFB primarily within areas of limestone forest, they are concentrated along the cliff line to the northwest of the airfield above Tarague Basin and to the east to Pati Point (Figure 3.5-5). Mariana fruit bats roosting and foraging along the limestone cliffs near AAFB have been exposed to military activities, including military aircraft and other anthropogenic noise, since the construction of the military installation in the 1940s (U.S. Department of the Navy, 2019a).

Within the mammalian order Chiroptera, microchiropterans (small, insectivorous bats or microbats) produce sounds of higher frequency than the megachiropterans (typically larger, fruit/nectar feeding bats or megabats). Microbats use sound energy in echolocation, while the megabats predominantly use it for social communication (Grinnell, 1995). Fruit bats in the genus *Rousettus* also use echolocation, although it is not as sophisticated as that in microbats (Koay et al. 1998). Hearing in *Pteropus* fruit bats such as the Mariana fruit bat is primarily used for communication or social activity and in detecting the approach of potential threats (e.g., predators) (Grinnell, 1995). For those species of fruit bats that have been tested for hearing sensitivity, their audiograms are very similar to those of humans, with similar upper and lower frequency limits and hearing threshold levels ((M. B. Calford et al., 1985); (G. Koay et al., 1998); (R.S. Heffner, 2006)).

Based on past surveys, there was one fruit bat detection in 2010–2015 within the expended booster drop area (see Figure 3.5-5) (unpublished Naval Facilities Engineering Command [NAVFAC] Marianas 2023 GIS data). The only known fruit bat roost on AAFB is located approximately 4 miles southeast of the proposed launch site (unpublished NAVFAC Pacific 2023 GIS data).

Figure 3.5-5: Known Occurrences of Mariana Fruit Bats on AAFB

Source: unpublished NAVFAC Marianas 2023 GIS data



Critical Habitat

In November 2004, 376 acres of critical habitat for the Mariana fruit bat, Guam Micronesian kingfisher (*Todiramphus cinnamominus*), and Mariana crow (*Corvus kubaryi*) was designated within the Guam National Wildlife Refuge at Ritidian Point north of AAFB (69 FR 62944) (see Figure 3.5-5). At the time of critical habitat designation, the U.S. Fish and Wildlife Service (USFWS) identified the primary constituent elements that are specific elements of the physical or biological features that provide for a species' life-history processes and are essential to the conservation of the species and may require special management or protection. The primary constituent elements required by the fruit bat, kingfisher, and crow for the biological needs of foraging, sheltering, roosting, and rearing of young are found in areas supporting limestone, secondary, ravine, swamp, agricultural, and coastal forests composed of native and introduced plant species (69 FR 62944). Under the PA, activities associated with the launch of the interceptor missile would only introduce noise into the environment and not result in any physical impact on fruit bat, crow, or kingfisher critical habitat or the associated primary constituent elements. Therefore, implementation of the PA would have no impact on designated critical habitat for the Mariana fruit bat, Mariana crow, or Guam Micronesian kingfisher, and critical habitat is not discussed further.

In addition, the Guam Micronesian kingfisher, Guam rail, and Mariana crow are extirpated from Guam and are not addressed in this EA/OEA.

3.5.2.3.2 Guam Tree Snail

The endemic Guam tree snail (*Partula radiolata*) was listed as endangered in November 2015 (80 FR 59424). Guam tree snails require cool, shaded forest habitat with high humidity and reduced air movement that prevents excessive water loss. The snails do not appear to require specific host plants and can be found on many different species of large-leaved plants (e.g., trees, shrubs, herbaceous plants, and even ferns), both native and introduced (U.S. Department of the Navy, 2022b). Prior to its listing in 2015, there were approximately 20 known populations on Guam, but extensive surveys in 2019 identified more than 50 populations. While some may support only a few individuals, others likely number in the thousands (U.S. Fish & Wildlife Service, 2022). Based on a 2022 survey, only one live Guam tree snail was observed within the currently proposed booster drop area (unpublished NAVFAC Marianas 2023 GIS data) (see Figure 3.5-4).

3.5.2.3.3 Plants

Based on surveys in 2020 and 2023, six ESA-listed plant species have been identified within the booster drop area: *Dendrobium guamense*, *Tuberolabium guamense*, *Cycas micronesica*, *Eugenia bryanii*, *Heritiera longipetiolata*, and *Tabernaemontana rotensis* (see Table 3.5-3 and Figure 3.5-4). All of the ESA-listed plant species were listed as endangered or threatened in November 2015 (80 FR 59424).

Dendrobium guamense and *Tuberolabium guamense* are epiphytes in the orchid family restricted to humid, moist native forests on Guam. Threats to both orchids include habitat loss and destruction from agriculture, urban development, nonnative animals and plants, fire, and typhoons, combined with herbivory by nonnative invertebrates such as slugs. Climate change (i.e., changes in precipitation and temperature) is expected to further exacerbate many of these threats in the future (U.S. Fish & Wildlife Service, 2022). Based on surveys in 2022 and 2023, only one *Dendrobium guamense* and seven *Tuberolabium guamense* have been observed within the booster drop area (see Table 3.5-3 and Figure 3.5-4).

Cycas micronesica is a gymnosperm in the cycad family (Cycadaceae) native to Guam, Rota, Pagan, Palau and Yap (80 FR 59424). *Cycas micronesica* used to be the most common understory tree in the region's limestone forests and can also be found in coastal strand habitat. During surveys in 2002, it was the most abundant tree on Guam with over 1.5 million trees. Their numbers are declining rapidly with a significant percentage of the cycads on Guam that are either in poor health or dying due to the cycad scale which quickly causes mortality of all life stages, preventing reproduction of *Cycas micronesica*, and potentially leading to its extirpation. Additional threats include predation by nonnative animals, secondary infestations by other insects, and loss of habitat due to development, and typhoons. Climate change is expected to further exacerbate many of these threats in the future (U.S. Fish & Wildlife Service, 2022).

Based on surveys in 2022 and 2023, more than 2,500 *Cycas micronesica* have been observed within the booster drop area (see Table 3.5-3 and Figure 3.5-4).

Eugenia bryanii is a short, low-lying perennial shrub in the myrtle family (Myrtaceae) endemic to Guam. It historically occurred on windy, exposed cliff lines along the western and eastern coasts (80 FR 59424). Threats to *Eugenia bryanii* include habitat loss and destruction from agriculture, urban development, nonnative animals and plants, fire, and typhoons, combined with herbivory by Philippine deer. Climate change is expected to further exacerbate many of these threats in the future (U.S. Fish & Wildlife Service, 2022). Based on surveys in 2022 and 2023, only one *Eugenia bryanii* has been observed within the booster drop area (see Table 3.5-3 and Figure 3.5-4).

Heritiera longipetiolata is a tree in the hibiscus family (Malvaceae) restricted to native limestone forests of Guam, often in rough karst terrain. *Tabernaemontana rotensis* is a small to medium-sized tree in the dogbane family (Apocynaceae) found within native limestone forests of Guam (80 FR 59424). Threats to both species include habitat loss and destruction from agriculture, urban development, nonnative animals and plants, and typhoons. Climate change is expected to further exacerbate many of these threats in the future (U.S. Fish & Wildlife Service, 2022). Based on surveys in 2022 and 2023, only one *Heritiera longipetiolata* and one *Tabernaemontana rotensis* have been observed within the booster drop area (see Table 3.5-3 and Figure 3.5-4).

3.5.2.3.4 Sea Turtles

In addition, the endangered Central West Pacific Distinct Population Segment of the green sea turtle (*Chelonia mydas*) is known to nest on AAFB within the Tarague Basin on five beaches: Explosive Ordnance Disposal, Pati, Scout, Sirena, and Tarague (see Figure 3.5-4) (U.S. Department of the Navy, 2022b). All of these beaches are east of the launch site on NWF. The endangered hawksbill turtle (*Eretmochelys imbricata*) is not known to nest on AAFB, occurs only rarely in the marine waters north of Guam, and is discussed in Section 3.6, Marine Biological Resources (U.S. Department of the Navy, 2022b).

3.6 Marine Biological Resources

3.6.1 Regulatory Setting

Regulatory settings under ESA and MBTA are described in detail in Section 3.5.1 (Terrestrial Biological Resources Regulatory Setting). Additional regulatory setting for Marine Biological Resources includes the Marine Mammal Protection Act (MMPA) and the Magnuson-Stevens Fishery Conservation and Management Act and Sustainable Fisheries Act. These regulations are described in detail in the following sections.

3.6.1.1 Marine Mammal Protection Act

All marine mammals are protected under the provisions of the MMPA (16 U.S.C. section 1361 et seq.). The MMPA prohibits any person or vessel from “taking” marine mammals in the U.S. or the high seas without authorization. Take is defined by MMPA regulation (50 CFR section 216.3) as to harass, hunt, capture, collect, or kill; or attempt to harass, hunt, capture, collect, or kill any marine mammal. Section 101(a)(5) of the MMPA directs the Secretary of the Department of Commerce to allow, upon request, the incidental (but not intentional) take of marine mammals if certain findings are made, and regulations are issued. Based on the detailed analysis in Section 4.6 (Marine Biological Resources) and given pre-consultation discussion with the National Marine Fisheries Service (NMFS), no takes are expected under the MMPA.

The MMPA defines two levels of harassment: Level A and Level B. Level A harassment of marine mammals is any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild. Level B harassment is defined as any act of pursuit, torment, or annoyance which has the potential to disturb a marine mammal or marine mammal stock in the wild. Level B harassment, as amended by the National Defense Authorization Act of Fiscal Year 2001 (Public Law 108-136) for military readiness activities, is defined as any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavior patterns including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering to a point where such behavioral patterns are abandoned or significantly altered (916 U.S.C. 1362(18)(B)(i) and (ii)). Further, under the MMPA, marine mammal stocks can be listed as depleted. The term “depleted” is defined by the MMPA as any case in which a species or population stock is determined to be below its optimum sustainable population. Several of the marine mammals in the ROI are considered depleted under the MMPA.

3.6.1.2 Magnuson-Stevens Fishery Conservation and Management Act and Sustainable Fisheries Act

The Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. section 1801 et seq.), enacted in 1976 and amended by the Sustainable Fisheries Act in 1996, mandates identification and conservation of essential fish habitat. Essential fish habitat is defined as those waters and substrates necessary for fish spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of essential fish habitat, “waters” include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; “substrate” includes sediment, hard bottom, structures underlying waters, and associated biological communities; “ necessary” means the habitat required to support a sustainable fishery and the managed species contribution to a healthy ecosystem; and spawning, breeding, feeding, or growth to maturity covers a species’ full life cycle (16 U.S.C section 1802). EFH that is especially important ecologically or particularly vulnerable to degradation may be designated as “habitat areas of particular concern” [HACP; 50 CFR Section 600.815(a)(8) rev 2022]. Federal agencies are required to consult with the National Marine Fisheries Service (NMFS) and to prepare an essential fish habitat assessment if potential adverse effects on essential fish habitat are anticipated from their activities.

3.6.2 Affected Environment

3.6.2.1 Region of Influence

The ROI includes marine areas that may be subject to effects of the PA and encompasses a 259,219 square nautical mile area (Figure 2.1-6) where flight test debris could land on the ocean surface and sink to the seafloor. Approximately 10.5 percent of the potential flight test debris zone would be within the U.S.'s EEZ east of Guam and would be at least 88 nautical miles east of Guam. No activities would take place in nearshore areas (Figure 2.1-6). There is no designated critical habitat for ESA-protected species within the ROI. Marine biological resources in the ROI are discussed below, and detailed life history information regarding ESA-listed species appears in Appendix G (Supporting Marine Biological Information).

3.6.2.1.1 Marine Habitats

Seamounts in the offshore portions of the ROI are areas of high biological productivity or "hot spots" of hard bottom habitat in relatively flat soft-bottom ocean basins. Several seamounts occur within the ROI (Figure 2.1-6). Seamounts are formed by vertical tectonic activity along converging plate margins. Tectonic activity creates undersea mountains with elevations greater than 1,000 meters (Rogers, 1994). The shallower waters of seamounts support high levels of biodiversity in remote areas of the Pacific Ocean. Fish, sea turtles, seabirds, and marine mammals utilize seamount areas for breeding and feeding (Rogers, 1994). For the purposes of this analysis, only seamounts with summits shallower than 2,000 meters from the sea surface will be analyzed (Yesson et al., 2011).

3.6.2.1.2 Marine Invertebrates

The ROI occurs greater than 88 nautical miles offshore, where only deep-water marine invertebrates may be found. Invertebrates, such as cold-coral and sponges, are typically found in depths of 50 meters or deeper (National Oceanic and Atmospheric Administration, 2021). Therefore, this analysis is limited to deep-water marine invertebrates.

3.6.2.1.3 Fishes

Migratory open-ocean fishes that could be present in the ROI include tunas, billfishes, and sharks. In the ROI, fish species diversity and abundance are highest around seamounts (U.S. Department of the Navy, 2015a). Three ESA-listed fish species occur within the ROI: the Indo-West Pacific Distinct Population Segment of the scalloped hammerhead shark (*Sphyrna lewini*), oceanic whitetip shark (*Carcharhinus longimanus*), and the giant manta ray (*Mobula birostris*). Detailed information on each species status species is located in Appendix G (Supporting Marine Biological Information).

3.6.2.1.4 Sea Turtles

Five sea turtle species, which are all ESA-listed, may inhabit the waters of the ROI (Table 3.6-1). All sea turtle species spend their juvenile years (2–14 years) in open ocean. Leatherback (*Dermochelys coriacea*) and olive ridley (*Lepidochelys olivacea*) turtles are thought to remain primarily in the open ocean throughout their lives, except when mating in coastal waters and laying eggs (National Marine Fisheries Service, 2020a). Green (*Chelonia mydas*), loggerhead

(*Caretta caretta*), and hawksbill (*Eretmochelys imbricata*) sea turtles primarily inhabit nearshore waters during adulthood. All species of sea turtles utilize open ocean corridors for migrating long distances between nesting and feeding grounds (U.S. Department of the Navy, 2015a). In Guam, green and hawksbill sea turtles are the most common (U.S. Department of the Navy, 2019b).

Table 3.6-1: Sea Turtle Species with Possible Presence in the ROI

Common Name	Scientific Name	ESA Status	Density (individuals/kilometer^2)
Green sea turtle	*Chelonia mydas*	E/T(1)	0.00039
Hawksbill sea turtle	*Eretmochelys imbricata*	E	0.000024
Loggerhead sea turtle(2)	*Caretta caretta*	E	0.000022
Olive ridley sea turtle	*Lepidochelys olivacea*	T	0.000001
Leatherback sea turtle	*Dermochelys coriacea*	E	0.000022

Sources: U.S. Department of the Navy (2015a), U.S. Department of the Navy (2018b), National Marine Fisheries Service (2020b)
Notes: E = Endangered T, = Threatened
(1) Central West Pacific Distinct Pacific Population Segment is listed as endangered, and East Indian-West Pacific Distinct Population Segment is listed as threatened. Both threatened and endangered populations could occur in the ROI.
(2) The North Pacific Ocean Distinct Population Segment

3.6.2.1.5 Marine Mammals

Twenty-six species of marine mammals have potential to be found in the ROI, with five species of whales being ESA-listed as endangered. All marine mammals in the ROI are protected under the MMPA. Marine mammals that have confirmed or potential occurrence in the ROI are listed in Table 3.6-2, and species distribution, ecology, and threats to their populations were described in the 2015 Final MITT EIS/OEIS and are incorporated by reference and in Appendix G (Supporting Marine Biological Information) (U.S. Department of the Navy, 2015c). The MITT Study Area and Guam Flight Test ROI overlap significantly, although the MITT Study Area extended west of Guam and the PA ROI extends slightly further east. Five ESA-listed whales are found in the ROI during spring, fall, and winter months (U.S. Department of the Navy, 2019b). Table 3.6-2 lists all non-ESA-listed and any special status species. ESA-listed species are described in detail below. Densities for marine mammals are also provided where available. Detailed information on each special status species is located in Appendix G (Supporting Marine Biological Information).

Table 3.6-2: Marine Mammals with Possible or Confirmed Presence in the ROI

Common Name	Scientific Name	ESA Status	Density (individual/kilometer^2)
Western north Pacific humpback whale	*Megaptera novaeangliae*	E	0.000089
Blue whale	*Balaenoptera musculus*	E	0.00005
Fin whale	*Balaenoptera physalus*	E	0.00006
Sei whale	*Balaenoptera borealis*	E	0.00029
Bryde's whale	*Balaenoptera brydei/edeni*	--	
Minke whale	*Balaenoptera acutorostrata*	--	
Omura's whale	*Balaenoptera omuari*	--	
Sperm whale	*Physeter macrocephalus*	E	0.00291
Pygmy sperm whale	*Kogia breviceps*	--	
Dwarf sperm whale	*Kogia sima*	--	
Killer whale[1]	*Orcinus orca*	--	
False killer whale	*Pseudorca crassidens*	---	
Pygmy killer whale	*Feresa attenuate*	--	
Short-finned pilot whale	*Globicephala macrorhynchus*	--	
Melon-headed whale	*Peponocephala electra*	--	
Common bottlenose dolphin	*Tursiops truncates*	--	
Pantropical spotted dolphin	*Stenella attenuate*	--	
Striped dolphin	*Stenella longirostris*	--	
Rough-toothed dolphin	*Steno bredanensis*	--	
Fraser's dolphin	*Lagenodelphis hosei*	--	
Risso's dolphin	*Grampus griseus*	--	
Cuvier's beaked whale	*Ziphius cavirostris*	--	
Blainville's beaked whale	*Mesoplodon densirostris*	--	
Longman's beaked whale	*Indopacetus pacificus*	--	
Ginkgo-toothed beaked whale	*Mesoplodon ginkgodens*	--	
Spinner Dolphin	*Stenella longirostris*	--	

Source: U.S. Department of the Navy (2015a) U.S. Department of the Navy (2018b), National Marine Fisheries Service (2020b)
Notes: E = Endangered
(1) Only the Southern Resident Distinct Population Segment is listed as endangered, but does not occur in the western Pacific or the ROI.

3.6.2.1.6 Seabirds

Seabirds spend most of their lives at sea and utilize open ocean as their primary habitat. Several species of seabirds have been observed on Guam, including the brown noddy (*Anous stolidus*), white tern (*Gygis alba*), black noddy (*Anous minutus*), and brown booby (*Sula leucogaster*) (U.S. Department of the Navy, 2022b). Since the ROI occurs more than 88 nautical miles offshore, occurrence of any seabird in the ROI would be rare. Detailed information species status species for short-tailed albatross (*Phoebastria albatrus)* is located in Appendix G (Supporting Marine Biological Information).

3.7 Cultural Resources

Cultural resources and historic properties include prehistoric and historic sites, structures, districts, artifacts, or any other physical evidence of human activity considered important to a culture, subculture, or community for scientific, traditional, religious, or any other reason.

Cultural resources are limited, nonrenewable resources whose potential for scientific research (or value as a traditional resource) may be easily diminished by actions impacting their integrity. Numerous laws and regulations require that possible effects to cultural resources be considered during the planning and execution of Federal undertakings. These laws and regulations stipulate a process of compliance, define the responsibilities of the Federal agency proposing the action, and prescribe the relationship among other involved agencies (e.g., State Historic Preservation Office (SHPO), the Advisory Council on Historic Preservation). In addition to NEPA, primary laws that pertain to the treatment of cultural resources during this environmental analysis are described in Section 3.7.1.

3.7.1 Regulatory Setting

NEPA is a procedural statue intended to ensure Federal agencies consider the environmental impacts of their actions in the decision-making process, including impacts to cultural resources. Effects to cultural resources under NEPA included ecological, aesthetic, historic, cultural economic, social, or health; whether direct, indirect, or cumulative (40 CFR 1508.1(g)).

NEPA’s analysis incorporates a broad range of federal laws, regulations, and executive orders, including the NHPA (54 U.S.C. 300101). Section 106 of the NHPA (54 U.S.C. 301608) mandates that Federal agencies with jurisdiction over a proposed Federal or federally assisted undertaking in any State shall take into account the effect of the undertaking on any historic property, and shall afford the Advisory Council on Historic Preservation a reasonable opportunity to comment with regard to the undertaking. The NHPA’s definition of “State” includes Guam and the Northern Mariana Islands.

The process for implementing Section 106 is codified by 36 CFR part 800, Protection of Historic Properties. These regulations define historic properties as any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in the National Register of Historic Places (NRHP) (36 CFR 60). "Historic properties” include artifacts, records, and remains that are related to and located within such properties (36 CFR 800.16(1)).

NHPA’s implementing regulations seek to accommodate historic preservation concerns with the needs of Federal undertakings through consultation among the agency and other parties with an interest in the effects of the undertaking on historic properties, including the Guam SHPO, other appropriate consulting parties, and members of the public. The goal of consultation is to identify historic properties potentially affected by the undertaking, assess its effects, and seek ways to avoid, minimize, or mitigate any adverse effects on historic properties. The Navy is completing a Section 106 consultation for the proposed undertaking associated with this PA.

The Territorial Submerged Lands Act (48 USC §§ 1705-1708) conveys to Guam, the Commonwealth of the Mariana Islands, and other U.S. territories certain submerged lands extending three geographical miles seaward from the coastline of each territory (48 USC § 1705(a)). Locations seaward of the three-mile limit are not included within the NHPA's definition of "State," therefore for this PA Section 106 does not apply to the EEZ or high seas areas.

NHPA includes Section 402 (54 USC § 307101(e)) which is a separate provision requiring federal agencies, prior to approving an undertaking outside the United States that may directly and adversely affect property on the World Heritage List or the applicable foreign country's equivalent of the NRHP, take into account the effect of the undertaking on the property for the purpose of avoiding or mitigating any adverse effects. When this section is triggered, the NHPA delegates to federal agencies the decision as to whom to consult and the manner in which that consultation occurs. This provision is applicable in the high seas beyond the EEZ.

The Sunken Military Craft Act (SMCA) of 2004 (10 U.S.C. § 113 et seq.) preserves sovereign status of sunken U.S. military vessels and aircraft regardless of the passage of time and mandates that all sunken military craft owned by the U.S. government shall be preserved and protected from unauthorized disturbance. This statute is applicable regardless of the submerged craft's location. The SMCA further requires that foreign submerged military craft lying within U.S. waters, such as those within the EEZ as described in this EA, be afforded such protections.

Other laws and regulations related to the management and preservation of cultural resources which may apply to this EA include:

- Archaeological Resources Protection Act of 1979
- Archaeological and Historic Preservation Act of 1974
- Executive Order 11593, Protection and Enhancement of Cultural Environment
- Territory of Guam Executive Order 89-9, Adopting Procedures for Preserving Archaeological Sites
- Territory of Guam Executive Order 89-24, Regarding Policies for Disposition of Archaeologically Recovered Human Remains

3.7.2 Affected Environment

3.7.2.1 Region of Influence

The ROI is defined as the geographical area or areas which the PA may directly or indirectly cause alterations in character or use of cultural resources and historic properties. The overall ROI includes portions of AAFB on NWF, and large portion of the BOA eastward of Guam. Direct effects would include any damage caused by operational activities and are limited to the area in which the PA would take place. Indirect effects would result in changes later in time or as a result of the direct effects and may include changes that may affect the character or use of a cultural resource or historic property or alterations to its setting or viewshed.

For the purposes of this EA/OEA, and based upon the variety of activities and physical settings, the ROI is subdivided into three areas for discussion: the potential launcher area, potential booster drop area, and the potential flight test debris area.

3.7.2.1.1 Launcher Area

The launcher area is a 5.51 acres portion of NWF, AAFB at which test site preparation, range safety, and land-based interceptor deployment, and the interceptor launch would occur (Figure 2.1-5). The ROI for the launcher area includes the 650-acre Northwest Field historic property boundary just to the north of the launcher area (Figure 2.1 1). This area of AAFB is centrally located on a relatively flat portion of Guam's northern plateau, which is comprised of coral limestone. The area is absent of native soils and vegetation which were razed during the construction of NWF, built in 1945 as a B-29 Superfortress base to support bombing campaigns against Japan after American forces recaptured Guam from the Axis nation.

3.7.2.1.2 Potential Booster Drop Area

The potential booster drop area is a 196.54 acre, oblong-shaped parcel on AAFB in which the first stage booster would drop. The drop area is under 600 m northeast of the launch area within the Munitions Storage Area, and situated on a mostly flat area near the eastern edge of Guam's northern limestone plateau. The total acreage represents a safety zone surrounding a 300 to 500 square foot impact area near the parcel's eastern side (Figure 2.1-5); there is no reasonable expectation the booster may land outside this smaller impact area.

3.7.2.1.3 Potential Flight Test Debris Area

The potential flight test debris area is a 259,219 square nautical mile (nm), irregular-shaped area extending from 88 nm to over 1,000 nm seaward of Guam's eastern coastline in which the proposed second-stage booster, extraction pallet and parachutes, and debris from the destroyed interceptor and target would land (Figure 2.1-6).

The western portion of this area (from 88 to 200nm from the coast of Guam or other Northern Mariana Islands) is within the US EEZ; waters extending beyond 200 nm are high seas and outside of any national jurisdiction. Waters in this area generally range from approximately 2,000 m to 9,600 m in depth; however, there are several seamounts and banks present in the area with depths ranging from 10m to 2,000m.

3.7.2.2 Existing Conditions

3.7.2.2.1 Launcher Area

NWF was decommissioned at the end of WWII, but its infrastructure has continued to support military operations at AAFB. Most recently, NWF has supported helicopter training, field exercises, and bivouacking operations. The launcher area is south of NWF's northern runway, which is an active runway, and nearby the THAAD anti-ballistic missile defense system. Paved former runways and access ways border all four sides of the launcher area; the interior portion of the area is heavily graded and/or bulldozed push overgrown with dense grasses.

NWF is historically important in the context of its association with WWII. The proposed launch area is immediately adjacent to a portion of the airfield which was assessed and determined as an NRHP-eligible historic property per 36 CFR § 60 under Criteria A – association with an event contributing a major pattern of U.S. history – specifically, WWII (GHBI# 66-08-1065). The proposed launch area is not located within the boundaries of the historic property. A Historic American Engineering Record (HAER) was completed for the NWF historic property in 2007. Per a 2006 Memorandum of Agreement signed between the SHPO and Air Force, the HAER documentation henceforth mitigates any adverse effects to NWF.

Though Guam's northern plateau has a rich history of pre-Contact use by native CHamoru, there are no archaeological findings to suggest CHamoru presence specifically in the launch area. This is potentially due to the heavy land modifications required to construct the airfield in the 1940s, which also stripped the area of intact soil deposits with potential to contain in situ archaeological material. The lack of vegetation also precludes the potential for culturally significant plants. The area is not currently open for public access. The launch area has been systematically surveyed for cultural and historic resources – none have been identified. Table 3.7-1 lists relevant surveys.

3.7.2.2.2 Potential Booster Drop Area

Approximately half of the booster drop area was razed during the construction of the nearby NWF, as described for the launch area. The easternmost portion of the booster drop area consists of undeveloped limestone forest. The expected impact area is within the razed portion of the booster drop area where there is limited to no likelihood for the presence of intact soil deposits.

Airplane aprons associated with NWF are prevalent throughout the area's western half. These aprons are not included as a contributing element to the NRHP-eligible portion of NWF. The apron area was ostensibly stripped of native soils during its construction, and there is extremely low to no potential for subsurface archaeological or historic materials. The forested area in the booster drop area's eastern portion has potential to contain limestone pockets with some native soils; thus, there may be potential for buried cultural or historic materials. The booster drop area is restricted from public use and no cultural practices are carried out in the area.

Systematic archaeological and cultural resource surveys of the booster drop area have not identified any resources meeting NRHP eligibility requirements. While the plateau is known to have a rich CHamoru history pre-Contact, surveys have not found specific evidence of sustained CHamoru use in the booster drop area. Relevant surveys are listed in Table 3.7-1.

3.7.2.2.3 Potential Flight Test Debris Zone

(National Oceanic and Atmospheric Administration, 2015)Human use of this span of ocean dates back centuries as a route to facilitate trading and voyaging routes between Asia, the Pacific islands, and the Americas, and continues to support transoceanic trade and fishing industries. The oceanic area east of Guam also played a crucial role in global geopolitics, particularly during WWII, which saw immense naval or oversea losses in its Pacific Theater.

The United States maintains sovereign status of approximately seven known submerged military craft in the potential flight test debris, including four ships and three airplanes (National Oceanic and Atmospheric Administration, 2015). The ships range in type and date of loss, reflecting the area's broad usage patterns. One of the ships, an infantry landing craft, was lost during WWII to enemy action. Of the other three, one was a transport barge lost by accident in the years immediately following WWII, and two sank as training targets in modern times. All three of the aircraft were lost during WWII. Japanese forces experienced considerable ship, submarine, and aircraft loss during WWII's Pacific Theater; and, while there are no verified instances of Japanese military vessels within the U.S. EEZ, historical accounts indicate that they may represent a type of resource with potential presence in the area. (Bagnasco, 1977).

While it is expected that these vessels lie within the potential flight test debris area, it is important to acknowledge that in certain cases their final known positions are deduced from historical records rather than verified through direct survey. Reliance on historical accounts introduces the possibility of significant margin of error and underscores the complexities inherent in accurately pinpointing exact locations of resources in this area.

CHamoru and Carolinian peoples developed cultural connections to the sea. The connection between the CHamoru and Carolinian peoples and the sea is a through line beginning with the cultures' origin stories and prevailing through traditional stories, chants, and oral histories. CHamoru and Carolinian peoples' connections to the waters throughout the Mariana Archipelago are demonstrated through modern implementation of traditional migration, fishing patterns, and navigation practices (McKinnon et al., 2014). Given the potential flight test debris area's great distance from shore, vocational or traditional cultural practices in this area may be limited.

Table 3.7-1: Previous Cultural Resource Studies at AAFB

Reference	Study Type	Resources Recorded Within Study Area
Archaeological Studies		
(Davis, 1983)	Archaeological Reconnaissance Survey	None
(Hunter-Anderson & Moore, 2000)	Cultural Resources Overview Survey	None
(Yee et al., 2004)	Archaeological Reconnaissance Survey	None
(Dixon et al., 2012)	Archaeological Reconnaissance Survey	None
(Craft et al., 2023)	Archaeological Reconnaissance Survey	ISO-MSA-006, ISO-MSA-007
Architectural Studies		
(Mason Architects Inc., 2004)	Architectural History Study	None
(Aaron et al., 2007)	Historic American Engineering Record	GHPI Site 66-08-1065, Northwest Field (U.S. military airfield)

3.7.2.3 Identified Historic Resources

Systematic pedestrian surveys have been completed for all terrestrial areas of the ROI and inform the findings of this EA. The depth and vastness of the flight test debris prohibits systematic survey for submerged cultural and historic resources. Consequently, a full inventory of cultural and historic resources is unavailable and existing data are incomplete. However, these incomplete data do not preclude sufficient evaluation of whether the PA may cause reasonably foreseeable significant adverse impacts. Further discussion on this conclusion is included in Section 4.7.1.

In the absence of direct survey, sources consulted to identify cultural and historic resources within the flight test debris area include the NRHP; National Oceanic and Atmospheric Administration's Office of Coast Survey Automated Wreck and Obstruction Information System and Electronic Navigational Chart, databases maintained by the U.S. Naval History and Heritage Command's Underwater Archaeology Branch (respective to SMCA); and the United Nations Educational, Scientific and Cultural Organization's World Heritage List (respective to NHPA Section 402).

One historic property exists within the ROI: GHBI # 66-08-1065, NWF. Seven other cultural properties are known to exist in the BOA per SMCA: four U.S. military shipwrecks and three submerged U.S. military aircraft.

3.8 Environmental Justice and Children's Environmental Health and Safety Risk

3.8.1 Regulatory Setting

The USEPA defines environmental justice as the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (U.S. Environmental Protection Agency, 2023b).

EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, requires each federal agency to identify and address, as appropriate, disproportionately high, and adverse human health or environmental impacts of its programs, policies, and activities on minority populations and low-income populations in the U.S. and its territories and possessions (The President, 1994).

EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, requires federal agencies to "make it a high priority to identify and assess environmental health and safety risks that may disproportionately affect children and shall ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks" (The President, 1997). Environmental health and safety risks to children are defined as those that are attributable to products or substances a child is likely to come into contact with or ingest, such as air, food, water, soil, and products that children use or to which they are exposed (The President, 1997).

EO 14096, *Revitalizing Our Nation's Commitment to Environmental Justice for All*, states that "to fulfill our Nation's promises of justice, liberty, and equality, every person must have clean air to breathe; clean water to drink; safe and healthy foods to eat; and an environment that is healthy, sustainable, climate resilient, and free from harmful pollution and chemical exposure" (The President, 2023). The CEQ has emphasized the importance of incorporating environmental justice review in the analyses conducted by federal agencies under the NEPA and of developing measures that avoid disproportionate environmental effects on minority populations and low-income populations. CEQ guidance also emphasizes relating environmental justice in reference to global warming, and the effect it has on minority populations and low-income populations.

3.8.2 Affected Environment

The ROI for potentially disproportionate and adverse human health and environmental impacts from the PA are the minority populations, low-income populations, and children within the vicinity of AAFB and areas potentially affected by the PA, including the village of Yigo.

AAFB is located in the village of Yigo, the second-most populated village on Guam. According to the 2020 Decennial Census of Island Areas by the U.S. Census Bureau, Yigo has a total population of 19,339, out of which 91 percent (17,595) identify as one race, and 9 percent (1,744) identify as two or more races. Native Hawaiian and Other Pacific Islanders make up 35.6 percent (6,882) of the total population, 42.5 percent (8,210) are Asian, 10 percent (1,934) are white, 3.5 percent (681) are Hispanic or Latino (of any race), 1.8 percent (341) are black, 0.2 percent (34) are American Indian or Alaska Native, and 1 percent (194) are some other race (U.S. Census Bureau, 2020a).

Guam has a total population of 153,836, out of which 90 percent (138,395) identify as one race, and 10 percent (15,441) identify as two or more races. Native Hawaiian and Other Pacific Islanders make up 46 percent (70,809) of the total population, 35.5 percent (54,586) are Asian, 6.8 percent (10,491) are white, 2.9 percent (4,522) are Hispanic or Latino (of any race), 0.9 percent (1,340) are black, 0.1 percent (214) are America Indian and Alaska Native, and 0.6 percent (955) are some other race (U.S. Census Bureau, 2020b).

According to the 2020 Decennial Census of Island Areas by the U.S. Census Bureau and as shown in Table 3.8-1, in 2019, 16.8 percent of people in families in Guam (excluding families in military housing units) had income below the poverty line, and 20.2 percent of all individuals in households (excluding people in military housing units) had income below the poverty line. In Yigo, 16.4 percent of people in families (excluding families in military housing units) had income below the poverty line, and 19.8 percent of all individuals in households (excluding people in military housing units) had income below the poverty line. For comparison, in the rest of the United States in 2019, only 8.5 percent of people in families had income below the poverty level, and 10.5 percent of all individuals had income below the poverty level. In addition, the median household income in Guam in 2019 was $58,289, and median household income in the rest of the United States in 2019 was $68,703. (U.S. Census Bureau, 2020c).

Table 3.8-1: Number and Percentage of Families and People with Income in 2019 Below the Poverty Level

	Guam (United States Territory)		Yigo		United States	
	Number below the poverty level	Percent below the poverty level	Number below the poverty level	Percent below the poverty level	Number below the poverty level	Percent below the poverty level
Families (excluding families in military housing units for Guam and Yigo)	5,694	16.8%	636	16.4%	22,430,000	8.5%
Families with female householder, no spouse present (excluding families in military housing units for Guam and Yigo)	2,530	32.7%	251	34.4%	11,260,000	24.3%
All individuals in households (excluding people in military housing units for Guam and Yigo)	29,408	20.2%	3,434	19.8%	33,980,000	10.5%

Out of Guam's total population, 41,487 (27 percent) are children (people who are 17 years and younger), whereas the village of Yigo's population has 5,460 children (28.2 percent), a slightly higher but similar overall percentage of Guam's population (U.S. Census Bureau, 2020a).

3.9 Public Health and Safety

Public health and safety includes considerations for any activities, occurrences, or operations that have the potential to affect one or more of the following:

The well-being, safety, or health of workers – Workers are considered to be persons directly involved with the operation producing the effect or who are physically present at the operational site.

The well-being, safety, or health of members of the public – Members of the public are considered to be persons not physically present at the location of the operation, including workers at nearby locations who are not involved in the operation and the off-installation population.

Also included within this category are hazards to equipment and structures.

3.9.1 Regulatory Setting

All operational activities at AAFB are subject to Air Force health and safety regulations. Air Force Policy Directive 91-2 (Safety Programs) establishes the U.S. Air Force's key safety policies and describes success-oriented feedback and performance metrics to measure policy implementation. These governing regulations include Air Force Manual 91-201, *Explosive Safety Standards*.

Contractors working on AAFB follow applicable Occupational Safety and Health Administration regulatory requirements (29 CFR), except when DoD or U.S. Air Force-specific requirements apply. Implementation of these regulatory requirements and procedures ensure that there is minimal risk to the health and safety of installation personnel and contractors, as well as to the general public, from installation operations.

While range safety is dependent on the location, facility, and mission, the DoD has established advisory standards and protocols to eliminate or acceptably minimize potential health and safety risks. The Range Commanders Council (RCC) standards are guidelines that provide definitive and quantifiable measures to protect mission-essential personnel and the general public. These guidelines address flight safety hazards (including inert debris) and consequences potentially generated by range operations. All risks to aircraft generated by testing activities at the proposed locations are within RCC standards. The four key RCC standards applied for missile launches are as follows:

- RCC Standard 319, *Flight Termination Systems Commonality Standard*
- RCC Standard 321, *Common Risk Criteria Standards for National Test Ranges*
- RCC Standard 323, *Range Safety Criteria for Unmanned Air Vehicles*

RCC Standard 324, *Global Positioning and Inertial Measurements Range Safety Tracking Systems Commonality Standard*

3.9.2 Affected Environment

The ROI for potential impacts on public health and safety are the areas associated with the PA, including adjacent land areas to the north, south, east, and west of NWF, and adjacent air and sea space. The population of concern for the PA consists of workers and members of the public in the vicinity of AAFB, including the village of Yigo.

Range Safety officials manage operational safety for projectiles, targets, missiles, and other hazardous activities on AAFB. Prior to a hazardous operation proceeding, the range is determined to be cleared using inputs from sensors, visual surveillance of the range, and radar data.

To ensure ground safety, the Range Safety Officer would develop a Launch Hazard Area (LHA) around the proposed launch site. This area is cleared of all but mission-essential test personnel during launch operations. In addition, a launch caution corridor, which is an area limited to essential personnel; and an impact line, demarcating the protection line for all non-mission-essential personnel, would be established.

Flight Safety provides protection to the general public and to AAFB personnel, ships, and aircraft operating in areas potentially affected by mission activities. Specific procedures, including regulations, directives, and flight safety plans, are required for the preparation and execution of missions involving aircraft, missile launches, and reentry payloads. A component of flight safety is based on the possibility of a flight termination after the missile has exited the vicinity of the launch pad. A flight termination boundary along the missile flight would be predetermined, should a launch malfunction or a flight termination action occur.

Prior to each flight test, the Flight Safety Analyst would define which airspace areas and underlying sea space areas would be affected, and the Chief of Range Operations would coordinate with the FAA and the U.S. Coast Guard to address any issues of concern. Air traffic and sea traffic would be rerouted from intercept debris and booster drop zone areas or rescheduled during the launch window. A local NOTMAR and NOTAM would be issued in the region of the flight test.

Flight tests would include the use of high-energy, non-ionizing radiation radars. Because of the potential hazard to personnel and aircraft operations from electromagnetic energy emitted by these radars, MDA is proposing to the FAA to establish a TFR above and around radar locations. A TFR, when activated, is airspace where aircraft operations are prohibited unless otherwise coordinated with and permitted by the appropriate Controlling or Using agencies. A TFR would be established as described in Section 3.2.2 (Affected Environment) and shown in Figure 3.2-2.

Emergency services are organizations that ensure public health and safety by addressing different emergencies. The three main emergency service functions are police, fire and rescue service, and emergency medical service. A stand-by emergency response team consisting of firefighting, safety, and medical personnel from AAFB would be located near the launch site to ensure immediate response and rapid control in the event of an accident. For each flight test launched from the proposed location, the allowable public risk limit for launch-related debris is extremely low in accordance with RCC Standard 321 criteria.

RCC Standard 321 Criteria

- Individuals within the general public must not be exposed to a probability of casualty greater than 1 in 1,000,000 for any single mission. Collective risk for the general public (i.e., the combined risk to all individuals exposed to the hazard) must not exceed a casualty expectation of 1 in 10,000 for any single mission.
- Non-mission ships would be restricted from nearshore hazard areas, where the probability of impact of debris capable of causing a casualty exceeds 1 in 10,000 for non-mission ships.
- Non-mission aircraft in nearshore areas would be restricted from hazard volumes of airspace, where the cumulative probability of impact of debris capable of causing a casualty on an aircraft exceeds 1 in 10,000,000 for all non-mission aircraft.

For comparison purposes, the 2021 average annual probability of fatality in the U.S. from non-transportation unintentional (accidental) injuries was 1 in 1,896 (National Safety Council, 2021). This probability record included falls, drowning, electrical shock, fire and burns, and poisoning. Thus, the risk of fatality to the public from the PA would be substantially less than the risk from non-transportation related accidents.

Flight tests would include the use of high-energy, non-ionizing radiation radars. Because of the potential hazard to personnel and aircraft operations from electromagnetic energy emitted by these radars, MDA is proposing to the FAA to establish a TFR above and around radar locations. A TFR, when activated, is airspace where aircraft operations are prohibited unless otherwise coordinated with and permitted by the appropriate Controlling or Using agencies.

3.9.2.1 Test Mishaps

Test mishaps are defined in terms of three scenarios: (1) termination or detonation on the launcher, (2) termination of a flight shortly after liftoff, and (3) termination of a flight after it has exited the vicinity of the launch site.

A test mishap termination of the interceptor on the launcher/land pad would be characterized by an explosion or detonation of the intercept propellants, or a scenario in which the intercept propellants burn without detonation and explosion. The LHA surrounding the launcher/launch pad would be calculated by range safety based on system specific hazards. All hazardous debris resulting from a termination on the launcher/launch pad would be contained within the LHA. The LHA would be cleared of unprotected personnel. Fire suppression, hazardous materials emergency responders, and emergency medical teams would be available during launch operations.

Termination of the interceptor shortly after liftoff would result in all hazardous debris being contained within the LHA. Non-mission-essential personnel are excluded from the LHA during launch operations. Personnel working within the LHA would be protected in buildings, vehicles, or behind berms.

Termination of the interceptor after it has exited the vicinity of the launcher would occur in the event of an off-course flight. The Flight Termination System would destroy the interceptor inflight, or the flight termination system would be activated to terminate the interceptor's forward thrust. The interceptor or its debris would then fall to the surface of the ocean and sink to the bottom. As previously discussed, an LHA would be established such that the probability of human casualties or property damage would be extremely low in the event of a mishap. The debris impact area also takes into account all planned interceptor and target impact areas within the surrounding BOA.

3.10 Noise

This section of the EA describes potential impacts related to noise as a result of the PA and alternatives. Types or sources of noise and the effects of noise on people and associated sensitive receptors in the human environment are discussed in this section. Noise in relation to biological resources is discussed in Section 3.5 (Terrestrial Biological Resources).

Sound consists of minute vibrations that travels through a medium, such as air or water, and can be 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 can cause hearing loss, the principal human response to noise is annoyance. Response to noise varies, depending on the type and characteristics of the noise, distance between the noise source and whoever hears it (the receptor), receptor sensitivity, and time of day. A noise-sensitive receptor is defined as a land use where people involved in indoor or outdoor activities may be subject to stress or considerable interference from noise. Such locations or facilities often include residential dwellings, hospitals, nursing homes, educational facilities, and libraries.

3.10.1 Regulatory Setting

3.10.1.1 Regulatory Framework

3.10.1.1.1 Noise Control Act

The Noise Control Act of 1972, as amended, directs all federal agencies to carry out programs within their jurisdiction in a manner that promotes an environment free from noise that jeopardizes health and welfare, to the fullest extent within agency authority.

3.10.1.1.2 Federal Interagency Committee on Urban Noise

The federal government suggests land-use compatibility criteria for different noise zones. Based on the guidelines in the Federal Interagency Committee on Urban Noise (Federal Interagency Committee on Urban Noise, 1980b), residential areas and schools are considered compatible where the Day-Night average sound level (DNL) is less than or equal to 65 dBA. Outdoor recreational activities are compatible with noise levels less than or equal to 70 dBA. Parks are compatible with noise levels less than or equal to 75 dBA (Federal Interagency Committee on Urban Noise, 1980b).

3.10.1.1.3 United States Environmental Protection Agency Noise Standards

The USEPA determined a 24-hour exposure level of 70 decibels (dB) as the level of environmental noise at which no measurable hearing loss would be expected to occur over a lifetime (U.S. Environmental Protection Agency, 1974). This exposure level is also the threshold for hearing loss avoidance.

3.10.1.1.4 Federal Highway Administration Noise Standards

Noise standards, regulations, and policies related to highway traffic noise have been adopted by the Federal Highway Administration. The administration’s Roadway Construction Noise Model User’s Guide provides a useful methodology to evaluate construction (including demolition) noise impacts and is used in this analysis (Federal Highway Administration, 2006).

3.10.1.1.5 U.S. Occupational Safety and Health Administration

29 CFR contains the principal set of rules and regulations from the U.S. Occupational Safety and Health Administration issued by federal agencies regarding occupational noise exposure. Specifically, regulations and standards governing general industry are provided in 29 CFR 1910.95.

3.10.2 Analysis Framework

3.10.2.1 Basics of Sound

The loudest sounds detected comfortably by the human ear have intensities a trillion times higher than sounds that can barely be detected. Therefore, using a linear scale to represent sound intensity is not feasible. The dB is a logarithmic unit used to represent the intensity of a sound, also referred to as the sound level. An increase of 10 dB represents a 10-fold increase in acoustic energy, while 20 dB is 100 times more intense, and 30 dB is 1,000 times more intense. However, acoustic energy and perceived loudness are not the same thing. When it comes to perceived loudness, an increase of 10 dB represents a two-fold or doubling of the noise as perceived by the receptor, as shown in Figure 3.10-1. The most common scale for characterizing sound is the dBA, which gives greater weight to the frequencies of sound to which the human ear is most sensitive. It is correlated with annoyance caused by noise sources such as traffic and construction.

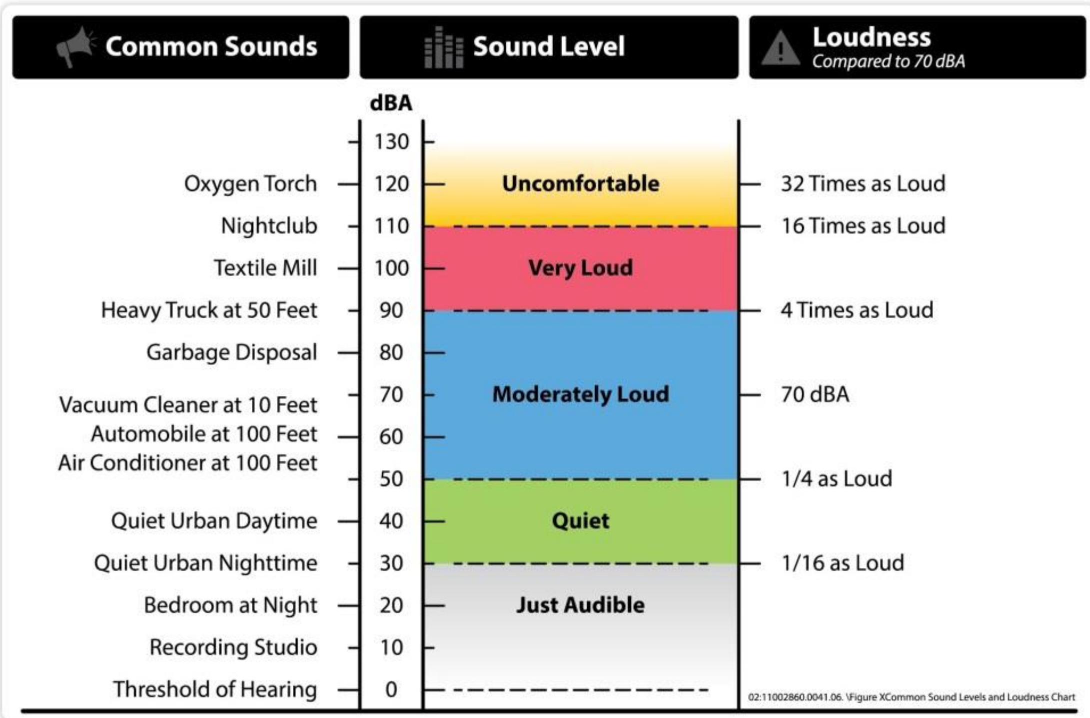
Some noise sources (e.g., air conditioner, vacuum cleaner) are measured as continuous sounds that maintain a constant sound level for a period of time. Other sources (e.g., automobile, heavy truck) are measured by the maximum sound produced during an event, such as a vehicle passing by. Other sounds (e.g., urban daytime, urban nighttime) are measured as averages taken over extended periods of time.

A metric is a system for measuring or quantifying a particular characteristic of a subject. Since noise is a complex physical phenomenon, multiple noise metrics help to more accurately quantify the noise environment. The noise metrics used in this EA/OEA are summarized below.

3.10.2.2 Maximum Sound Level

The maximum sound level (Lmax), measured in dB, is the maximum sound level of a sound event. Figure 3.10-1 provides typical A-weighted noise levels in various indoor and outdoor environments.

Figure 3.10-1: Typical A-Weighted Environmental Noise Levels



Day-Night Average Sound Level

The DNL metric may be used to define cumulative noise dosage, or noise exposure, over a 24-hour period. To compute DNL, the logarithmically calculated total noise energy over 24 hours, during which numerous events may have occurred, is averaged over the time period. Additionally, an extra weighting of 10 dB is assigned to any sound levels occurring between the hours of 10:00:00 p.m. and 6:59:59 a.m. This penalty is intended to account for the greater annoyance that nighttime noise is presumed to cause for most people. DNL is the standard noise exposure metric used by the U.S. Department of Housing and Urban Development, FAA, USEPA, and the DoD. Most people are exposed to sound levels of 50–55 DNL or higher on a daily basis. Research indicates about 87 percent of the population is not highly annoyed by outdoor sound levels below 65 dB DNL (Federal Interagency Committee on Urban Noise, 1980a). The FAA is currently evaluating the accuracy of the Federal Interagency Committee's research on noise exposure-annoyance relationships for aircraft noise. Therefore, the 65 dB DNL noise contour is used to determine compatibility of military operations with local land use.

3.10.2.3 Noise Effects

Some studies have linked increases in noise with human health effects, such as hearing impairment, sleep disturbance, cardiovascular effects, and psychophysiological effects (Van Kempen et al., 2002). Both short- and long-term exposure to very loud noises and long-term exposure to lower levels of sound (chronic exposure) can affect health. Damage to hair cells of the cochlea (the auditory portion of the inner ear) and hearing impairment can be caused by acute exposure to sounds greater than 120 dB (Babisch, 2005; Goelzer et al., 2001).

<u>Propagation of Sound in the Environment</u>

In an ideal setting in which sound propagates away from a point source in air 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 (noise in relation to biological resources, as well as how sound propagates in water, is discussed in Sections 3.5 (Terrestrial Biological Resources) and 3.6 (Marine Biological Resources). 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 an approximation of reduction with distance. Wind is the single-most important meteorological factor within approximately 500 feet of the sound source, as wind can refract sound waves upward (headwind) or down towards the ground (tailwind). Similarly, vertical air temperature gradients are more important in sound propagation over longer distances, with sound waves tending to refract towards areas of cooler air. Humidity can also have a major effect on received sound levels, with increasing humidity increasing the attenuation of the sound wave, decreasing the distance which the sound travels.

Whether natural or man-made, a large object or barrier in the path between a sound source and a receptor can reduce 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, often reducing sound levels by 5–10 dB. The impact of this shielding is dependent on the size and location of the barrier, with topographical barriers (e.g., hills, mountains) reducing propagation more than a small wall or building.

3.10.3 Affected Environment

The project ROI includes all areas where noise is generated by activities under all alternatives. The ROI for the project includes all areas off DoD lands where launch noise could be audible.

The proposed launch site on NWF on AAFB is situated at the north end of Guam, with approximately 12,667 feet (2.4 miles) of heavy vegetation before reaching the southern boundary of AAFB. The closest residences from the proposed launch site are approximately 2.44 miles south, immediately south of Guam Route 9, 3, and 3A (Potts Junction). The closest school to the proposed site is Machananao Elementary School (2.89 miles south). The closest church is Santa Bernadita Church, approximately 2.89 miles south (Table 3.10-1). At these distances, it is unlikely that any setup or non-launch noise generated at the proposed launch site would reach sensitive receptors. Therefore, they are not discussed further in this section. Road noise is the most prominent noise source at these locations, given their proximity to the main road. Other noise sources include aviation noise, construction noise, and environmental noise. Ambient noise levels collected in August 2023 near Machananao Elementary School noted ambient noise levels between 45.4 and 75.4 dBA (Appendix F, Ambient Sound Measurements on or Adjacent to Andersen Air Force Base and Naval Base Guam, Guam). Vehicles passing these locations had Lmax levels ranging from 65.9 to 83 dBA. Aircraft overflights at these locations had Lmax levels ranging from 66.2 to 84.3 dBA.

Table 3.10-1: Sensitive Receptors Adjacent to AAFB

Receptor	Distance from Launch Location (miles)	Distance from Launch Location (feet)
Closest Residences (Potts Junction)	2.44	12,894
Machananao Elementary School	2.89	15,257
Finegayan Elementary School	3.99	21,108
Astumbo Elementary/Middle School	4.99	26,375
Santa Bernadita Church	2.89	15,188
Church of God	3.17	16,749
Abundant Life Church	3.47	18,305

4.0 Environmental Consequences

4.1 Introduction

This section is organized by resource element in the same order as introduced in Chapter 3.0 (Affected Environment). For each resource element, the analysis methods are described, and project-specific impacts are then discussed relative to the activities of Alternative 1, 2, and the No Action Alternative. Unless otherwise noted, the following discussion applies to potential impacts that would result from activities described in Chapter 2.0 (Description of the Proposed Action and Alternatives) of this document. Cumulative impacts for each resource for each alternative are described in Section 4.11 (Cumulative Impacts).

4.2 Airspace Management

Table 4.2-1 describes the criteria used to determine whether the PA would result in a less than significant impact or significant impact on airspace management.

Table 4.2-1: Criteria for Determining the Significance of Proposed Action Stressors on Airspace Management

Impact Descriptor	Level of Impact	Significance Conclusions
Negligible	Proposed activities do not cause a detectable increase in flight restrictions on navigable airspace or a reduction in airport and airfield access. The activities would not result in unusual changes in regular aircraft flight course, altitude, or instrument procedure; or hinder the ability of air services to respond to an emergency. Safety is not impacted.	Less than significant impact
Minor	Proposed activities could rarely result in a detectable increase in flight restrictions on navigable airspace or noticeably reduced access to airports and airfields. Inflight procedures would be altered but would be temporary and would not cause detectable increases in fuel consumption or delays. Safety is not impacted.	
Moderate	Flight restrictions on navigable airspace cause occasional delays, longer flight times and distances, and increased fuel consumption. Some flight operations may be suspended temporarily. Safety is not impacted.	
Major	Flight restrictions occur routinely and result in rerouting aircraft or suspension of flight operations. Rerouting delays cause excessive, unplanned fuel consumption and delays. Some flight operations cannot be conducted throughout portions of the Study Area. Safety margins may be reduced.	Significant impact

Target and interceptor launches and intercepts would be conducted in compliance with DoD Instruction 4540.01, Use of International Airspace by U.S. Military Aircraft and for Missile and Projectile Firings, which states that "Firing areas must be selected so that trajectories or flight profiles are clear of established oceanic air routes or areas of known surface or air activity." Prior to conducting flight tests, MDA and test planners would identify test areas with the FAA that meet test objectives while minimizing impacts on air carriers.

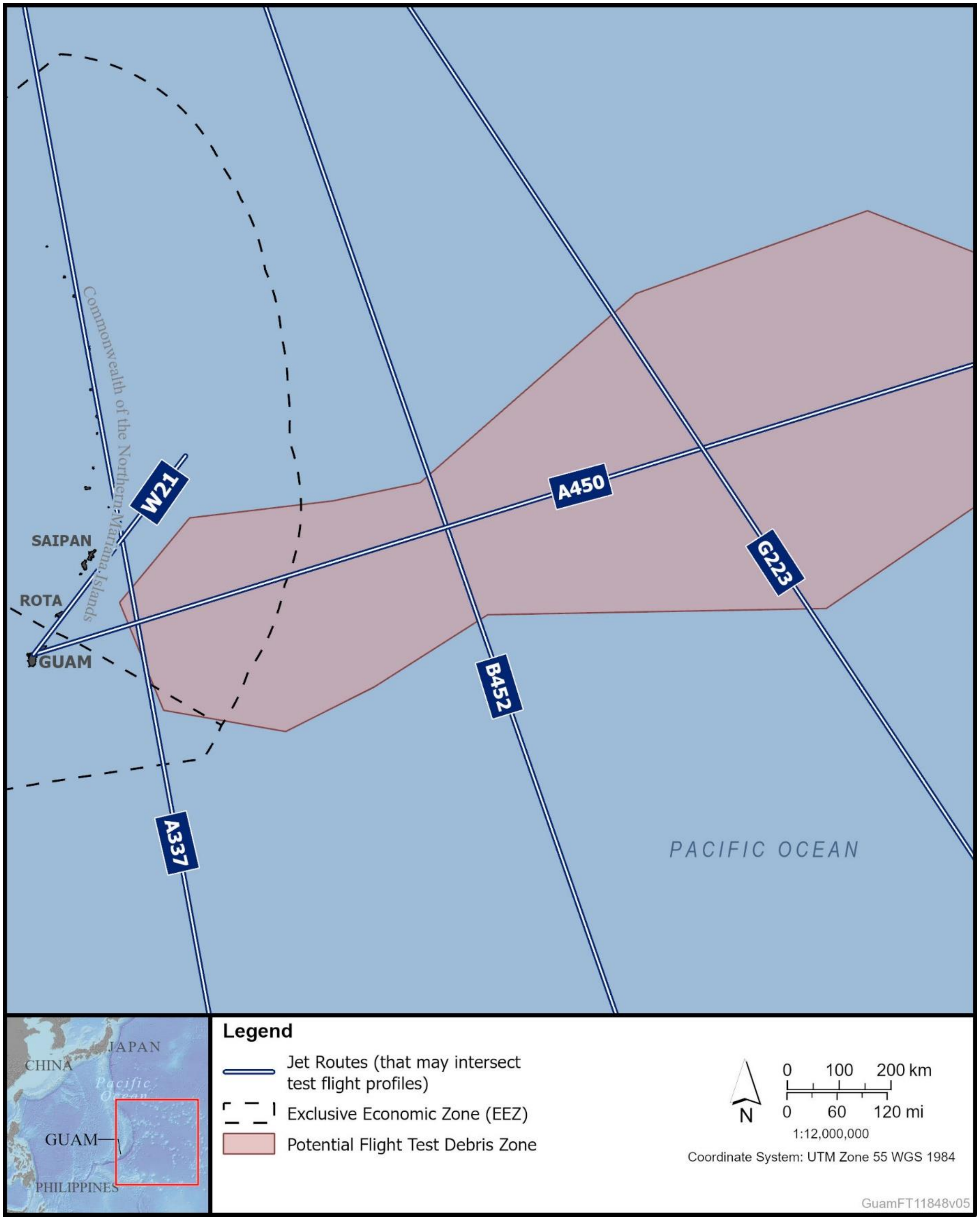
The location and size of airspace closures for radar testing and interceptor flight test operations are influenced by multiple factors, including hardware sensor reliability and weather. The size of airspace closures may shrink as reliability is established with results and analysis from each launch.

This flight test would not require permanent special use airspace. Temporary Flight Restrictions would already be in place for operation of the associated radar.

The FAA conducts an analysis of the constraints on airspace efficiency and capacity for each launch operation. This information helps the FAA determine whether the proposed launch would result in an unacceptable limitation on air traffic. MDA coordinates directly with FAA to deconflict planned flight tests, including trajectories and debris field. Prior analyses have concluded that the majority of missile testing operations that occur in oceanic regions, such as where interceptor flight test operations would occur, result in minor or minimal impacts on commercial and private users of airspace. This is largely due to the relatively low aircraft traffic density in oceanic regions and the ability of the FAA to manage the airspace for all users.

Launches would be of short duration and scheduled in advance to minimize interruption to airspace. The duration of a typical flight test would be approximately 8 hours. Airspace surveillance procedures would last as little as 45 minutes, or as long as 3.5 hours if the test were delayed, after which it would be rescheduled. En-route flights would utilize established alternative routes to minimize interruption to air traffic. Radar-only test windows are anticipated to be less than 8 hours, at any single time. The FAA and MDA launch planning team would take steps to reduce the airspace closure durations as a mission unfolds. An overlay of the potential test flight debris field and Jet Routes which overlay that area is depicted in Figure 4.2-1.

Figure 4.2-1: Jet Routes and Potential Flight Test Debris Zone



4.2.1 Proposed Action

Impact on Flight Operations (Land-based Flight Tests or Tracking Exercises). The potential for impacts were considered on several categories of flight users: commercial and air taxi, general aviation, and military operations. Each of these were analyzed for both departure and arrival from Runway 6 and Runway 24 at Guam International Airport. All users were analyzed for flights into and out of AAFB.

The estimated number of aircraft affected (8-hour window) and potential general air traffic re-routing are provided below:

- Commercial, Air Taxi, and General Aviation. Guam International experiences about 120 airport operations per any 24-hour period. Therefore, an estimated 40 airport operations occur in an average 8-hour window. Flights are predominately from and to South Korea and Japan. Some daily flights are from and to Rota, Saipan, Hawaii, Chuuk, Manilla, and Palau. Impacts on flight operations using Runway 6 and Runway 24 at Guam International Airport would be minor. Although historical flight tracks transit through proposed TFR and NOTAM areas, there is adequate airspace to route these flights around those areas with no discernable increase in time or fuel consumption. The temporary effects on commercial and air taxi operations would be considered minor.
- AAFB. Aircraft flying into or out of AAFB may have some impacts on their operations by the proposed airspace. Depending on the southern lateral boundaries of the proposed airspace, aircraft may need to conduct immediate turns to the south to avoid those airspace boundaries. The effects on military aircraft operations would be considered minor.
- Transient (overflight in airspace east Guam). Based on publicly available flight tracking data, there are eight transient flights in any 24-hour period in the airspace east of Guam (potential flight test debris field). In general, these flights are between New Zealand and airports in Japan or South Korea. With the notifications available via NOTAMs, transient flights could be routed to avoid proposed airspace areas, resulting in an imperceptible change in time or distance traveled. The effects on transient aircraft flights would be considered negligible.

Impact on Flight Operations (Land- or Sea-based Flight Tests or Tracking Exercises). For land-based action, the impacts remain as those described above. For potential sea-based action, the impacts on airport traffic would be non-existent. Transient air traffic intending to transit the BOA where the potential flight test debris field would exist may be required to plan their route of flight so as to avoid that field, as would be directed via NOTAM. The long distances involved in trans-oceanic flights in this region provide opportunity to avoid such flight restricted areas, similar in nature to planning to avoid large or severe weather systems.

4.2.1.1 Alternative 1

Under Alternative 1, up to two land-based flight tests or tracking exercises would be conducted from NWF, AAFB per year for 10 years.

Close coordination with the FAA, Guam Center Radar Approach Control, and Guam International and AAFB Air Traffic Control Towers by the launch operations manager would minimize the potential for any adverse impacts on airspace use in the vicinity of the launch site and planned missile downrange profile. Aircraft within the region would be subject to a NOTAM to advise avoidance of weapon system radar operations, the launch of interceptors, and missile intercepts. Airspace closures would be temporary, lasting approximately 8 hours for each flight test event, and generally would occur up to two times a year. The FAA would also establish a TFR, as shown in Figure 3.2-2, to protect all aircraft, both military and civilian, from the non-ionizing High-intensity Radiated Field of the AN/TPY-6 radar when active.

The analysis conclusions for airspace management under Alternative 1 are consistent with a minor determination, as described in Table 4.2-1, and therefore would result in a less than significant impact on airspace management.

4.2.1.2 Alternative 2 (Preferred Alternative)

Under Alternative 2 (Preferred Alternative), up to two land- or sea-based flight tests or tracking exercises would be conducted per year for 10 years from NWF, AAFB, or from a U.S. Navy ship at sea in the BOA of the western Pacific Ocean. Sea-based flight tests or tracking exercises under Alternative 2 (Preferred Alternative) would take place far from land and populated areas. As in Alternative 1, rerouting of air traffic to avoid the test area poses the greatest challenge to airspace management. Aircraft within the region would be subject to a NOTAM to advise avoidance of weapon system radar operations, the launch of interceptors, and missile intercepts. Airspace closures would be temporary (lasting approximately 8 hours for each flight test event, one primary test event window) and generally would occur up to two times a year. During land-based flight tests, the FAA would also establish a TFR, as shown in Figure 3.2-2, to protect all aircraft, both military and civilian, from the non-ionizing High-intensity Radiated Field of the TPY-6 radar when active.

The analysis conclusions for airspace management under Alternative 2 (Preferred Alternative) are consistent with a minor determination, as described in Table 4.2-1, and therefore would result in a less than significant impact on airspace management.

4.2.2 No Action Alternative

Under the No Action Alternative, the PA would not occur. AAFB would continue with normal activities, and MDA would not enhance the defense of Guam against the threat presented by short-, mid-, and long-range missiles, cruise missiles, and hypersonic vehicles. Therefore, no impact on airspace management would occur.

4.3 Air Quality

Table 4.3-1 describes the criteria used to determine whether the PA would result in a less than significant impact or significant impact on air quality.

Table 4.3-1: Criteria for Determining the Significance of Proposed Action Stressors on Air Quality

<table>
<tr><th>Impact Descriptor</th><th>Level of Impact</th><th>Significance Conclusions</th></tr>
<tr><td>Negligible</td><td>Impacts would be temporary (lasting up to several hours). Measurable or anticipated degree of change would not be detectable or would be only slightly detectable. Impacts are not expected to cause a violation; contribute to a new violation; contribute to an ongoing violation of the NAAQS; or cause appreciable risks to populations, including sensitive receptors, resulting from the exposure to HAPs</td><td rowspan="3">Less than significant impact</td></tr>
<tr><td>Minor</td><td>Impacts would be temporary or short term (lasting several days to several weeks). Measurable or anticipated degree of change would have a slight effect, causing a slightly noticeable change compared to existing conditions. Impacts are not expected to cause a violation; contribute to a new violation; contribute to an ongoing violation of the NAAQS; or cause appreciable risks to populations, including sensitive receptors, resulting from the exposure to HAPs.</td></tr>
<tr><td>Moderate</td><td>Impacts would be short term or long term (lasting several months or longer). A measurable or anticipated degree of change is readily apparent, appreciable, and would be noticed by most people. However. the impacts are low enough that would not result in a measurable impact on air quality or cause a violation; contribute to a new violation; contribute to an ongoing violation of the NAAQS; or cause appreciable risks to populations, including sensitive receptors, resulting from the exposure to HAPs.</td></tr>
<tr><td>Major</td><td>Measurable or anticipated degree of change would be substantial, causing a highly noticeable change compared to existing conditions. Impacts are expected to cause a violation, or contribute to a new violation, or contribute to an ongoing violation of the NAAQS. Exposure to HAP emissions would cause significant and unacceptable health impacts on populations, including sensitive receptors.</td><td>Significant impact</td></tr>
</table>

This section discusses the conformity evaluation and potential short-term and long-term effects to air quality, under NEPA and EO 12114, that could result from implementation of the PA. Effects on air quality are based on estimated direct and indirect emissions associated with the action alternatives. The detailed Air Quality Impact Study is included in Appendix H (Air Quality Impact Study).

4.3.1 General Conformity Evaluation

A General Conformity Evaluation is triggered for the PA under both alternatives because the transport routes from NWF to Port of Guam and from Port of Los Angeles to Minnesota pass through some NAAQS nonattainment and maintenance areas. Table 4.3-2 summarizes the total emissions for this activity and compares the emissions to the lowest applicable *de minimis* threshold for each pollutant. As shown, the total emissions are well below all applicable thresholds. As such, a conformity determination is not required for the PA. A signed Record of Non-Applicability (RONA) is presented in Appendix H (Air Quality Impact Study) to document this determination.

Table 4.3-2: Alternative 1 and 2 Total Criteria Pollutant Emissions for Post Launch Transport of Assets

Emissions	Total Emissions, ton/year					
	NO_x	SO_x	CO	VOC	PM_{10}	$PM_{2.5}$
Truck Transport, Post-Flight Test, from NWF to Port of Guam and from Port of Los Angeles to Minnesota	0.02	0.00	0.00	0.00	1.04	0.11
Lowest *de minimis* threshold	10	100	100	10	70	70
Exceeds threshold?	**No**	**No**	**No**	**No**	**No**	**No**

4.3.2 Impact Analysis – NEPA

Emissions are expected to begin in the first quarter of Fiscal Year 2025. Up to two flight tests or tracking exercises could be conducted per year. Each test could last up to 8 hours. The typical duration to setup, calibrate, and execute each test is 45 days.

4.3.2.1 Alternative 1

Alternative 1 would implement the use of land-based launch systems for interceptor launch with land-based sensor integration. All emissions, criteria pollutant and HAP, under this alternative would be released at 3,000 feet or less above ground level over land and out to 3 nautical miles off shore. No emissions occur between 3 and 12 nautical miles from shore. Table 4.3-3 presents a summary of Alternative 1 criteria pollutant emissions for each activity, including those generated within 3 nautical miles from shore. For the PA, HAPs are primarily generated, in addition to criteria air pollutants, by combustion of fuels. Table 4.3-3 through Table 4.3-6 present the estimated emissions for HAPs of concern, grouped based on their potential cancer, non-cancer chronic, and acute health impacts, that would be emitted under Alternative 1.

Table 4.3-3: Alternative 1 Criteria Pollutant Emissions Generated on Land and Within 3 Nautical Miles from Shore

Emissions	Total Emissions, ton/year					
	NO_x	SO_x	CO	VOC	PM_{10}	$PM_{2.5}$
Aircraft	8.96	0.37	0.92	0.06	1.11	1.00
Truck Transport, Flight Test	0.03	0.00	0.02	0.00	44.88	4.49
Truck Transport, Post-Flight Test, from NWF to Port of Guam and from Los Angeles to Minnesota	0.02	0.00	0.00	0.00	1.04	0.11
Test Assets and Range Safety Generators	1.00	3.14	12.10	3.70	0.05	0.05
Climate Control Generators	0.15	0.00	0.20	0.01	0.01	0.01
Missile Launch			0.63		1.17	1.17
Personnel Commute to the Site	1.70	0.03	34.00	2.07	3.40	0.85
Total	**11.86**	**3.54**	**47.87**	**5.84**	**51.66**	**7.67**

Note: Numbers may not add up exactly due to rounding.

Table 4.3-4: Alternative 1 Estimated Carcinogenic HAP Emissions Generated on Land and Within 12 Nautical Miles from Shore

Pollutant	Total, ton/year	Main Contributing Activity
Naphthalene	0.002	Personnel Commute
1,3 Butadiene	0.030	Personnel Commute
Formaldehyde	0.094	Personnel Commute, Test Assets and Range Safety Generators
Benzene	0.133	Personnel Commute, Test Assets and Range Safety Generators
Ethylbenzene	0.053	Personnel Commute
Acetaldehyde	0.040	Personnel Commute, Test Assets and Range Safety Generators

Table 4.3-5: Alternative 1 Estimated Non-Cancer Chronic HAP Emissions Generated on Land and Within 12 Nautical Miles from Shore

Pollutant	Total, ton/year	Main Contributing Activity
Toluene	0.265	Personnel Commute
Styrene	0.042	Personnel Commute
Hexane	0.050	Personnel Commute
Methylethylbenzene	0.050	Personnel Commute
Ethylbenzene	0.053	Personnel Commute
Phenol	0.0001	Aircraft
Xylenes	0.213	Personnel Commute
Benzene	0.133	Personnel Commute, Test Assets and Range Safety Generators

Pollutant	Total, ton/year	Main Contributing Activity
Hydrochloric Acid	0.630	Missile Launch
Formaldehyde	0.094	Personnel Commute, Test Assets and Range Safety Generators
Acetaldehyde	0.040	Personnel Commute, Test Assets and Range Safety Generators
Propanal	0.002	Personnel Commute
Naphthalene	0.002	Personnel Commute
Acrolein	0.009	Personnel Commute

Table 4.3-6: Alternative 1 Estimated Non-Cancer Acute HAP Emissions Generated on Land Within 12 Nautical Miles from Shore

Pollutant	Total, pound/hour	Main Contributing Activity
Propanal (Propionaldehyde)	0.02	Personnel Commute
Hexane	0.053	Personnel Commute
Xylenes	2.26	Personnel Commute
Styrene	0.045	Personnel Commute
Phenol	0.00	Aircraft
Toluene	2.80	Personnel Commute
Hydrochloric Acid	630	Missile Launch
Acetaldehyde	0.042	Personnel Commute, Test Assets and Range Safety Generators
Formaldehyde	1.00	Personnel Commute, Test Assets and Range Safety Generators
Benzene	1.29	Personnel Commute, Test Assets and Range Safety Generators
Methylethylbenzene	0.52	Personnel Commute
2,2,4-Trimethylpentane	0.89	Personnel Commute

Flight Test Setup and Preparation

Set up and flight test preparation activities include transport of the range safety equipment, interceptor systems, target missiles, and interceptor missile by aircraft from various continental United States locations to Guam. Following arrival in Guam, the equipment is transported by trucks to a location adjacent to AAFB NWF. In addition, diesel-fueled air conditioning units would be used at the main airfield for aircraft climate control while parked at the airfield until the flight test event begins.

Aircraft criteria pollutant and HAP emissions that occur at elevations below the 3,000 feet above ground level limit would be from takeoff and landing operations as the aircraft approaches, lands, takes off, and departs the main active airfield at AAFB. These emissions would be released along their 3,000-plus feet flight path. Aircraft emission plumes have directional momentum opposite to the thrust of the aircraft that is expected to overcome buoyancy from the exhaust gas temperature of the aircraft engine. Aircraft emission plumes form behind the aircraft along its flight path and are transported downwind. The takeoff and landing criteria pollutant emissions are relatively minor and short term; any resulting pollutant concentration increases are expected to dissipate within 24 hours. Therefore, these emissions are not expected to interfere with the attainment of AAQS. The small quantities of HAPs emitted along the runway and the flight path below 3,000 feet above ground level are not expected to result in appreciable concentrations at any nearby receptors. Therefore, the potential for exposure is very low, and the health risk presented by the emissions is similarly very low.

The criteria pollutant and HAP emissions from the diesel-fueled air conditioning units used for aircraft climate control would also occur at the airfield. These emissions are expected to occur continuously for approximately 5 days after arrival until transport and staging of the missiles for the flight test prior to each launch, resulting in long-term (i.e., greater than 24 hours) emissions. However, given the size of the units and the engine tier (Tier 3 or higher), the total emissions are relatively low. Due to expected downwash of plumes released from short exhaust stacks typically built into these types of units, pollutant concentrations would increase in the immediate vicinity downwind of the stacks.

Vehicle criteria pollutant and HAP emissions are due to the transport of equipment to the site. The emissions are short-term (i.e., lasting less than 24 hours), relatively small, and occur along the path from the main airfield to NWF. In preparation and set up for each test, five trucks would be used for each transport activity, traveling 30 miles roundtrip, 5 days per month for 2 months, resulting in 4,500 vehicle miles traveled for pre-launch truck activities per test. Emissions are expected to initially rise in the immediate vicinity of the activity; however, wakes diffuse drastically depending on wind velocity. Wakes developed from wind flowing past the equipment body or equipment in motion cause downwash of exhaust plume. Downwash is expected to overcome any plume rise that could have resulted from buoyancy and momentum and increase ground-level concentrations.

The prevailing easterly winds would help to disperse the emissions generated at the main airfield and across the path to NWF downwind to west of the airfield and NWF, where AAFB personnel and tenants are sparsely present. Occasional northerly wind could transport these emissions from the airfield to on-base locations such as the commissary and the fitness track. Due to the relatively low criteria pollutant and HAP emissions, occurring infrequently and given the distance to downwind receptors (i.e., greater than 0.5 miles), these emissions are not expected to interfere with the attainment of AAQS or contribute to human health risks from HAP exposure in areas where public presence is expected.

<u>Flight Test Execution</u>

Aircraft criteria pollutant and HAP emissions would occur during the Flight Test in support of target launches. Most of this activity would occur at elevations greater than 3,000 feet above ground level/MSL. Aircraft takeoff and landing would occur at the active airfield at AAFB. The takeoff and landing emissions are infrequent, relatively minor, and short term; any resulting pollutant concentration increases are expected to dissipate within 24 hours. The small quantities of HAPs emitted along the runway and the flight path below 3,000 feet above ground level are not expected to result in appreciable concentrations at any nearby receptors. Therefore, the potential for exposure is very low, and the health risk presented by the emissions is similarly very low.

Within the project site at the NWF, generator emissions, vehicle emissions from personnel travel to the site and emissions due to the detonation of the interceptor missile would contribute to the overall emissions and temporary increases in pollutant concentrations downwind of the activity.

The diesel generators are required since grid power is not available in locations where the PA would occur. All prime power generators would be equipped with Tier 4 Final engines to minimize emissions of criteria pollutants and HAPs. The prime generators would operate continuously and result in long-term emissions. Backup generators would be equipped with Tier 3 engines that would only run when one of the prime generators is down. Operational activities would comply with Guam Air Pollution Control Standards and Regulations, including obtaining all approvals required to operate the generators. In July 2023, MDA submitted a Synthetic Minor Noncovered Source Air Permit Application to the Guam EPA to obtain the permits for the diesel-fueled generators. HAP emissions from the proposed diesel generators were previously quantified by MDA in the July 2023 Synthetic Minor Noncovered Source Air Permit Application and shown to be relatively small.

NWF is at least 2 miles away from any offsite receptors. AAFB and their tenant activities that are not associated with the PA are located to the west of the NWF. Figure 3.3-1 shows that wind directions are mostly from the east, which would transport emissions away from public areas most of the time; southerly winds are infrequent. The easterly winds could transport emissions to areas where human exposure could occur; however, the nearest tenant commands are approximately 0.3 miles away and given the magnitude of emissions, are expected to be impacted at a minor level of impacts limited to the duration and frequency of the flight tests.

Vehicle criteria pollutant and HAP emissions from personnel travel to the site would occur over an estimated 20-mile distance to NWF from various locations on the island. It is conservatively estimated that, for each test event, 350 personnel would commute 40 miles roundtrip to the site, seven days per week for three months, resulting in 1.2 million vehicle miles traveled per test. Emissions are expected to initially rise in the immediate vicinity of the activity; however, wakes developed from wind flowing past the equipment body or equipment in motion cause downwash of exhaust plume. Downwash is expected to overcome any plume rise that could have resulted from buoyancy and momentum and increase ground-level concentrations. Total particulate emissions from the entire activity, expressed in tons per year, are predominantly the dust generated from travel on roads. However, along the path traveled, emissions, including particulate matter emissions are relatively low, and any impacts are expected to be at a minor level.

Aluminum oxide particles, and hydrogen chloride, are expected to be released during interceptor missile launches. Aluminum oxide, aluminum chloride, and ferric oxide particles are categorized as PM emissions; hydrogen chloride is a HAP. Because the emissions would be widely dispersed and mostly over ocean waters due to their release characteristics in the atmosphere, they would reach the ground or ocean surface at expected concentration levels that would not have adverse effects on humans or wildlife.

Post-Flight Test

Post-flight test emissions would occur from personnel travel to the booster drop zone, the extraction of the first stage booster by a helicopter or backhoe, and the shipment of the equipment by ship and truck to Minnesota for refurbishment. The vehicle, backhoe, and helicopter activities are short-term, lasting less than a few hours, and producing nearly negligible emissions. Due to the prevailing wind directions from the east, which would transport emissions away from public areas most of the time, and proximity to the nearest receptors, any impacts are expected to be at a negligible level.

The shipment of the equipment by truck to Minnesota would occur over 6,000 miles per test. It is anticipated that, at the conclusion of each test, three trucks would travel 2,000 miles per truck from Port of Los Angeles to Minnesota. Concentrations of criteria pollutants and HAPs would temporarily increase in the immediate vicinity of the activity. Emissions, including particulate matter emissions, are relatively low and any impacts are expected to be at a minor level.

Due to expected low concentrations impacting locations of exposure on an infrequent basis for short durations, Alternative 1 emissions are not expected to interfere with the attainment of AAQS or contribute to human health risks from HAP exposure in areas where public presence is expected.

The analysis conclusions for air quality under Alternative 1 are consistent with a minor determination, as described in Table 4.3-1, and therefore would result in a less than significant impact on air quality.

4.3.2.2 Alternative 2 (Preferred Alternative)

Alternative 2 (Preferred Alternative) would implement the use of land- or sea-based launch systems for interceptor launch with land-, airborne-, sea-, and space-based sensor integration. Under this alternative, a Navy Aegis cruiser or destroyer vessel would pull into NBG to conduct a mission brief with the flight test team prior to and after the test. In addition to emissions generated over land, estimated emissions released within 3 nautical miles and 12 nautical miles from shore are analyzed, respectively, for attainment of AAQS and all other air impact analysis under NEPA. All other vessel activities under Alternative 2 are performed by vessels already in locations beyond 12 nautical miles. It was assumed that each year, one interceptor missile would launch from AAFB and one would launch from a U.S. Navy ship underway in the Western

Pacific BOA, which is the open ocean area beyond 12 nautical miles from shore. All other activities remain the same as Alternative 1. Table 4.3-7 summarizes Alternative 2 criteria pollutant emissions that would be released over land and within 3 nautical miles from shore for each activity. Table 4.3-8 summarizes Alternative 2 criteria pollutant emissions that would be released over land and within 12 nautical miles from shore for each activity. The estimated emissions for HAPs of concern within 12 nautical miles are the same as those presented for Alternative 1 since the contribution to HAP emissions from vessel operations within 12 nautical miles is insignificant.

Table 4.3-7: Alternative 2 Criteria Pollutant Emissions Generated on Land and Within 3 Nautical Miles from Shore

Emissions	Total Emissions, Ton/yr					
	NO_x	SO_x	CO	VOC	PM_{10}	$PM_{2.5}$
Aircraft	8.96	0.37	0.92	0.06	1.11	1.00
Vessel - Test Flight	0.09	0.00	0.01	0.00	0.00	0.00
Truck Transport, Flight Test	0.03	0.00	0.02	0.00	44.88	4.49
Truck Transport, Post-Flight Test, from NWF to Port of Guam and from Los Angeles to Minnesota	0.02	0.00	0.00	0.00	1.04	0.11
Test Assets and Range Safety Generators	1.00	3.14	12.10	3.70	0.05	0.05
Climate Control Generator	0.15	0.00	0.20	0.01	0.01	0.01
Missile Launch			0.32		0.58	0.58
Personnel Commute to the Site	1.70	0.03	34.00	2.07	3.40	0.85
Total	**11.95**	**3.54**	**47.57**	**5.84**	**51.07**	**7.09**

Note: Numbers may not add up exactly due to rounding.

Table 4.3-8: Alternative 2 Criteria Pollutant Emissions Generated on Land and Within 12 Nautical Miles from Shore

Emissions	Total Emissions, Ton/yr					
	NO_x	SO_x	CO	VOC	PM_{10}	$PM_{2.5}$
Aircraft	8.96	0.37	0.92	0.06	1.11	1.00
Vessel - Test Flight	0.38	0.00	0.03	0.00	0.01	0.01
Truck Transport, Flight Test	0.03	0.00	0.02	0.00	44.88	4.49
Truck Transport, from NWF to Port of Guam and from Los Angeles to Minnesota	0.02	0.00	0.00	0.00	1.04	0.11
Test Assets and Range Safety Generators	1.00	3.14	12.10	3.70	0.05	0.05

Emissions	Total Emissions, Ton/yr					
	NO_x	**SO_x**	**CO**	**VOC**	**PM_{10}**	**$PM_{2.5}$**
Climate Control Generator	0.15	0.00	0.20	0.01	0.01	0.01
Missile Launch			0.32		0.58	0.58
Personnel Commute to the Site	1.70	0.03	34.00	2.07	3.40	0.85
Total	**12.23**	**3.54**	**47.59**	**5.84**	**51.08**	**7.10**

Note: Numbers may not add up exactly due to rounding.

Alternative 2 emissions within 12 nautical miles are slightly higher than Alternative 1 due to the addition of vessel activity. These emissions are not expected to significantly increase concentrations of criteria pollutants or HAPs or have an impact on human health. All other impact discussions presented for Alternative 1 also apply to Alternative 2.

Due to the expected dispersion and transport of pollutant plumes from intermittent and low rates of emissions, under local meteorological conditions, and infrequent public exposure, Alternative 2 emissions are not expected to interfere with the attainment of AAQS or contribute to human health risks from HAP exposure in areas where public presence is expected.

The analysis conclusions for air quality under Alternative 2 (Preferred Alternative) are consistent with a minor determination, as described in Table 4.3-1, and therefore would result in less than significant impact on air quality.

4.3.3 Impact Analysis – EO 12114

4.3.3.1 Alternative 1

For this alternative, activities beyond 12 nautical miles of the U.S. coastline occur in elevations greater than 3,000 feet above ground level. As such, these activities are not analyzed under EO 12114 for Alternative 1.

4.3.3.2 Alternative 2 (Preferred Alternative)

Under this alternative, one interceptor missile would launch from a U.S. Navy ship underway in the Western Pacific BOA, which is the open ocean area beyond 12 nautical miles of the U.S. coastline. Table 4.3-9 presents a summary of Alternative 2 criteria pollutant emissions in distances beyond 12 nautical miles. Table 4.3-10 through Table 4.3-12 present the estimated emissions of HAPs of concern, group based on their potential cancer, non-cancer chronic, and non-cancer acute health impacts, that would be emitted under Alternative 2 in distances beyond 12 nautical miles from shore.

Table 4.3-9: Alternative 2 Criteria Pollutant Emissions Greater than 12 Nautical Miles from Shore

Emissions	Total Emissions, Ton/yr					
	NO_x	SO_x	CO	VOC	PM_{10}	$PM_{2.5}$
Vessel	0.46	0.00	0.24	0.02	0.01	0.01
Missile Launch			0.32		0.584	0.584
Total	**0.46**	**0.00**	**0.55**	**0.02**	**0.59**	**0.59**

Note: Numbers may not add up exactly due to rounding.

Table 4.3-10: Alternative 2 Estimated Carcinogenic HAP Emissions Greater than 12 Nautical Miles from Shore

Pollutant	Total, ton/year	Main Contributing Activity
Naphthalene	0.00050	Vessel
Propanal (Propionaldehyde)	0.00002	Vessel
Formaldehyde	0.00068	Vessel
Benzene	0.00008	Vessel
Acetaldehyde	0.00016	Vessel

Table 4.3-11: Alternative 2 Estimated Non-Cancer Chronic HAP Emissions Greater than 12 Nautical Miles from Shore

Pollutant	Total, ton/year	Main Contributing Activity
Toluene	0.00003	Vessel
Hexane	0.00004	Vessel
Xylenes	0.00002	Vessel
Benzene	0.00008	Vessel
Hydrochloric Acid	0.31500	Missile Launch
Formaldehyde	0.00068	Vessel
Acetaldehyde	0.00016	Vessel
Acrolein	0.00003	Vessel

Table 4.3-12: Alternative 2 Estimated Non-Cancer Acute HAP Emissions Greater than 12 Nautical Miles from Shore

Pollutant	Total, pound/hour	Main Contributing Activity
Propanal (Propionaldehyde)	0.005	Vessel
Hexane	0.01	Vessel
Xylenes	0.005	Vessel
Phenol	0.025	Vessel
Toluene	0.0075	Vessel
Hydrochloric Acid	630	Missile Launch

Pollutant	Total, pound/hour	Main Contributing Activity
Acetaldehyde	0.04	Vessel
Formaldehyde	0.17	Vessel
Benzene	0.02	Vessel

Due to the expected dispersion and transport of pollutant plumes from intermittent and low rates of emissions, under local meteorological conditions, and infrequent public exposure, Alternative 2 emissions are not expected to interfere with the attainment of AAQS or contribute to human health risks from HAP exposure in areas where public presence is expected.

The analysis conclusions for air quality under Alternative 2 (Preferred Alternative) are consistent with a minor determination, as described in Table 4.3-1, and therefore would result in less than significant impact on air quality.

4.3.4 No Action Alternative

Under the No Action Alternative, no flight tests would occur from land- or sea-based launchers, and no tracking exercises to test and calibrate the land-based and airborne sensors would occur. AAFB would continue with normal activities. Short-term and long-term air quality conditions in the project area would remain unchanged. Due to no changes to activities and therefore no new pollutant emissions, there would be no impact on air quality.

4.4 Climate Change and Greenhouse Gases

Table 4.4-1 describes the criteria used to determine whether the PA would result in a less than significant impact or significant impact on climate change and greenhouse gases.

Table 4.4-1: Criteria for Determining the Significance of Proposed Action Stressors on Climate Change and Greenhouse Gases

Impact Descriptor	Level of Impact	Significance Conclusions
Negligible	Proposed activities do not cause a detectable increase of GHG emissions, resulting in an insignificant impact on local and global GHG emissions and climate change. GHG emissions and climate change are not impacted.	Less than significant impact
Minor	Proposed activities result in a minor increase of GHG emissions, resulting in an insignificant impact on local and global GHG emissions and climate change. GHG emissions and climate change are not impacted.	
Moderate	Proposed activities cause detectable but moderate increases of GHG emissions, resulting in an insignificant impact on local and global GHG emissions and climate change. GHG emissions and climate change are not impacted.	
Major	Proposed activities cause major increases of GHG emissions, resulting in a significant impact on local and global GHG emissions and climate change. GHG emissions and climate change are impacted.	Significant impact

This section discusses the potential effects that could result from implementation of the PA's GHG emissions on climate change. GHG emissions generated from the PA contribute to global atmosphere, regardless of the specific location within the ROI that they are produced. The GHG emissions are expected to begin in late 2024 and emit annually for the next 10 years. The estimated GHG emissions for both alternatives are comparable to 1,400 cars per year on the road, as a typical passenger vehicle emits approximately 5 tons of CO_2 per year. Overall, the total GHG emissions from the PA alternatives are expected to be small and have a relatively insignificant impact on the global GHG emissions and climate change.

Table 4.4-2 compares the emissions for Alternative 1 and Alternative 2 (Preferred Alternative).

Table 4.4-2: Comparison of GHG Emissions for Alternative 1 and Alternative 2 (Preferred Alternative)

Emissions	CO_2e (MT) per year	
	Alternative 1	**Alternative 2**
Aircraft	4,549	4,549
Vessel		177
Truck Transport, Flight Test	13.52	13.52
Truck Transport, Post-Flight Test, from NWF to Port of Guam and from Los Angeles to Minnesota	15.16	15.16
Flight Test Diesel Generators	1,617	1,617
Climate Control Generator	25	25
Missile and Target Launches	1.61	1.61
Personnel Commute to the Site	1,641	1,641
Total	**7,863**	**8,040**

4.4.1 Proposed Action

4.4.1.1 Alternative 1

GHG emissions generated from Alternative 1 would total 7,863 MT per year. This is equivalent to 0.00001 percent of the global GHG emissions, approximately 0.0001 percent of the reported U.S. Emissions in 2021 and approximately 0.6 percent of the 2022 GHG emissions reported by Guam's large emitting facilities. Expected GHG emissions are relatively minor and make up a negligible percentage of the global GHG emissions. The analysis conclusions for climate change and greenhouse gases under Alternative 1 are consistent with a minor determination, as described in Table 4.4-1, and therefore would result in a less than significant impact on climate change and greenhouse gases.

4.4.1.2 Alternative 2 (Preferred Alternative)

Alternative 2 would result in a 2.3 percent increase in GHG emissions compared to Alternative 1 due to the addition of vessel activity. For the same reasons stated under Alternative 1, expected GHG emissions would be minor and make up a negligible percentage of the global GHG emissions. The analysis conclusions for climate change and greenhouse gases under Alternative 2 (Preferred Alternative) are consistent with a minor determination, as described in Table 4.4-1, and therefore would result in a less than significant impact on climate change and greenhouse gases.

4.4.2 No Action Alternative

Under the No Action Alternative, the PA would not occur. AAFB would continue with normal activities. Therefore, no impact on climate changes and greenhouse gases would occur.

4.5 Terrestrial Biological Resources

Table 4.5-1 describes the criteria used to determine whether the PA would result in a less than significant impact or significant impact on terrestrial biological resources.

Table 4.5-1: Criteria for Determining the Significance of Proposed Action Stressors on Terrestrial Biological Resources

Impact Descriptor	Level of Impact	Significance Conclusions
Negligible	Impacts on wildlife species would be limited to temporary (lasting several hours) behavioral disturbances to individuals located within the project area. No mortality or debilitating injury to any individuals would occur. There would be no displacement of wildlife from preferred breeding and feeding areas, nest sites, nursery grounds, or migratory routes. Impacts on vegetation would be temporary with no lasting damage or alteration.	Less than significant impact
Minor	Impacts on terrestrial wildlife species would be temporary or short term (lasting several days to several weeks) and within the natural range of variability of species' populations, habitats, and the natural processes sustaining them. This could include non-life-threatening injury to individuals and small disruptions of time-sensitive behaviors such as breeding. Displacement of wildlife from preferred breeding and feeding areas, nursery grounds, or migratory routes would be short term and limited to the project area. Any resulting increased competition, additional energy expenditure, or loss of young would not affect overall population numbers or demographic structure. Impacts on vegetation (e.g., trampled or crushed vegetation) would be easily recoverable with no long-term or permanent damage or alteration.	
Moderate	Impacts on terrestrial wildlife species would be short term or long term (lasting several months or longer) and outside the natural range of variability of species' populations, habitats, and the natural processes	

Impact Descriptor	Level of Impact	Significance Conclusions
	sustaining them. This could include debilitating injury or mortality and disruptions of time-sensitive behaviors such as breeding. Behavioral responses and displacement would be expected from individuals within the project area, its immediate surroundings, or beyond. Long-term displacement of individuals from preferred breeding and feeding areas, nursery grounds, or migratory routes would occur. Vegetation would be damaged or altered potentially over the long term but would recover.	
Major	Impacts on terrestrial wildlife species would be short term or long term and well outside the natural range of variability of species' populations, habitats, or the natural processes sustaining them. This could include extensive (i.e., affecting a large proportion of the local population), life-threatening, or debilitating injury and mortality and substantial disruption of time-sensitive behaviors such as breeding. Displacement of wildlife from preferred breeding or feeding areas, nursery grounds, or migratory routes would occur within project areas, their immediate surroundings, and beyond. Impacts would be considered major if they threatened the continued existence of any species. Full recovery of species' populations would not be expected to occur in a reasonable time. Vegetation would be degraded over the long term or permanently.	Significant impact

4.5.1 Proposed Action

4.5.1.1 Alternative 1

Implementation of Alternative 1 could impact terrestrial biological resources. The four stressors that may potentially impact terrestrial biological resources are described in Table 4.5-2.

Table 4.5-2: Terrestrial Biological Resource Stressors

Stressor	Description
Noise	Activities under the PA would generate noise in the environment that may affect the Mariana fruit bat, such as the missile launch and the potential use of a helicopter for the recovery of the first stage booster.
Physical Disturbance and Strike	ESA-listed plant and animal species may be impacted from a direct strike from the expended booster stage, recovery team personnel walking to and from the booster recovery site and directly impacting ESA-listed species, and the downwash from the helicopter during booster recovery operations.
Physical Presence	The physical presence of personnel that are conducting booster recovery activities within the booster drop area may cause Mariana fruit bats to exhibit temporary behavioral changes if the species is present.

DoD personnel would implement best management practices (BMPs) to avoid and minimize impacts on terrestrial biological resources from the PA. BMPs are described in Table 4.5-3.

Table 4.5-3: BMPs Associated with the PA

BMP	Description
Biosecurity Outreach and Education	The DoD will implement a natural resources education program to ensure all military and contractor personnel are informed of the biological resources in the project area, including invasive species, special-status species, avoidance measures, and reporting requirements in the project area.
Brown Treesnake Interdiction	Joint Region Marianas has established a comprehensive brown treesnake interdiction program to ensure that military activities, including the transport of civilian and military personnel and equipment to and from Guam, do not contribute to the spread of the brown treesnake to other islands or regions. Brown treesnake interdiction requirements (e.g., trapping and inspections at ports and cargo facilities, aircraft, biosecurity plans for training events) are specified in DoD instructions (i.e., 36 Wing Instruction 32-7004, Brown Tree Snake Control Plan and Commander Navy Region Marianas Instruction 5090.10A, Brown Tree Snake Control and Interdiction Plan). The PA would comply with these established procedures.
Biological Monitor	A qualified biological monitor must be present and monitor all booster recovery activities. This includes ensuring that no unnecessary vegetation, particularly ESA-listed species, is disturbed or damaged while accessing the site of the expended booster, while preparing the booster for extraction, and when exiting the recovery area. The biomonitor will flag ESA-listed species for avoidance during the ingress and egress of the recovery area and during the preparation and retrieval of the booster.

4.5.1.1.1 Wildlife

<u>Noise</u>

All sounds have a spectral content, which means their magnitude or level changes with frequency, where frequency is measured in cycles per second or Hertz. 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 Hertz; humans hear best in the range of 1,000–4,000 Hertz. A-weighting is a frequency-dependent adjustment of sound level used to approximate the natural range and sensitivity of the human auditory system. As terrestrial wildlife species generally have a similar hearing range as humans, the A-weighted decibel (dBA) is commonly used to assess effects on terrestrial mammals and birds. A-weighting provides a conservative estimate of mammal hearing and is the best readily available weighting for mammal studies (Dooling & Popper, 2007).

During a launch event, the noise level starts at the ambient or background noise level (approximately 30–40 dBA; (Missile Defense Agency, 2024)), rises to the maximum sound level as the missile leaves the launcher, and returns to the ambient or background level as the missile recedes into the distance. The highest dBA level measured during a single event where the sound level changes value with time is called the maximum A-weighted sound level or $L_{A,max}$.

Wildlife could be exposed to increased noise levels during activities associated with Alternative 1. Increased noise levels would result from the interceptor missile launch, operation of generators, and helicopter operations during first stage booster recovery.

Launch noise is unique to each type of rocket being launched (e.g., size of rocket and thrust), the launch location, atmospheric conditions, and location of the receptors (e.g., human, wildlife) in relation to the rocket trajectory. Due to the size of the interceptor missiles that would be used for the proposed flight tests, the launch noise would be short term and is expected to exceed the ground level ambient sound environment of 30–40 dBA for approximately 1–2 seconds. It should be emphasized that the missile launch is exactly vertical for approximately 2,000 feet above the ground before the missile begins its more horizontal trajectory to the northeast over the Pacific Ocean. That is, the missile would be more than 2,000 feet above the ground as it transitions from the vertical launch angle and to the northeast over the ocean.

Launch noise would result in a sudden, acoustical event of approximately 125 dBA maximum sound level at the launch site. The sound levels would decrease away from the launch site with received levels of 110 dBA, 100 dBA, and 90 dBA maximum sound level at approximately 1,500 feet, 4,500 feet, and 13,500 feet, respectively, from the launch site (Figure 3.5-1) (see also Section 3.10, Noise). Additionally, Guam is known for heavy rain, persistent wind, and high sea states which contribute to ambient noise levels. Weather conditions during launches could provide some sound attenuation for nearby wildlife. Wildlife present in the ROI may exhibit a startle response, and either remain in place or flee the area. Given the launch event is expected to only last 1–2 seconds after which the noise from the missile would not be audible, such startle responses would be brief, only occur once per flight test, and would not result in population-level effects to any wildlife species.

Under Alternative 1, 19 diesel generators would be used to provide power to the various assets at the test site. It is expected that received noise levels 50 feet from the outside boundary of the launch site would be less than 75 dBA.

During recovery operation of the expended first stage booster, a helicopter would be used to lift the booster from the booster drop area and transport it back to the airfield at AAFB. Total time of the helicopter on station during recovery operations is estimated to be approximately 5 minutes. Given that wildlife in and around the booster drop zone are accustomed to aircraft activities at AAFB, disturbance to wildlife would likely only result in minor behavioral responses.

For these reasons, noise impacts on wildlife from activities under Alternative 1 would likely be limited to short-term, minor disturbances and not be significant.

Physical Disturbance and Strike

The only potential for physical disturbance and strike to wildlife under Alternative 1 would be from the expended first stage booster within the booster drop area. Given the size of the booster and infrequent nature of the flight tests, it is unlikely the falling booster would result in direct strike on wildlife. As such, impacts on wildlife as a result of physical disturbance and strike would be minor and not significant.

Physical Presence

The only potential for the physical presence of flight test personnel in the proximity of wildlife is during the recovery of the first stage booster within the booster drop area. Personnel presence during recovery could result in a startle response, resulting in nearby wildlife fleeing the area. However, these impacts would be short term and not result in any long-term behavioral or population-level impacts. For these reasons, impacts on wildlife from physical presence under Alternative 1 would be minor and not significant.

Exposure to Electromagnetic Energy (EME)

Flying wildlife, including birds and bats, could be exposed to EME if they enter the field of regard while a radar is operating. For the FEM-02 flight test, an AN/TPY-6 radar would be used. The safety keep-out zone for human safety is based on 30-minute averaged levels of EME exposure, and areas outside the keep-out zone are safe for people and wildlife. Though airborne wildlife could fly within the safety keep-out zone, it would be extremely unlikely that they would remain within that area and be exposed to EME long enough to cause any adverse effects.

Impacts on wildlife would be unlikely and are expected to have no effect for the following reasons:

- The keep-out zone is in a highly developed area of AAFB, and there is a lack of roost or resting tree habitat within the safety keep-out zone near the radar.
- Flight behavior and ecology would make it extremely unlikely an individual would exceed the 30-minute average exposure limit.
- Individuals flying through the field of regard would not exceed the effect threshold.
- Similar military, FAA, and weather radars have been operating on Guam, and there is no evidence of adverse effects to wildlife from their use.

Therefore, under Alternative 1, impacts from EME exposure from radar operations would be negligible.

4.5.1.1.2 Special Status Species

In accordance with section 7 of the ESA, the Navy, on behalf of MDA, is consulting with the USFWS regarding potential impacts on ESA-listed species from implementation of the PA. The outcome of the consultation will be provided in the Final EA.

<u>Noise</u>

ESA-listed Plants and Guam Tree Snail. As the plant and tree snail species do not hear, there would be no impacts on ESA-listed plants or the Guam tree snail due to noise.

Mariana Fruit Bat. Mariana fruit bats may be exposed to elevated noise levels from the interceptor missile launch, generators, and helicopter operations under Alternative 1. Although fruit bats may use the areas around the launch site to move between roost and foraging sites, due to the developed nature of the launch area and occurrence of pre-launch activities by personnel, it is highly unlikely that a Mariana fruit bat would be present in the immediate vicinity of the launch site at the time of a launch. However, it is expected that any fruit bat on AAFB at the time of the launch would receive maximum sound levels of approximately 85 to 110 dBA. Received noise levels at the only known Mariana fruit bat roost on AAFB would be approximately 87 dBA.

Individual fruit bats present in the ROI during a missile launch may exhibit a startle response, and either remain in place or fly to adjacent trees depending on when the launch took (i.e., at night while fruit bats are foraging or during the day when they are roosting). Given the launch event is expected to last only 1–2 seconds, after which the noise from the missile would not be audible, such a startle response would be brief, only occur during a launch, and would not be expected to affect individual animal fitness or have population-level effects. Any exposure of Mariana fruit bats to sound from the proposed missile launch is likely to result in only minor behavioral responses that are considered to be insignificant (i.e., would never reach a magnitude where take of a fruit bat is likely to occur) (as discussed in Section 4.5.1.1.1, Wildlife).

Should the first stage booster land within the heavily forested area of the booster drop area, a helicopter would be used to lift the booster from the booster drop area and transport it back to the airfield at AAFB. Total time of the helicopter over the recovery area during recovery operations is estimated to be approximately 5 minutes. Although the helicopter may fly over roosting fruit bats during its transit from the airfield at AAFB to the booster recovery area at the MSA, given fruit bats are accustomed to aircraft activity at AAFB, the helicopter would maintain an altitude greater than 100 feet above the tree canopy, and the time in the air would be relatively short (10 minutes round trip), any exposure of Mariana fruit bats to sound from the helicopter is likely to result in only minor behavioral responses that are considered to be insignificant and discountable.

Should the first stage booster land in an area that is accessible by the recovery team with a flatbed truck and backhoe (i.e., not forested), the potential for a fruit bat to be roosting in the vicinity is considered very low, and disturbance would be highly unlikely and discountable.

Mariana fruit bat exposure to noise from generators would be less than 75 dBA and would be considered minor. Lastly, impacts on fruit bats from helicopter operations would be short term and minor for the same reasons stated above. For these reasons, overall noise impacts on Mariana fruit bats from activities under Alternative 1 would be minor.

Physical Disturbance and Strike

ESA-listed Plants and Guam Tree Snail. Guam tree snails and the ESA-listed plant species within the first stage booster drop area could be impacted from the expended booster when it hits the ground. *Cycas micronesica* is the predominant ESA-listed species that occurs within the booster drop area, with over 2,500 individuals documented during 2023 surveys. Five of the remaining plant species and the Guam tree snail account for only a single occurrence each and *Tuberolabium guamense* has seven occurrences (Table 3.5-3). Based on the maximum expected 500-square foot impact footprint of the booster when it falls to the ground and the known occurrences of Guam tree snails and ESA-listed plants within the booster drop area (Figure 3.5-4), and assuming the worst case scenario that the booster lands within an area with the highest density of ESA-listed species, the highest number of individuals that would be struck by the booster would be nine *Cycas micronesica*. The estimated impact on ESA-listed species within all other potential 500-square foot impact areas throughout the booster drop area would range from 0 to 6 individuals. The locations of the seven *Tuberolabium guamense* are so spread apart that even if the booster landed in the proximity of these seven individuals, only a single individual could be impacted within a 500 square foot area. However, the probability of the booster landing on multiple ESA-listed species is extremely low and discountable, and the potential for the booster to land on any of the species that only have single occurrences in the booster drop area is so unlikely as to be discountable.

Should the first stage booster land within the heavily forested area of the booster drop area, a helicopter would be used to lift the booster from the booster drop area and transport it back to the airfield at AAFB. Total time of the helicopter over the recovery area during recovery operations is estimated to be approximately 5 minutes and would be at an altitude of 100 feet. The speed of the downwash from the helicopter is estimated to be approximately 40–50 miles per hour. This is significantly below the sustained wind speeds of 100–135 miles per hour for a typical typhoon that may impact northern Guam each year and last for hours.

To avoid impacts on ESA-listed plants and Guam tree snails during booster recovery efforts, a qualified biomonitor will be present and monitor all booster recovery activities. This includes ensuring that no unnecessary vegetation, particularly ESA-listed species, is disturbed or damaged while the booster recovery team walks to and from the booster landing site and prepares the booster for extraction by helicopter.

Mariana Fruit Bat. The only potential for physical disturbance or strike of a Mariana fruit bat from the proposed flight test activities is if the expended first stage booster fell on a fruit bat. Given the size of the booster, the very rare occurrence of fruit bats within the potential booster drop area, and location of the only known fruit bat roost on AAFB approximately 4 miles from the booster drop area, the potential for the expended first stage booster to strike a fruit bat during a proposed test flight is considered discountable and minor.

Physical Presence

ESA-listed plants and Guam Tree Snail. Due to the presence of a biomonitor during recovery activities to ensure effects to Guam tree snails and all ESA-listed plant species are avoided, the presence of the booster recovery team within the booster drop area would not result in significant impacts on Guam tree snails and the ESA-listed plant species.

Mariana Fruit Bat. The only potential for the physical presence of flight test personnel in the proximity of a Mariana fruit bat is during the recovery of the first stage booster. Human activity would occur during ingress and egress of the booster drop location, the recovery team would be at the recovery site for a limited amount of time, and a biomonitor would be present to ensure recovery activities avoid effects to all ESA-listed species. If a Mariana fruit bat was present in the area, these activities would be expected to result in only minor behavioral responses, such as movement to a nearby tree; would not be expected to affect individual animal fitness or have population-level effects; and would be considered to be insignificant and discountable.

Exposure to EME

ESA-listed species. EME from radar operations would have no effect on ESA-listed plants and invertebrates and negligible effect on Mariana fruit bats.

The analysis conclusions for terrestrial biological resources under Alternative 1 are consistent with a moderate determination, as described in Table 4.5-1, and therefore would result in a less than significant impact on terrestrial biological resources.

4.5.1.2 Alternative 2 (Preferred Alternative)

Under Alternative 2, test launches may be land- or sea-based (see Chapter 2.0, Description of the Proposed Action and Alternatives). For land-based launches, all impacts on wildlife and special-status species would be consistent with the analysis done under Alternative 1 (see Section 4.5.1.1, Alternative 1). Impacts resulting from sea-based launches would have no impact on terrestrial biological resources. Impacts on marine biological resources are discussed in Section 4.6, Marine Biological Resources.

The analysis conclusions for terrestrial biological resources under Alternative 2 (Preferred Alternative) are consistent with a moderate determination, as described in Table 4.5-1**,** and therefore would result in less than significant impacts on terrestrial biological resources.

4.5.2 No Action Alternative

Under the No Action Alternative, the PA would not occur. AAFB would continue with normal activities, and MDA would not enhance the defense of Guam against the threat presented by short-, mid-, and long-range missiles, cruise missiles, and hypersonic vehicles. Therefore, no impact on terrestrial biological resources would occur.

4.6 Marine Biological Resources

Table 4.6-1 describes the criteria used to determine whether the PA would result in a less than significant impact or significant impact on marine biological resources.

Table 4.6-1: Criteria for Determining the Significance of Proposed Action Stressors on Marine Biological Resources

Impact Descriptor	Level of Impact	Significance Conclusions
Negligible	Impacts on marine habitats, marine invertebrates, fishes, marine mammals, sea turtles, and seabirds would be temporary (lasting up to several hours) and would not be outside the natural range of variability of species' populations, their habitats, or the natural processes sustaining them. Impacts could include disturbances to behaviors of individuals without interference to feeding, reproduction, or other biologically important functions at a level which would result in impacts at the population levels. No mortality or debilitating injury to any individual marine mammal or sea turtle would occur. There would be no displacement of marine mammals or sea turtles from preferred breeding, feeding, or nursery grounds, migratory routes, or designated critical habitat.	Less than significant impact
Minor	Impacts on marine habitats, marine invertebrates, fishes, marine mammals, sea turtles, and seabirds would be temporary or short term (lasting several days to several weeks) but would not be outside the natural range of variability of species' populations, their habitats, or the natural processes sustaining them. Impacts could include non-life-threatening injury (e.g., minor strike, temporary hearing impairment) to individual marine mammals and sea turtles and disruptions of behavioral patterns, including occasional disruption of communication or echolocation, and displacement of individuals or groups that would not result in interference to feeding, reproduction, or other biological important functions affecting population levels.	
Moderate	Impacts on marine habitats, marine invertebrates, fishes, marine mammals, sea turtles, and seabirds would be short term or long term (lasting several months or longer) and outside the natural range of variability of species' populations, their habitats, or the natural	

Impact Descriptor	Level of Impact	Significance Conclusions
	processes sustaining them. Impacts could include injury (up to and including mortal injury to an individual) and repeated disruptions of communication or echolocation and time-sensitive behaviors such as feeding and breeding, but in low enough numbers such that the continued viability of the population is not threatened. Behavioral responses to disturbance by individuals or groups could be expected throughout the ROI.	
Major	Impacts on marine habitats, marine invertebrates, fishes, marine mammals, sea turtles, and seabirds would be short term or long term and well outside the natural range of variability of species' populations, their habitats, or the natural processes sustaining them. Impacts could include extensive (i.e., affecting a large proportion [greater than 50%] of the local population), life-threatening, or debilitating injury and mortality and substantial disruption of communication or echolocation and time-sensitive behaviors such as breeding so that the continued viability of the local population is seriously threatened. Displacement from preferred breeding, feeding, or nursery grounds, migratory routes, or designated critical habitat would be short term or long term within and well beyond the project area. Full recovery of a population would not be expected to occur in a reasonable time.	Significant impact

4.6.1 Proposed Action

4.6.1.1 Alternative 1

Alternative 1 proposes land-based launches from AAFB, NWF to the northeast over the ROI. The target missile would be launched over the ocean via aircraft (C-17 or similar). The interceptor is a three-stage missile with two booster drops. The first booster would land on AAFB and second booster would land in the ROI at pre-determined distance at least 200 nautical miles offshore of Guam (outside the EEZ). The target is a two stage missile with one booster drop. Each air launched target would result in a pallet attached with up to 5 parachutes and 64 lines per parachute (320 lines total) (see Chapter 2.0, Description of the Proposed Action and Alternatives). Upon successful interception, debris would fall into the ocean in predetermined areas within the ROI (Figure 2.1-6). Under Alternative 1, marine biological resources could be impacted by debris from successful target intercept and stage drop-off as well as debris impact/splashdown noise. Potential stressors analyzed under Alternative 1 are listed below:

- Physical disturbance and strike. (interception debris, expended stages)
- Ingestion (debris)
- Entanglement (parachutes and lines)
- Noise (debris impact)
- Secondary stressors (chemical contamination)

Generally, environmental analyses for flight tests of missile systems have concluded that there would be no significant impacts on biological resources in the BOA (National Marine Fisheries Service, 2020a) (National Marine Fisheries Service, 2018; U.S. Department of the Navy, 2015c; United States Air Force, 2020). Furthermore, these analyses have indicated that adverse effects to marine biological resources (including special status species or sensitive habitats in the BOA) are unlikely for these types of flight tests (National Marine Fisheries Service, 2020a) (National Marine Fisheries Service, 2018; U.S. Department of the Navy, 2015c; United States Air Force, 2020).

- 2015 MITT Final EIS/OEIS (U.S. Department of the Navy, 2015a)
- 2018 Hawaii-Southern California Training and Testing EIS/OEIS (U.S. Department of the Navy, 2018a)
- 2020 Final Air-Launches Rapid Response Weapon (ARRW) EA/OEA (United States Air Force, 2020)
- 2020 MITT Biological Opinion (National Marine Fisheries Service, 2020a)

4.6.1.1.1 Physical Disturbance and Strike

After interception, much debris would burn up in the atmosphere. However, some pieces tens of kilograms in weight may remain and enter the water, while most would be less than 10 grams per item. Expended booster stages and the parachute assembly would also enter the water outside of the EEZ (see Chapter 2.0, Description of the Proposed Action and Alternatives). Intercept debris would pose the greatest strike potential for marine biological resources, particularly marine mammals, sea turtles, and fishes, due to the potential for debris to be scattered across the ROI, whereas only a single target extraction vehicle and up to three total boosters would land on the ocean surface per flight test. Marine biological resources at or just below the surface of the water would be most susceptible to injury from strike, given the velocity with which the debris would strike the water; however, the velocity of these materials would rapidly decrease after surface contact and as they travel through the water column.

Marine Invertebrates. Debris could potentially settle on deep water invertebrates on seamounts (cold-coral and sponges). Debris would sink slowly through the water column. At slow speeds, impacts resulting from direct impact would be negligible. Debris that settles on top of marine invertebrates could impact the species' ability to thrive normally. There are 42 seamounts and banks (shallower than 2,000 meters) within the 259,219 square nautical mile ROI where debris has potential to fall. While most debris as a result of the interception would be expected to burn in the atmosphere after the impact, some smaller sizes of debris may enter the water, in addition to the booster stages and parachute assembly. However, given the sparse distribution of marine biological resources, and sparse distribution of seamounts in the ROI, the likelihood of physical disturbance and strike impacts on marine invertebrates under Alternative 1 would be extremely low and considered negligible.

Fishes. Fishes occur throughout the ROI and therefore have the potential to be present in nearly any area where debris may land. Fishes near the surface or in the upper water column have the potential to be struck by debris as they enter the water. Given the low population sizes, large ROI, and small amount of debris landing on the ocean surface, the infrequency of flight tests, and individuals being unlikely to be at the ocean surface, a direct strike on fishes is highly unlikely. While there is limited density data for fishes in the ROI, more than 88 nautical miles offshore, they would have low densities similar to sea turtles and marine mammals. As such, it is highly unlikely that fishes would be present at a given time or place where pieces of debris may fall. Since they do not breathe air, fishes would be subsurface where debris would slow rapidly after entering the ocean. Fishes below the surface and near locations where debris lands are likely to swim away to avoid sinking pieces of debris. Given these factors, impacts on fishes from physical disturbance and strike under Alternative 1 would be considered negligible.

Sea Turtles. While no strike from debris has ever been reported on sea turtles, the possibility of strike still exists. For sea turtles, the primary concern is the potential strike with interception debris at or near the water's surface. While disturbance or strike from an item as it falls through the water column is possible, it is not likely because the debris generally sinks through the water slowly and can be avoided by most sea turtles. Sea turtle densities in the western Pacific BOA are extremely low (see Table 3.6-1). Due to the large size the of ROI (259,219 square nautical miles), small size of the pieces of debris (most less than 10 grams), and low sea turtle densities, the probability of any sea turtle being impacted by falling debris would be extremely low. As such, impacts on sea turtles under Alternative 1 would be considered negligible.

Marine Mammals. For marine mammals, the primary concern is the potential strike with interception debris at or near the water's surface, which could result in injury or death. Whales migrate through lower latitudes in the Pacific Ocean during winter months, and therefore have the potential to be present in the ROI during the PA (between November to December). Further, marine mammals are known to make foraging dives and would not be present at the surface 100 percent of the time. Due to the large size of the ROI, small amount of debris landing on the ocean surface, infrequency of flight tests, low likelihood for a marine mammal to be present at the surface the same time as debris, and low density of marine mammals (Table 3.6-2), the possibility of strike from falling debris would be extremely low. As such, impacts on marine mammals under Alternative 1 would be considered negligible.

Seabirds. Debris in the ROI could result in physical injury or behavioral disturbances to seabirds in the air, at the surface, or underwater during foraging dives. Overall adverse effects to common species could occur, but would not change species abundance or distribution. Adverse effects to ESA-listed seabirds is highly unlikely due to the low densities of seabirds in the ROI, small amount of debris landing on the ocean surface, and the infrequency of flight tests. As such, potential physical disturbance and strike impacts on seabirds under Alternative 1 would be considered negligible.

4.6.1.1.2 Ingestion

Fishes, sea turtles, marine mammals, and seabirds could experience impacts from accidental ingestion of target intercept debris. Expended stages and parachutes would be large in size, would remain intact, and would therefore not be accidentally ingested (U.S. Department of the Navy, 2015a). Further, parachutes would sink to the sea floor where depths are generally greater than 2,000 m and out of the diving and feeding range of most ESA-listed species. Given the short duration that an unrecovered parachute would remain in the water column, consideration of the low densities of protected species, and also given the size of the parachutes, ingestion is not considered likely. Potential ingestion impacts would be limited to small (less than 10 grams) and medium (less than a kilogram) pieces of interception debris. Flight tests and subsequent debris would be infrequent (twice annually or less). All debris would sink to the ocean bottom where depths reach thousands of feet and where most species do not occur. In the unlikely event that an animal may encounter and attempt to ingest a piece of debris or "taste" an item, it is likely that the individual would expel it (Felix et al., 1995). Therefore, given the limited time debris would be in the water column, infrequency of flight tests, and low density of marine life in the ROI, it is not likely that items would be accidentally ingested by marine life in the ROI. As such, the likelihood of any fish, sea turtle, marine mammal, or seabird being in the exact location of suspended debris and ingesting debris is extremely low, and potential ingestion impacts on marine biological resources under Alternative 1 would be considered minor.

4.6.1.1.3 Entanglement

Marine biological resources present in the ROI may become entangled by parachutes and lines from the flight test. Parachutes landing in the ROI would be weighted, relatively large (15–94 feet in diameter), connected to the pallet by lines, and be designed to sink relatively quickly (see Chapter 2, Description of Proposed Action and Alternatives). The pallet (including the parachutes and lines) would be expended more than 200 nautical miles offshore, where marine biological resource densities are the lowest and most seafloor depths are greater than 2,000 meters (Figure 2.1-6 and Figure 2.1-7). Once parachutes and lines have completely sunk to the seafloor, they would be inaccessible to most marine life at such depths (2,000 to 9,600 meters). Fishes, marine mammals, and sea turtles would be at risk of entanglement while parachutes are suspended in the water column, which would be a relatively short period of time. Marine biological resources would have to be in the exact location as the pallet, in the short window the pallet would be suspended in the water column, and during infrequent flight tests (up to two per year) to be at risk of entanglement. Further, although unlikely, an encounter may not result in entanglement, as species may exhibit avoidance behaviors. Therefore, since it is unlikely that any given species would be within the drop zones in the brief window parachutes and lines are suspended in the water column, given the low densities of marine life greater than 200 nautical miles offshore, and that any encounter would not likely result in entanglement, the potential of entanglement impacts under Alternative 1 would be considered minor.

4.6.1.1.4 Noise Stressors

Noise stressors under Alternative 1 would result in noise from impact (splashdown) noise from debris, aircraft overflights, and interceptor launch. For reasons detailed in Section 4.10 (Noise), sonic booms generated under Alternative 1 would not be expected to be large. Further, the cliff on AAFB where the interceptor launch would take place is hundreds of feet above the water. As sound would not travel downwards, launch noise would be inaudible to any marine biological resources in the nearshore or offshore areas. Aircraft overflight noise may be audible at the water; however, very little of that sound is transmitted into the water (U.S. Department of the Navy, 2019b). This is supported by the final rule for the Takes of Marine Mammals Incidental to Specified Activities: Taking Marine Mammals Incidental to U.S. Space Force Launches and Supporting Activities at Vandenberg Space Force Base, Vandenberg, California, where NMFS concluded that "noise from the specific activities is unlikely to ensonify subsurface waters to an extent that could result in take of cetaceans….the likelihood of planned activities resulting in the harassment of any cetacean to be so low as to be discountable" (89 FR 25163). For these reasons, impacts from the missile launch and aircraft overflights would have insignificant impacts on marine biological resources and are not evaluated further.

Impacts on marine biological resources from splashdown noise of debris may have the potential to affect the behavior and hearing sensitivity in fishes, sea turtles, and marine mammals. Loud sounds might cause these organisms to quickly react, altering their normal behavior either briefly or more long term. Marine biological resources would have to be at or near the surface to be exposed to appreciable noise levels (U.S. Department of the Navy, 2015a). As previously discussed, densities of fish, marine mammals, sea turtles, and sea birds in the ROI would be extremely low, and the probability of marine biological resources being present in the impacted area and the probability of said species also being near the surface at the time of impact is highly unlikely. As such, noise impacts on marine biological resources under Alternative 1 would be expected to be minor and therefore less than significant.

4.6.1.1.5 Secondary Stressors

Interceptors used during flight tests would be non-explosive, kinetic vehicles. No nuclear or conventional explosive warheads would be used. Further, boosters would expend all solid propellant prior to dropping into the ocean over depths between 100 and 9,600 meters (majority of the ROI is between 2,000 and 9,600 meters). The target missile battery components may include lithium, nickel-cadmium, or other type of batteries that would be expended into the ROI. These potential hazardous materials would be very small in relation to the ROI and sink to the seafloor relatively quickly, where they would be out of range of most marine biological resources. As such, impacts from secondary stressors under Alternative 1 would be expected to be negligible and therefore less than significant.

4.6.1.1.6 Special Status Species

Impacts on special status species would be less than significant for the reasons described in the stressors analyses (Sections 4.6.1.1.1–4.6.1.1.4). MDA is currently consulting with NMFS in regard to impacts on ESA-listed species in accordance with ESA section 7. The outcome from consultation with NMFS will be included in the final version of this document.

The analysis conclusions for marine biological resources under Alternative 1 are consistent with a minor determination, as described in Table 4.6-1, and therefore would result in a less than significant impact on marine biological resources.

4.6.1.2 Alternative 2 (Preferred Alternative)

Alternative 2 (Preferred Alternative) would have the land-based intercept as proposed in Alternative 1 (see Chapter 2.0, Description of the Proposed Action and Alternatives). Potential impacts for the land-based missile intercept scenario would be the same as those described under Alternative 1. Alternative 2 proposes the option to conduct at-sea launches or land-based launches. At sea-launches would be ship-based, with all proposed activities occurring at sea. Compared to what was analyzed under Alternative 1, noise stressors resulting from an at-sea launch would be the only meaningful difference to impacts on marine biological resources. Stressors analyzed above under Alternative 1 would be the same under Alternative 2.

4.6.1.2.1 Noise Stressors

An at-sea missile launch could result in increased sound events over the ROI. Fishes, sea turtles, marine mammals, and seabirds in the ROI could be exposed to launch noise from an at-sea missile launch. Each at-sea flight test could result in a sudden, loud noise disturbance. Animals would have to be at or near the waters’ surface to exposed to appreciable noise levels (U.S. Department of the Navy, 2015a). The 2020 MITT Biological Opinion determined that marine biological resources responses to launch noises have not been widely recorded; however, marine biological resources within the launch area may exhibit a startle response (e.g., alert, startle, dive, avoid). Startle responses would be brief and have no long-term impact on individuals or populations (National Marine Fisheries Service, 2020a). As mentioned in Section 3.6.2 (Affected Environment), marine biological resource densities in the ROI are extremely low, and the probability of species being present in the launch area, at the same time as a flight test, and being at or near the surface, would be unlikely (National Marine Fisheries Service, 2020a). Other acoustic stressors, including aircraft overflights and debris splashdown noise, would be the same as under Alternative 1. As such, all acoustic impacts on marine biological resources under Alternative 2 would be considered minor.

4.6.1.2.2 Special Status Species

Impacts on special status species are all minor for reasons described in Section 4.6.1.1 (Alternative 1). MDA is currently consulting with NMFS regarding impacts on ESA-listed species in accordance with ESA Section 7. The outcome from consultation with NMFS will be included in the final version of this document.

The analysis conclusions for marine biological resources under Alternative 2 (Preferred Alternative) are consistent with a minor determination, as described in Table 4.6-1 and therefore would result a less than significant impact on marine biological resources.

4.6.2 No Action Alternative

Under the No Action Alternative, the PA would not occur. AAFB would continue with normal activities, and MDA would not enhance the defense of Guam against the threat presented by short-, mid-, and long-range missiles, cruise missiles, and hypersonic vehicles. Therefore, no impacts on marine habitats, invertebrates, fishes, sea turtles, marine mammals, or seabirds would occur.

4.7 Cultural Resources

Table 4.7-1 describes the criteria used to determine whether the PA would result in a less than significant impact or significant impact on cultural resources and historic properties.

Table 4.7-1: Criteria for Determining the Significance of Proposed Action Stressors on Cultural Resources and Historic Properties

Impact Descriptor	Level of Impact	Significance Conclusions
Negligible	Proposed activities do not cause a detectable increase in risks to the integrity of cultural resources and historic properties. Cultural resources and historic properties are not impacted.	Less than significant impact
Minor	Proposed activities rarely result in a detectable increase in risks to the integrity of cultural resources and historic properties. Cultural resources and historic properties are not impacted.	
Moderate	Proposed activities present moderate risks to the integrity of cultural resources and historic properties. Cultural resources and historic properties are not impacted.	
Major	Proposed activities present major risks to the integrity of cultural resources and historic properties. Cultural resources and historic properties are impacted.	Significant impact

4.7.1 Proposed Action

4.7.1.1 Alternative 1

Under Alternative 1, up to two land-based flight tests or tracking exercises per year would be conducted from NWF, AAFB, for 10 years. Flight test and tracking exercise activities at AAFB would include interceptor launches and first stage booster drops. All launch related activities would occur outside of the NWF historic property boundaries. The launch area's environmental conditions make it extremely unlikely that additional, undetected historic properties exist. The nature of the PA, including the test site preparations, installation of range safety equipment, and deployment of land-based interceptors are occurring at a ground-surface level or on heavily disturbed lands. The aesthetic aspects of the PA are consistent with activities already occurring in and around the area, and have no potential to impact setting, feeling, or viewshed. The launch itself will be from a temporary Vertical Launcher mounted to a concrete pad or moveable, truck mounted system and will not affect the ground surface below.

Within the booster drop area, the impact of the booster has potential to displace soils and expose previously unidentified cultural or historic material beneath the ground surface. The likelihood of this occurring is incredibly low, and that probability is further diminished when considering the expected landing area is on razed grounds.

Incomplete data within the flight test debris do not preclude sufficient evaluation of whether the PA may cause reasonably foreseeable significant adverse impacts. Given that the explosion would occur in the exosphere and most of the debris would incinerate before reaching the earth's surface, the material count of debris sinking to the seafloor would be extremely low and extremely dispersed. There are only seven known resources afforded protection under the SMCA in a 259,219 nm^2 area, and no known World Heritage Sites. The sparse site density and extensive dispersal of debris are such that the probability of debris settling near a submerged resource is extremely low; the probability of debris making direct impact is even more implausible.

In the extraordinary instance that debris were to land near or on a submerged cultural or historic resource, the velocity of smaller materials would be so diminished by hydrodynamic drag and drift that their impact would not have enough energy to cause damage, and their presence near the resource would be transitory due to oceanic currents (Schmid, 1969). Regarding larger objects such as the booster: the quantity of such debris would be so low as to render contact with a cultural resource beyond statistical reason. Thus, there is no potential to impact cultural or historic resources with the flight test debris.

The analysis conclusions for cultural resources under Alternative 1 are consistent with a minor determination, as described in Table 4.7-1 and therefore would result in less than significant impacts on cultural resources.

4.7.1.2 Alternative 2 (Preferred Alternative)

Under Alternative 2 (Preferred Alternative), up to two land- or sea-based flight tests or tracking exercises would be conducted per year for 10 years from the same location on AAFB as described under Alternative 1. The analysis conclusions for cultural resources under Alternative 2 (Preferred Alternative) are consistent with a minor determination, as described in Table 4.7-1 and therefore would result in less than significant impacts on cultural resources.

4.7.2 No Action Alternative

Under the No Action Alternative, the PA would not occur. Therefore, no impact on cultural resources would occur.

4.8 Environmental Justice and Children's Environmental Health and Safety Risks

Table 4.8-1 describes the criteria used to determine whether the PA would result in a less than significant impact or significant impact on environmental justice.

Table 4.8-1: Criteria for Determining the Significance of Proposed Action Stressors on Environmental Justice

Impact Descriptor	Level of Impact	Significance Conclusions
Negligible	Proposed activities do not cause a detectable increase in disproportionate impacts or adverse effects on low-income or minority populations, nor do they cause a detectable increase in environmental health and safety risks that would disproportionately affect children. Environmental justice is not impacted.	Less than significant impact
Minor	Proposed activities rarely result in a detectable increase in disproportionate impacts or adverse effects on low-income or minority populations. Proposed activities could also rarely result in a detectable increase in environmental health and safety risks that would disproportionately affect children. Environmental justice is not impacted.	Less than significant impact
Moderate	Proposed activities cause moderate, but not disproportionate, impacts or adverse effects on low-income or minority populations. Proposed activities also cause moderate, but not disproportionate, environmental health and safety risks to children. Environmental justice is not impacted.	Less than significant impact
Major	Proposed activities cause disproportionate impacts or adverse effects on low-income or minority populations. Proposed activities also disproportionately expose children to environmental health and safety risks. Environmental justice is impacted.	Significant impact

4.8.1 Proposed Action

4.8.1.1 Alternative 1

Under Alternative 1, up to two land-based flight tests or tracking exercises would be conducted from NWF, AAFB per year for 10 years.

As later discussed in Section 4.9.1 (Proposed Action), the policies, procedures, and standard operating procedures in place protect the health and safety of installation personnel and the general public and ensure public health and safety impacts from the PA would be minor. In addition, impacts from air quality (Section 4.3), climate change and greenhouse gases (Section 4.4.1), and noise (Section 4.10.1) would also be minor. As discussed in Appendix A (Environmental Resources Eliminated from Further Detailed Analysis), there are no anticipated impacts on socioeconomic resources as a result of the PA.

As previously discussed in Section 2.1 (Proposed Action), access to select private properties on the boundary of AAFB would need to be restricted to ensure public safety. Public lands to the north, east, and west of NWF, including the Guam National Wildlife Refuge may need be closed during the flight test event. Access would be restored to all closed public and private lands at the conclusion of the flight test event.

Therefore, there would be no disproportionately high impacts on or adverse effects to any low-income or minority populations in the vicinity of AAFB. In addition, the policies and procedures identified in Sections 2.1.1 (Flight Test and Tracking Process and Equipment) and Section 4.9.1 (Proposed Action) that protect the health and safety of the public and workers also protect children. Thus, Alternative 1 would not disproportionately expose children to environmental health or safety risks.

The analysis conclusions for environmental justice under Alternative 1 are consistent with a minor determination, as described in

Table 4.8-1, and therefore would result in a less than significant impact on environmental justice.

4.8.1.2 Alternative 2 (Preferred Alternative)

Under Alternative 2 (Preferred Alternative), up to two land- or sea-based flight tests or tracking exercises would be conducted per year for 10 years from NWF, AAFB, or from a U.S. Navy ship at sea in the BOA of the western Pacific Ocean.

Disproportionate and adverse impacts on low-income, minority populations, and children from land-based flight tests or tracking exercises are the same as described in Section 4.8.1.1 (Alternative 1). Sea-based flight tests or tracking exercises would occur in the BOA of the western Pacific Ocean, far removed from Guam. Therefore, there would be no potential for disproportionately high impacts or adverse effects on minority populations or low-income populations, or potential to disproportionately expose children to environmental health or safety risks.

The analysis conclusions for environmental justice under Alternative 2 (Preferred Alternative) are consistent with a minor determination, as described in

Table 4.8-1, and therefore would result in a less than significant impact on environmental justice.

4.8.2 No Action Alternative

Under the No Action Alternative, the PA would not occur, AAFB would continue with normal activities, and there would be no potential for disproportionately high and adverse human health or environmental impacts on minority populations and low-income populations. In addition, there would be no potential for exposing children to environmental health or safety risks.

4.9 Public Health and Safety

Table 4.9-1 describes the criteria used to determine whether the PA would result in a less than significant impact or significant impact on health and safety.

Table 4.9-1: Criteria for Determining the Significance of Proposed Action Stressors on Health and Safety

Impact Descriptor	Level of Impact	Significance Conclusions
Negligible	Proposed activities do not cause a detectable increase in risks to the wellbeing, safety, or health of the public or workers, nor does it cause a detectable increase in hazards to equipment and structures. Public health and safety is not impacted.	Less than significant impact
Minor	Proposed activities rarely result in a detectable increase in risks to the well-being, safety, or health of the public or workers. Proposed activities also rarely result in a detectable increase in hazards to equipment and structures. Public health and safety is not impacted.	
Moderate	Proposed activities present moderate risks to the well-being, safety, or health of the public or workers. Proposed activities also present moderate hazards to equipment and structures. Public health and safety is not impacted.	
Major	Proposed activities present major risks to the well-being, safety, or health of the public or workers. Proposed activities also present major hazards to equipment and structures. Public health and safety is impacted.	Significant impact

4.9.1 Proposed Action

4.9.1.1 Alternative 1

Under Alternative 1, up to two land-based flight tests or tracking exercises would be conducted from NWF, AAFB per year for 10 years. Physical interactions with flight test equipment and debris pose the greatest risk to public health and safety. Adherence to the policies and procedures identified in Sections 2.1.1 (Flight Test and Tracking Process and Equipment) and 3.9.2 protect the health and safety of the public and workers. These and other procedures provide ground safety, flight safety, range clearance and surveillance, sea-surface area clearance and surveillance, and commercial air traffic control. They include coordination with the Federal Aviation Administration and U.S. Coast Guard and the publishing of NOTMARs and NOTAMs. The FAA would also limit the use of affected airspace, through a TFR, to protect aircraft from the HIRF hazard posed by active radars.

Range safety equipment includes radars, telemetry collection devices, and flight termination systems to track the launch of an interceptor through fly-out from AAFB to the BOA. Radars would be used to detect and track the target during the flight tests. A description of range safety assets is provided in Appendix D (Range Safety Asset Descriptions).

Prior to flight test activities, applicable safety regulations would be followed in the transport and handling of hazardous materials. An appropriate explosive safety quantity distance zone would be established and maintained around facilities where missiles or other ordnance are stored or handled in accordance with all applicable federal, territorial, local, and U.S. Air Force regulations. In addition, U.S. Army, U.S. Air Force, U.S. Navy, or MDA personnel would conduct a comprehensive safety analysis to determine specific launch and flight hazards for each flight test. A standard dispersion computer model for both normal and aborted launch scenarios would be run by installation safety personnel. As part of the analysis, risk to off-installation areas and non-participating aircraft, sea vessels, and personnel, would be determined. The results of the analysis would then be used to identify the launch hazard area, expended booster drop zones, debris impact areas, terminal hazard area, and flight termination boundary. The location and dimensions of the impact zones for each flight test would be determined by range safety personnel, based on detailed launch planning and trajectory modeling.

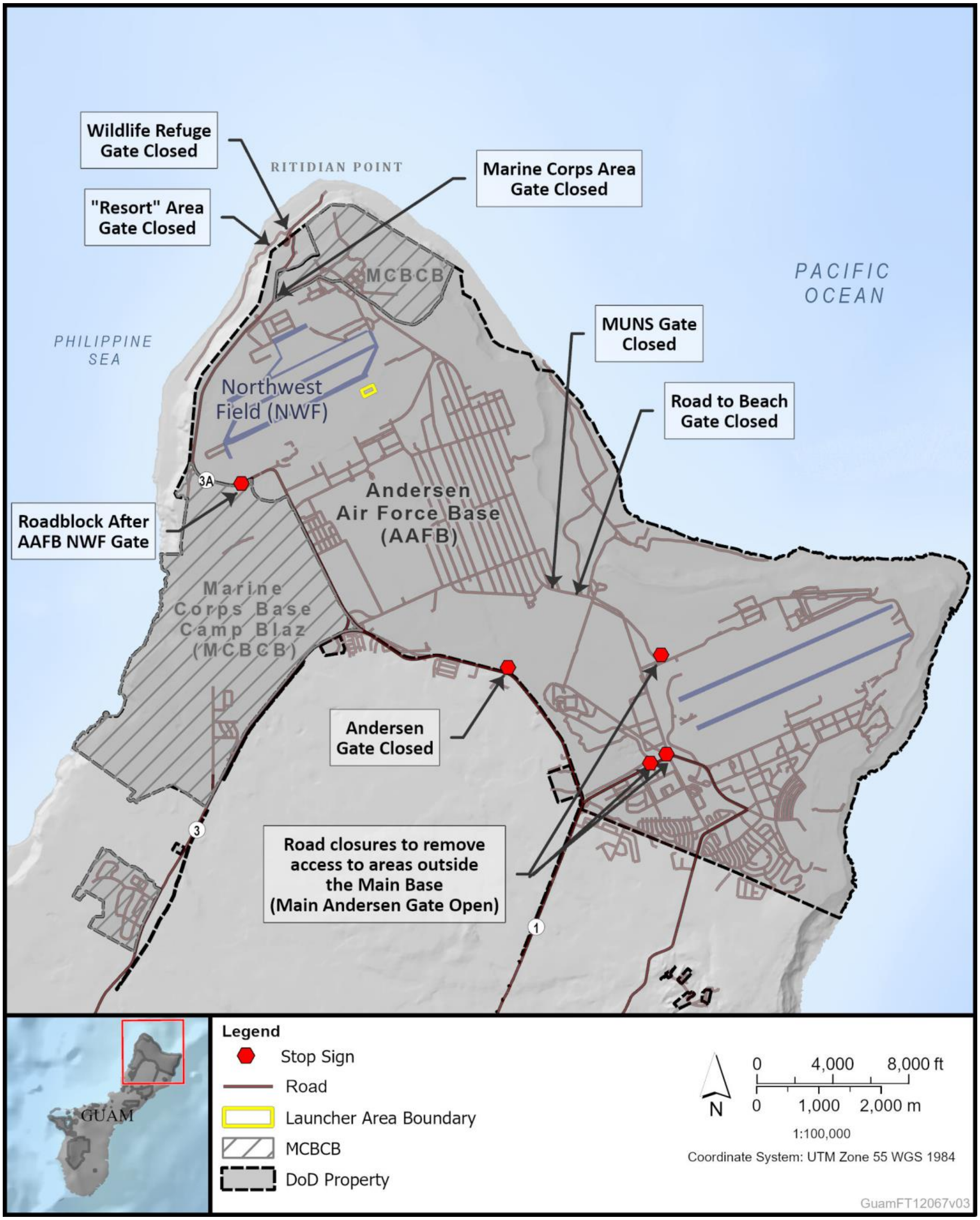
A restricted access plan would be developed for areas on AAFB that are in the vicinity of the proposed launch site. A plan for roadblocks, access control, restricted access, and security sweeps would be developed to ensure that public personnel are not located in the areas north, south, east and west of the proposed launch site. Figure 4.9-1 shows the specific roadblocks and gate closures that would be put in place prior to any land-based flight test or tracking exercises. In addition, there would be seven closed circuit cameras at the launch site to monitor and ensure the safe execution of launch activities.

As previously discussed in Section 2.1 (Proposed Action), access to select private properties on the boundary of AAFB would need to be restricted to ensure public safety. Public lands to the north, east, and west of NWF, including the Guam National Wildlife Refuge, may need be closed during the flight test event to ensure public health and safety. Closures would last for four days, and access would be restored to all closed public and private lands at the conclusion of the flight test event.

Test mishaps as described in Section 3.9.2.1 (Test Mishaps) are not reasonably foreseeable because the launch systems evaluated in this EA/OEA are mature systems.

The analysis conclusions for public health and safety under Alternative 1 are consistent with a minor determination, as described in Table 4.9-1, and therefore would result in a less than significant impact on public health and safety.

Figure 4.9-1: FEM-02 Roadblock and Gate Closures



4.9.1.2 Alternative 2 (Preferred Alternative)

Under Alternative 2 (Preferred Alternative), up to two land- or sea-based flight tests or tracking exercises would be conducted per year for 10 years from NWF, AAFB, or from a U.S. Navy ship at-sea in the BOA of the western Pacific Ocean. As in Alternative 1, physical interactions with flight test equipment and debris pose the greatest risk to public health and safety.

4.9.1.2.1 Land-Based Flight Tests and Tracking Exercises

For the same reasons described in Section 4.9.1.1 (Alternative 1), impacts on public health and safety from the land-based flight tests or tracking exercises would be minor.

4.9.1.2.2 Sea-Based Flight Tests and Tracking Exercises

Sea-based flight tests or tracking exercises would occur in the BOA of the western Pacific Ocean, far removed from Guam. As under Alternative 1, adherence to the policies and procedures identified in Sections 2.1.1 (Flight Test and Tracking Process and Equipment) and 3.9.2 (Affected Environment) protect the health and safety of the public and workers. These and other procedures provide flight safety, range clearance and surveillance, sea-surface area clearance and surveillance, and commercial air traffic control. They include coordination with the FAA and U.S. Coast Guard and the publishing of NOTMARs and NOTAMs. Land access restrictions would not be necessary for sea-based flight tests and tracking exercises because interceptor launches, target launches, and target intercepts would occur over the BOA of the western Pacific Ocean.

Prior to flight test activities, applicable safety regulations would be followed in the transport and handling of hazardous materials. An appropriate explosive safety quantity distance would be established and maintained around facilities where missiles or other ordnance are stored or handled in accordance with all applicable federal, state, local, and U.S. Navy/U.S. Air Force regulations. In addition, U.S. Army, U.S. Air Force, U.S. Navy, or MDA personnel would conduct a comprehensive safety analysis to determine specific launch and flight hazards for each flight test. A standard dispersion computer model for both normal and aborted launch scenarios would be run by installation safety personnel. As part of the analysis, risks to non-participating aircraft and sea vessels would be determined. The results of the analysis would then be used to identify the launch hazard area, expended booster drop zones, debris impact areas, terminal hazard area, and flight termination boundary. The location and dimensions of the impact zones for each flight test would be determined by range safety personnel based on detailed launch planning and trajectory modeling.

The analysis conclusions for public health and safety under Alternative 2 (Preferred Alternative) are consistent with a minor determination, as described in Table 4.9-1, and therefore would result in a less than significant impact on public health and safety.

4.9.2 No Action Alternative

Under the No Action Alternative, the PA would not occur. AAFB would continue with normal activities, and there would be no potential for additional impacts on public health and safety. Therefore, no impact on public health and safety would occur.

4.10 Noise

Table 4.10-1 describes the criteria used to determine whether the PA would result in a less than significant impact or significant impact on noise.

Table 4.10-1: Criteria for Determining the Significance of Proposed Action Stressors on Noise

Impact Descriptor	Level of Impact	Significance Conclusions
Negligible	Proposed activities do not cause a detectable increase in noise impacts on human receptors. Noise from proposed activities would be audible and higher than typical ambient levels, but not so much that received noise levels would impact human receptors or degrade the noise environment. Noise is not impacted.	Less than significant impact
Minor	Proposed activities rarely result in a detectable increase in noise impacts on human receptors. Noise from proposed activities would be audible and higher than typical ambient levels, but not so much that received levels would impact human receptors or degrade the noise environment. Noise is not impacted.	
Moderate	Proposed activities cause moderate increases in noise impacts on human receptors. Noise from proposed activities would be audible and higher than typical ambient levels, but not so much that received levels would impact human receptors or degrade the noise environment. Noise is not impacted.	
Major	Proposed activities cause significant noise impacts on human receptors. Noise from proposed activities is audible and significantly higher than typical ambient levels, resulting in increased received noise levels by human receptors and an overall degradation of the noise environment. Noise is impacted.	Significant impact

4.10.1 Proposed Action

4.10.1.1 Alternative 1

4.10.1.1.1 Launch Noise

Each missile test launch would generate individual acoustical events that would be very loud near the launch pad but would attenuate rapidly with distance. These events would be relatively short in duration, lasting approximately 5–10 seconds each. Noise levels generated by each test would vary, depending on missile system configuration, trajectory, and weather conditions. In general, noise during the launches and in flight soon after launch would be clearly audible to nearby areas both on and off AAFB.

A comparable missile system to those proposed for these missile tests is for the THAAD system. The THAAD is a solid-fuel surface-to-air missile with a launch booster comparable to the PAC-3 MSE and other defensive weapon missile systems. Noise from the THAAD missile has been carried forward as a surrogate to reflect a reasonable upper limit of effects from any of the proposed systems. Sound levels during launch for the THAAD missile were recorded and measured to be 119.7 dBA (Lmax) at a distance of 275 feet from the launch site (U.S. Department of Defense Missile Defense Agency, 2017). Potential noise levels received at the sound level meter locations were conservatively calculated utilizing only the attenuation rate for a point source and compared to recorded ambient noise levels. Table 4.10-2 presents the approximate received noise levels at representative locations and Figure 4.10-1 shows approximate distances to various noise levels.

Table 4.10-2: Approximate Received Launch Noise Levels at Sensitive Receptors

Receptor	Distance from Launch Location (miles/feet)	Estimated Ambient Levels (dBA)	Estimated Received Maximum Noise Level (dBA)
Closest Residences (Potts Junction)	2.44/12,894	45.4–75.4	86
Machananao Elementary School	2.89/15,257	45.4–75.4	85
Finegayan Elementary School	3.99/21,108	51.2–77.4	82
Astumbo Elementary/Middle School	4.99/26,375	51.2–77.4	80
Santa Bernadita Church	2.89/15,188	45.4–75.4	85
Church of God	3.17/16,749	45.4–75.4	84
Abundant Life Church	3.47/18,305	45.4–75.4	83

Figure 4.10-1: Estimated Launch Noise Contours

While sound levels can be characterized as very loud near the launch pad, launches would occur infrequently, be short in duration, and have a minute effect on the overall sound in the area (e.g., DNL). If there is only one launch per day, DNL can be calculated by subtracting a constant representing 10 times the logarithm of the 86,400 seconds in a 24-hour day (49.4). Based on information presented in Table 4.10-2, the Sound Exposure Level of a THAAD missile at the location of closest residences shortly after launch was estimated to be 86.1 dBA (Sound Exposure Level = Lmax +10log [event duration], (U.S. Department of Defense Missile Defense Agency, 2017). A single THAAD missile launch at a distance of 12,894 feet, the DNL would be 36.7 dBA. Based upon the limited number of proposed launches the overall sound levels would never exceed 65 dBA DNL.

However, launch noise events could still be audible at sensitive receptors and be considered to be intrusive noise events. Given the sound environment at these locations, launch noise would be higher than typical ambient levels, but would be comparable to a large truck or airplane overflight. Therefore, while audible, two launches per year at the proposed location would not significantly degrade the noise environment.

4.10.1.1.2 Potential Sonic Boom

A sonic boom is the thunder-like noise a person hears when an aircraft or other type of projectile flies overhead faster than the speed of sound (supersonic). Air reacts like a fluid to supersonic objects. As objects travel through the air, the air molecules are pushed aside with great force; this forms a shock wave much like a boat creates a bow wave. The bigger and heavier the projectile, the more air it displaces. The shock wave forms a cone of pressurized air molecules which move outward and rearward in all directions and can extend to the ground.

The angle of the cone (μ) at a given Mach number M is given by the following equation:

$$\mu = \arcsin\left(\frac{1}{M}\right)$$

When the projectile is at the speed of sound, the Mach cone is 90°, perpendicular to the projectile. As the projectile passes Mach 1, the Mach cone quickly becomes more angular (Table 4.10-3). Both speed and flight angle dictate whether the Mach cone would intersect with the surface of the earth. In short, when flying upwards at an angle higher than 90°−μ, the cone would never “hit” the ground.

Table 4.10-3: Speed Versus Mach Cone Angle

Mach	Mach Cone Angle (μ)	Flight Angle[1]
1	90.0	0.0
1.1	65.4	24.6
2	30.0	60.0
3	19.5	70.5
4	14.5	75.5
5	11.5	78.5
6	9.6	80.4
7	8.2	81.8

(1) Flight angle is relative to vertical (0 degrees)

Interceptor missile trajectories are designed to meet the incoming target at elevation, meaning the initial portion of the flight (before final intercept) is vertical, or near vertical. In the case of the interceptor missiles proposed for use under the PA, the flight would include the near-vertical launch from AAFB and initial subsonic ascent, transition into supersonic flight (while still maintaining flight angle), and maneuver at supersonic speeds to intercept the incoming missile (at elevation). Because the initial phase of the flight and transition to supersonic speeds would occur while the interceptor is ascending at a steep angle, the Mach cone angle would not be directed back at the launch site, but downrange (if at all). Additionally, while the supersonic flight of the interceptor missile would generate a sonic boom, the size, design, and trajectory of interceptors limits the magnitude of the generated sonic boom.

As presented in Table 4.10-3, the faster the projectile travels, the more horizontal the projectile needs to be for the Mach cone to interact with the earth's surface. Also, the ratio of projectile length to maximum cross-sectional area also influences the intensity of the sonic boom. The longer and slenderer the projectile, the weaker the shock waves. Further, altitude determines the distance shock waves travel before reaching the ground, and this has the most significant effect on intensity. As the shock cone gets wider, and it moves outward and downward, its strength is reduced. Generally, the higher the aircraft, the greater the distance the shock wave must travel, reducing the intensity of the sonic boom.

Given the speed a missile can travel (upwards of Mach 5), the narrowness of the Mach cone, and the size and weight of the interceptor missile, it is anticipated that any sonic boom created from interceptor missiles proposed for usage under the PA would be low intensity. For comparison, estimates of sound pressures for much larger missiles (Minuteman III) than those which would be used in the PA are less than 149 dB in air (United States Air Force, 2006). The Minuteman missile is 60 feet long, 5.5 feet in diameter, and weight at launch is approximately 79,000 pounds. In contrast, a typical interceptor missile proposed for use is 6.2 meters (20 feet) long, 0.4 meters (1.3 feet) in diameter, and weighs 1,460 pounds at launch (Missile Defense Project, 2021). In the case of the PA, the magnitude of the sonic boom is not expected to be large due to the size, shape, and weight of the interceptor missile. Any sonic boom would be typically audible for only a few milliseconds, and as described above, would be of less intensity than larger rockets, which have been considered by USFWS as less than significant to marine species (United States Air Force, 2006).

The analysis conclusions for noise under Alternative 1 are consistent with a minor determination, as described in Table 4.10-1, and therefore would result in a less than significant impact on noise.

4.10.1.2 Alternative 2 (Preferred Alternative)

Under Alternative 2 (Preferred Alternative), up to two land- or sea-based flight tests or tracking exercises would be conducted per year for 10 years from NWF, AAFB, or from a U.S. Navy ship at sea in the BOA of the western Pacific Ocean. Impacts from land-based launch systems would be the same as described above for Alternative 1 (Section 4.10.1.1). Given distances from sensitive receptor to sea-based systems, there are no anticipated noise impacts under Alternative 2 (Preferred Alternative).

The analysis conclusions for noise under Alternative 2 (Preferred Alternative) are consistent with a minor determination, as described in Table 4.10-1, and therefore would result in a less than significant impact on noise.

4.10.2 No Action Alternative

Under the No Action Alternative, the PA would not occur. AAFB would continue with normal activities, and there would be no additional significant noise-generating activities. Therefore, no impact on noise would occur.

4.11 Cumulative Impacts

This chapter (1) defines cumulative impacts; (2) describes past, present, and reasonably foreseeable future actions relevant to cumulative impacts; (3) analyzes the incremental interaction the PA may have with other actions; and (4) evaluates cumulative impacts potentially resulting from these interactions.

4.11.1 Definition of Cumulative Impacts

The approach taken in the cumulative impacts follows the objectives of NEPA, CEQ regulations, and the CEQ guidance. Cumulative impacts are defined in 40 CFR 1508.1(g) as “effects on the environment that results from the incremental effects of the action when added to the other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative effects can result from actions with individually minor but collectively significant effects taking place over a period of time.”

To determine the scope of environmental impact analyses, agencies shall consider cumulative actions, which when viewed with other PAs may have cumulatively significant impacts and should therefore be discussed in the same impact analysis document.

In addition, CEQ and USEPA have published guidance addressing implementation of cumulative impact analyses—Guidance on the Consideration of Past Actions in Cumulative Effects Analysis (Council on Environmental Quality, 2005) and Consideration of Cumulative Impacts in Environmental Protection Agency Review of NEPA Documents (U.S. Environmental Protection Agency, 1999). CEQ guidance entitled Considering Cumulative Impacts Under NEPA (1997) states that cumulative impact analyses should

> "…determine the magnitude and significance of the environmental consequences of the proposed action in the context of the cumulative impacts of other past, present, and future actions...identify significant cumulative impacts…[and]…focus on truly meaningful impacts."

Cumulative impacts are most likely to arise when a relationship or synergism exists between a PA and other actions expected to occur in a similar location or during a similar time period. Actions overlapping with or in close proximity to the PA would be expected to have more potential for a relationship than those more geographically separated. Similarly, relatively concurrent actions would tend to offer a higher potential for cumulative impacts. To identify cumulative impacts, the analysis needs to address the following three fundamental questions:

- Does a relationship exist such that affected resource areas of the PA might interact with the affected resource areas of past, present, or reasonably foreseeable actions?
- If one or more of the affected resource areas of the PA and another action could be expected to interact, would the PA affect or be affected by impacts of the other action?
- If such a relationship exists, then does an assessment reveal any potentially significant impacts not identified when the PA is considered alone?

4.11.2 Scope of Cumulative Impacts

The scope of the cumulative impacts analysis involves the geographic extent of the effects of the PA. For this EA/OEA, the ROI of each resource area delimits the geographic extent of the cumulative impacts analysis. In general, the study area includes those resource areas previously identified in Chapter 3.0 (Affected Environment). The time frame for cumulative impacts is not bound by a specific future time frame, but rather centers on the timing of the PA. The cumulative impact analysis can include activities occurring in the past, present, and reasonably foreseeable future actions.

Another factor influencing the scope of cumulative impacts analysis involves identifying other actions to consider. Beyond determining that the geographic scope and time frame for the actions interrelate to the PA, the analysis employs the measure of "reasonably foreseeable" to include or exclude other actions. For the purposes of this analysis, public documents prepared by federal, state, and local government agencies form the primary sources of information regarding reasonably foreseeable actions. Documents used to identify other actions include notices of intent for EISs and EAs, management plans, land use plans, and other planning related studies.

4.11.3 Past, Present, and Reasonably Foreseeable Actions

This section focuses on past, present, and reasonably foreseeable future actions that occur within or potentially impact resources analyzed in the Action Area. Using the first fundamental question included in Section 4.11.1 (Definition of Cumulative Impacts) in determining which projects to include in the cumulative impacts analysis, a preliminary determination was made as to whether a relationship exists such that the affected resource areas of the PA might interact with the affected resource area of a past, present, or reasonably foreseeable future action. If no such potential relationship exists, the action was not carried forward into the cumulative impacts analysis. In accordance with CEQ guidance (Council on Environmental Quality, 2005), these actions considered but excluded from further cumulative effect analysis are not catalogued here because the intent is to focus the analysis on the meaningful actions relevant to inform decision making. Some future actions may be excluded from analysis due to limited available information (Force Design 2030 EIS, Defense Logistics Agency Bulk Fuel Storage EIS, Mawar EAs, etc.). Actions included in this cumulative impact analysis were determined to affect resource areas that the PA would also affect and are briefly described in Table 4.11-1.

Table 4.11-1: Cumulative Action Evaluation

#	Project	Project Description	Resource Impacted	Project Timeframe		
				Past	Present	Future
1	F-15 Beddown and Infrastructure Upgrades at Andersen Air Force Base, Guam	The F-15 Beddown and Infrastructure Upgrades at AAFB EIS analyzes the impacts of proposed training operations and infrastructure upgrades to the airfield operations area and Munitions Storage Area (MSA) at North Ramp and MSA-1 sites. Infrastructure upgrades include updating utilities (e.g., stormwater, generators, fuel storage), paved areas, and facilities. The Draft EIS is anticipated mid-2024, and the Final mid-2025. Because this EIS is in progress, impacts are analyzed generally.	TBD		X	X

#	Project	Project Description	Resource Impacted	Project Timeframe		
				Past	Present	Future
2	Beddown of Space Control Squadrons (SPCS) #4 and #5 at two Air National Guard locations	The Beddown EA analyzes locations for the placement of facilities associated with the beddown of two SPCS missions. The Final Finding of No Significant Impact was released April 2022. The Preferred Alternative for SPCS #5 is to utilize a 10-acre site at AAFB. All environmental consequences were determined to be negligible by the EA and would not contribute to cumulative impacts when combined with the Proposed Action.	Noise, Air Quality, and Terrestrial Biological Resources	X	X	X

#	Project	Project Description	Resource Impacted	Project Timeframe		
				Past	Present	Future
3	Mariana Islands Training and Testing	The 2015 MITT Final EIS/OEIS to assesses the potential impacts associated with ongoing at-sea and Farallon de Medinilla training and testing activities conducted within the Study Area for decades. In June 2020, a Supplemental EIS/OEIS was released. On August 7, 2020, the Navy released the Record of Decision to implement the Preferred Alternative (Alternative 2) (U.S. Department of the Navy, 2020). Continuing cumulative impacts could occur for marine biological resources and air quality.	Marine Biological Resources, Air Quality	X	X	X

#	Project	Project Description	Resource Impacted	Project Timeframe		
				Past	Present	Future
4	J-008-01 Firefighter Training Facilities	The project includes constructing fire fighter training facilities including a training tower, mockups, fuel tanks, observation/control tower, and training course (Emergency Vehicle Operator Course). A Finding of No Significant Impacts was signed in October 2023. The project may contribute to continuing cumulative impacts on air quality and noise.	Air quality, Noise		X	X

#	Project	Project Description	Resource Impacted	Project Timeframe		
				Past	Present	Future
5	Enhanced Integrated Air and Missile Defense (EIAMD) System on Guam EIS	The project includes construction, deployment, and operation of a combination of components from the MDA, U.S. Army, and U.S. Navy that have been integrated for air and missile defense. These components would be positioned on sites on DoD lands and private lands across Guam. The project may contribute to continuing cumulative impacts on airspace, air quality, climate change and greenhouse gases, terrestrial biological resources, cultural resources and historic properties, environmental justice, public health and safety, and noise. The EIS is in process of being developed, and impacts won't be finalized until the EIS is finalized. As such, impacts associated with this project are not analyzed further. Cumulative analysis for this project will be completed in the EIS.	TBD			X

4.11.4 Cumulative Impact Analysis

4.11.4.1 Airspace Management

4.11.4.1.1 Alternative 1

Future actions from the EIAMD System project could contribute to cumulative impacts on airspace management from operations and maintenance. The EIAMD system uses several high-energy, non-ionizing radiation radars in its normal operation. Due to the potential hazard to personnel and aircraft operations from electromagnetic energy emitted by radars, the Air Force and the MDA are requesting the FAA establish restricted areas around and above EIAMD radar locations. As a result of the proposed restricted areas, air traffic controllers would have less airspace available for handling and routing aircraft that enters Guam's airspace. This would result in fewer options available and could make sequencing of aircraft a greater challenge for air traffic controllers during heavy use periods.

Cumulative impacts on airspace management would only potentially occur in the event EIAMD operations and maintenance, and land-based flight tests or tracking exercises, occur simultaneously. Flight tests or tracking exercises would occur infrequently (one to two times per year), and all airspace restrictions and closures would only be for the duration of flight test or tracking exercise activities. Land-based flight tests or tracking exercises would not be scheduled to occur during EIAMD operations and maintenance. There are no reasonably foreseeable significant cumulative impacts when added to the effects of other past, present, and reasonably foreseeable future actions considered in this cumulative analysis.

4.11.4.1.2 Alternative 2 (Preferred Alternative)

Future cumulative impacts from the EIAMD System project and implementation of Alternative 2 (Preferred Alternative) would be the same as described in Section 4.11.4.1.1 (Alternative 1) for land- and flight tests or tracking exercises.

Sea-based flight tests or tracking exercises would occur far from land and populated areas and occur infrequently (one to two times per year). Cumulative impacts on airspace would only potentially occur in the event EIAMD operations and maintenance, and sea-based flight tests or tracking exercises, occur simultaneously. Airspace restrictions and closures under Alternative 2 would only be for the duration of flight tests or tracking exercise activities, and sea-based flight tests or tracking exercises would not be scheduled to occur during EIAMD operations and maintenance. As such, there are no reasonably foreseeable significant cumulative impacts when added to the effects of other past, present, and reasonably foreseeable future actions considered in this cumulative analysis.

4.11.4.1.3 No Action Alternative

Under the No Action Alternative, the PA would not occur, and there would be no cumulative impacts on airspace management from mission-related airspace restrictions.

4.11.4.2 Air Quality

4.11.4.2.1 Alternative 1

Past, present, and future actions from MITT would result in an overall increase in annual at-sea air emissions. The 2020 MITT Supplemental EIS/OEIS concluded that the increase in emissions would not impact NAAQS attainment status and would be below the *de minimis* thresholds. Emissions under Alternative 1 would temporarily and infrequently cause low increases in concentrations of criteria pollutants and HAPs immediately downwind of the emissions release, where public presence is not expected. As such, the implementation of Alternative 1 would have no measurable cumulative impact on air quality when combined with MITT activities.

The Firefighter Training Facilities project would generate emissions during present and future facility construction and operation at Marine Corps Base Camp Blaz. Construction activities would mitigate emissions from fugitive dust and burning of fossil fuels by complying with Guam Air Pollution Control Standards. Emissions under Alternative 1 would temporarily and infrequently cause low increases in concentrations of criteria pollutants and HAPs immediately downwind of the emissions release where public presence is not expected. As such, the implementation of Alternative 1 would have no measurable cumulative impact on air quality when combined with present or future facility construction and operational activities of the Firefighter Training Facilities project at Marine Corps Base Camp Blaz.

The SPCS Beddown project was determined to have minor impacts on air quality. Impacts from the project would be short term and primarily from construction, which would likely be completed prior to the construction that would occur from Alternative 1. As such, implementation of Alternative 1 would have no measurable cumulative impact on air quality.

Future impacts on air quality from the EIAMD System and associated operations and the F-15 Beddown and Infrastructure Upgrades have not yet been evaluated.

There are no reasonably foreseeable significant cumulative impacts when added to the effects of other past, present, and reasonably foreseeable future actions considered in this cumulative analysis.

4.11.4.2.2 Alternative 2 (Preferred Alternative)

Under Alternative 2 (Preferred Alternative), emissions would be slightly higher than Alternative 1. However, emissions would not be expected to significantly increase concentrations of HAPs or impact the attainment of NAAQS. Therefore, for the same reasons as stated in Section

4.11.4.2.1 (Alternative 1), the implementation of Alternative 2 (Preferred Alternative) would have no measurable cumulative impacts on air quality when combined with either past, present, and future actions from the MITT project, SPCS Beddown, or present and future facility construction and operational activities of the Firefighter Training Facilities project at Marine Corps Base Camp Blaz. There are no reasonably foreseeable significant cumulative impacts when added to the effects of other past, present, and reasonably foreseeable future actions considered in this cumulative analysis.

4.11.4.2.3 No Action Alternative

Under the No Action Alternative, the PA would not occur, and there would be no cumulative impacts on air quality from mission related emissions.

4.11.4.3 Climate Change and Greenhouse Gases

4.11.4.3.1 Alternative 1

Present and future actions from the Firefighter Training Facilities project were evaluated to have a negligible impact on GHG emissions and climate change. Clearing of degraded limestone forest associated with the project would result in a loss of 2.5 tons of CO_2 per year in carbon sequestration. The Navy would mitigate the impacts from the loss by revegetating with native vegetation or a seed mix and contouring the fence lines as needed to comply with the Department of the Navy's Climate Action 2030 (U.S. Department of the Navy, 2022a).

Future impacts on climate change and greenhouse gases from the EIAMD System and associated operations and the F-15 Beddown and Infrastructure Upgrades have not yet been evaluated.

Under Alternative 1, GHG emissions would be small and make up a tiny percentage of Guam's total GHG emissions. As such, there are no reasonably foreseeable significant cumulative impacts when added to the effects of other past, present, and reasonably foreseeable future actions considered in this cumulative analysis.

4.11.4.3.2 Alternative 2 (Preferred Alternative)

Under Alternative 2 (Preferred Alternative), GHG emissions would be slightly higher than Alternative 1. However, GHG emissions would still be small and make up a tiny percentage of Guam's total GHG emissions. Therefore, for the same reasons as stated in Section 4.11.4.3.1 (Alternative 1), the implementation of Alternative 2 (Preferred Alternative) would have no measurable cumulative impacts on GHG emissions and climate change when combined with present and future actions from the Firefighter Training Facilities project at Marine Corps Base Camp Blaz. As such, there are no reasonably foreseeable significant cumulative impacts when added to the effects of other past, present, and reasonably foreseeable future actions considered in this cumulative analysis.

4.11.4.3.3 No Action Alternative

Under the No Action Alternative, the PA would not occur, and there would be no cumulative impacts on GHG emissions and climate change from mission-related GHG emissions or activities impacting climate change.

4.11.4.4 Terrestrial Biological Resources

4.11.4.4.1 Alternative 1

Future impacts on terrestrial biological resources from the EIAMD System and associated operations and the F-15 Beddown and Infrastructure Upgrades have not yet been evaluated.

The SPCS Beddown activities occur in previously disturbed areas and would not disturb wildlife habitat. Noise impacts would not exceed ambient levels and would have negligible impacts on wildlife.

As such, there are no measurable cumulative impacts on terrestrial biological resources when added with the other projects described in Table 4.11-1, which would have a significant impact on terrestrial biological resources. Therefore, there are no reasonably foreseeable significant cumulative impacts when added to the effects of other past, present, and reasonably foreseeable future actions considered in this cumulative analysis.

4.11.4.4.2 Alternative 2 (Preferred Alternative)

For the same reasons discussed in Section 4.11.4.4.1, there are no measurable cumulative impacts on terrestrial biological resources when added with the other projects described in Table 4.11-1, which would have a significant impact on terrestrial biological resources.

Therefore, there are no reasonably foreseeable significant cumulative impacts when added to the effects of other past, present, and reasonably foreseeable future actions considered in this cumulative analysis.

4.11.4.5 Marine Biological Resources

4.11.4.5.1 Alternative 1

Past, present, and future actions from MITT may contribute to cumulative impacts on marine species from noise, electromagnetic energy, entanglement, and ingestion. The 2015 MITT Final EIS/OEIS analyzed impacts from a broad spectrum of training activities (e.g., anti-air warfare, strike warfare, amphibious warfare) at varying frequencies (U.S. Department of the Navy, 2015b). The likelihood of such impacts was determined to be remote due to the size and location of the MITT study area (U.S. Department of the Navy, 2015b). Further, the scope of military training activities associated with the PA is minute relative to those analyzed in the 2015 MITT Final EIS/OEIS.

Noise, electromagnetic energy, entanglement, and ingestion impacts on marine species from the PA would be negligible. As such, the implementation of Alternative 1 would have no measurable cumulative impacts on marine biological resources when combined with past, present, and future actions from MITT.

Therefore, there are no reasonably foreseeable significant cumulative impacts when added to the effects of other past, present, and reasonably foreseeable future actions considered in this cumulative analysis.

4.11.4.5.2 Alternative 2 (Preferred Alternative)

For the same reasons discussed in Section 4.11.4.5.1 (Alternative 1), implementation of Alternative 2 (Preferred Alternative) would have no measurable cumulative impacts on marine biological resources when combined with past, present, and future actions from MITT.

Therefore, there are no reasonably foreseeable significant cumulative impacts when added to the effects of other past, present, and reasonably foreseeable future actions considered in this cumulative analysis.

4.11.4.5.3 No Action Alternative

Under the No Action Alternative, the PA would not occur, and there would be no cumulative impacts on marine biological resources from mission-related activities.

4.11.4.6 Cultural Resources and Historic Properties

Future impacts on cultural resources and historic properties from the EIAMD System and associated operations and the F-15 Beddown and Infrastructure Upgrades have not yet been evaluated. In this case, there would be no measurable cumulative impacts on cultural resources and historic properties when activities from all alternatives are combined with projects described in Table 4.11-1. Therefore, there are no reasonably foreseeable significant cumulative impacts when added to the effects of other past, present, and reasonably foreseeable future actions considered in this cumulative analysis.

4.11.4.7 Environmental Justice

Future impacts on environmental justice from the EIAMD System and associated operations and the F-15 Beddown and Infrastructure Upgrades have not yet been evaluated.

In this case, there would be no measurable cumulative impacts on environmental justice when activities from all alternatives are combined with the projects described in Table 4.11-1 which would have a significant impact on environmental justice. Therefore, there are no reasonably foreseeable significant cumulative impacts when added to the effects of other past, present, and reasonably foreseeable future actions considered in this cumulative analysis.

4.11.4.8 Public Health and Safety

Future impacts on noise from the EIAMD System and associated operations and the F-15 Beddown and Infrastructure Upgrades have not yet been evaluated. In this case, there would be no cumulative impacts on public health and safety when activities from all alternatives are combined with the projects described in Table 4.11-1. Therefore, there are no reasonably foreseeable significant cumulative impacts when added to the effects of other past, present, and reasonably foreseeable future actions considered in this cumulative analysis.

4.11.4.9 Noise

4.11.4.9.1 Alternative 1

Present and future facility construction and operations from the Firefighter Training Facilities project would generate noise along Route 3, which could impact residents. However, these noise impacts were evaluated to be in line with existing peak hour traffic noise along Route 3 and below the Guam Loudest Hourly Noise Standards for the exterior of schools. Due to the relative proximity of Marine Corps Base Camp Blaz (Firefighter Training Facilities project ROI) to NWF, potential cumulative noise impacts may occur in the event activities from the Firefighter Training Facilities project and the PA occur simultaneously. Since the PA would occur infrequently (one to two times per year), there is a very low probability of concurrent activities. As such, the implementation of Alternative 1 would have no measurable cumulative impacts on noise when combined with present and future actions from the Firefighter Training Facilities project at Marine Corps Base Camp Blaz.

Future impacts on noise from the EIAMD System and associated operations and the F-15 Beddown and Infrastructure Upgrades have not yet been evaluated. There are no reasonably foreseeable significant cumulative impacts when added to the effects of other past, present, and reasonably foreseeable future actions considered in this cumulative analysis.

4.11.4.9.2 Alternative 2 (Preferred Alternative)

Under Alternative 2 (Preferred Alternative), noise impacts from land-based flight tests or tracking exercises would be the same as Alternative 1. However, noise impacts from sea-based flight tests or tracking exercises under Alternative 2 (Preferred Alternative) are not anticipated given the distances between sensitive receptors and the sea-based systems at time of launch. Therefore, for the same reasons as stated in Section 4.11.4.9.1 (Alternative 1), the implementation of Alternative 2 (Preferred Alternative) would have no measurable cumulative impacts on noise when combined with present and future actions from the Firefighter Training Facilities project at Marine Corps Base Camp Blaz.

Future impacts on noise from the EIAMD System and associated operations and the F-15 Beddown and Infrastructure Upgrades have not yet been evaluated.

There are no reasonably foreseeable significant cumulative impacts when added to the effects of other past, present, and reasonably foreseeable future actions considered in this cumulative analysis.

4.11.4.9.3 No Action Alternative

Under the No Action Alternative, the PA would not occur, and there would be no cumulative impacts on noise from mission-related activities.

4.12 Summary of Mitigations and Proposed Best Practices

NEPA requires federal agencies to consider appropriate mitigation measures to avoid, minimize, or compensate for specific impacts. This chapter describes actions MDA and the services are taking to avoid and minimize impacts from the PA and identifies potential mitigation measures for consideration to further minimize or offset remaining adverse environmental impacts from the PA analyzed in this EA/OEA.

4.12.1 Avoidance and Minimization Incorporated into the Proposed Action

4.12.1.1 Best Management Practices and Conservation Measures

MDA and the services would implement BMPs and conservation measures to avoid and minimize adverse impacts from the PA. BMPs and conservation measures included in the PA are discussed in applicable resource sections of this chapter.

4.12.1.2 Other Avoidance, Minimization, and Mitigation Measures

The following measures to avoid, minimize, or mitigate environmental impacts associated with the PA are included in this EA/OEA:

- After the conclusion of FEM-02, a helicopter would be used to retrieve the interceptor’s first booster stage.
- Undeveloped areas would not be used for placement, storage, or launch of flight test or tracking exercise components.

No other measures to avoid, minimize, or mitigate environmental impacts associated with the PA are included in this EA/OEA.

5.0 References

Aaron, J., D. Hart, and S.C. Baker. (2007). *Northwest Field* (Historic American Engineering Record). Washington, D.C: National Park Service, U.S. Department of the Interior.

Babisch, W. (2005). Guest Editorial, Noise and Health. *Environmental Health Perspectives 113* (1): 14.

Council on Environmental Quality. (2005). *Guidance on the Consideration of Past Actions in Cumulative Effects Analysis*. Washington, DC: Executive Office of the President, Council on Environmental Quality.

Council on Environmental Quality. (2023). *National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions and Climate Change*. Washington, DC: Council on Environmental Quality.

Craft, C., A. Sims, K. S. Stiles, K. Ablog, M. Kringler, R. Roldon, H. Shear, and E. Strother. (2023). *Revised Draft Cultural Resources Assessment in Support of the Enhanced Integrated Air and Missile Defense (EIAMD) System on Guam Environmental Impact Statement (EIS)*. Honolulu, Hawaii: Kleinfelder, Inc.

Davis, R. D. (1983). *Andersen Air Force Base Central Compound Reconnaissance Survey*. Hagåtña, Guåhan: Territorial Archaeology Laboratory.

Dixon, B., R. Schaefer, and T. McCurdy. (2012). *Level 1 Archaeological Reconnaissance of 800 Acres within Selected Properties on Andersen Air Force Base, Guam. Volume 1: Narrative and Volume 2: Site Descriptions*. Hagåtña, Guåhan: TEC Inc.

Dooling, R. J. and A. N. Popper. (2007). *The Effects of Highway Noise on Birds*. Sacramento, CA: The California Department of Transportation Division of Environmental Analysis.

EA Engineering Science and Technology Inc. PBC. (2020). *Biological Assessment for the Utilities and Infrastructure Area Development Plan Supporting the Terminal High-Altitude Air Defense (THAAD) System at Andersen Air Force Base, Guam*. Honolulu, HI: U.S. Fish & Wildlife Service, Pacific Islands Fish and Wildlife Office.

Federal Highway Administration. (2006). *Roadway Construction Noise Model User's Guide, Federal Highway Administration*. Washington, DC: U.S. Department of Transportation.

Federal Interagency Committee on Urban Noise. (1980a). *Guidelines for Considering Noise in Land Use Planning and Control*. Washington, D.C.: U.S. Environmental Protection Agency, U.S. Department of Transportation, U.S. Department of Housing and Urban Development, U.S. Department of Defense, and Veterans Administration.

Federal Interagency Committee on Urban Noise. (1980b). *Guidelines for Considering Noise in Land Use Planning and Control*. Washington, DC: U.S. Environmental Protection Agency, U.S. Department of Transportation, U.S. Department of Housing and Urban Development, U.S. Department of Defense, and Veterans Administration.

Felix, A., M. E. Stevens, and R. L. Wallace. (1995). Unpalatability of a colonial rotifer, *Sinantherina socialis,* to small zooplanktivorous fishes. *Invertebrate Biology 114* (2): 139–144.

G. Koay, R.S. Heffner, and H. E. Heffner. (1998). Hearing in a Megachiropteran Fruit Bat (Rousettus aegyptiacus). *Journal of Comparative Psychology 112* (No. 4): 371-382.

Goelzer, B., C. H. Hansen, and G. Sehmdt. (2001). Occupational exposure to noise: Evaluation, prevention and control. Retrieved from http://www.who.int/occupational_health/publications/occupnoise/en/.

Grinnell, A. D. (1995). *Hearing in Bats: An Overview*. New York, NY: Springer-Verlag.

Hawaii Department of Health. (2022). *State of Hawaii Annual Summary 2021 Air Quality Data*. Pearl City, HI: State of Hawaii Department of Health.

Hunter-Anderson, R. L. and D. R. Moore. (2000). *Final Report – Phase I Archaeological Survey and Specialized Studies in Undeveloped Portions of Nimitz Hill, Territory of Guam, Mariana Islands*. Mangilao, Guåhan: Micronesian Archaeological Research Services.

M. B. Calford, L. Z. Wise, and J. D. Pettigrew. (1985). Audiogram of the Grey-Headed Flying-Fox, *Pteropus Poliocephalus* (Megachiroptera: Pteropodidae). *Australian Mammalogy 8* (4): 309–312. DOI:https://doi.org/10.1071/AM85030

Mason Architects Inc. (2004). *Historic Building and Associated Landscape/Viewsheds Inventory and Evaluation For Andersen Air Force Base, Guam 2004 Update*. Honolulu, Hawai‘i.

McKinnon, J., Mushynsky J., and G. Cabrera. (2014). A Fluid Sea in the Mariana Islands: Community Archaeology and Mapping the Seascape of Saipan. *Journal of Maritime Archaeology*.

Missile Defense Agency. (2024). *Ambient Sound Measurements On or Adjacent to Andersen Air Force Base and Naval Base Guam, Guam*. Fort Belvoir, VA: U.S. Department of Defense, Missile Defense Agency.

Missile Defense Project. (2021). *Terminal High Altitude Area Defense (THAAD)*. Retrieved December 13, 2023, from https://missilethreat.csis.org/system/thaad/.

National Academy of Sciences. (2020). *Climate Change: Evidence & Causes*. Washington, DC: The National Academies Press.

National Marine Fisheries Service. (2018). *Biological Opinion on U.S. Navy Hawaii-Southern California Training and Testing and the National Marine Fisheries Service's Promulgation of Regulations Pursuant to the Marine Mammal Protection Act for the Navy to "Take" Marine Mammals Incidental to Hawaii-Southern California Training and Testing*. Silver Spring, MD: National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources.

National Marine Fisheries Service. (2020a). *Biological Opinion on (1) United States (U.S.) Navy Mariana Islands Training and Test Activities; and (2) the National Marine Fisheries Service's promulgation of regulations and issuance of a letter of authorization pursuant to the Marine Mammal Protection Act for the U.S. Navy to "take" marine mammals incidental to Mariana Islands Training and Testing activities from August 2020 through August 2027*.

National Marine Fisheries Service. (2020b). *Biological Opinion on (1) United States (U.S.) Navy Mariana Islands Training and Testing Activities; and (2) the National Marine Fisheries Service's promulgation of regulations and issuance of a letter of authorization pursuant to the Marine Mammal Protection Act for the U.S. Navy to “take” marine mammals incidental to Mariana Islands Training and Testing activities from August 2020 through August 2027*. National Marine Fisheries Service.

National Oceanic and Atmospheric Administration. (2015). *Automated Wreck and Obstruction Avoidance database*. Retrieved August 2015, from https://nauticalcharts.noaa.gov/data/wrecks-and-obstructions.html.

National Oceanic and Atmospheric Administration. (2021). *Preliminary List of Deep-Sea Coral Taxa in the U.S. Mariana Archipelago*. Manoa, HI; Silver Spring, MD; Washington, DC: National Oceanic and Atmospheric Administration.

National Safety Council. (2021). *All Injuries*. Retrieved September 6, 2023, from https://injuryfacts.nsc.org/all-injuries/overview/.

Naval Facilities Engineering Command Marianas. (2020). *Monitoring Mariana Fruit Bats on Andersen Air Force Base 2020*. Asan, GU: Naval Facilities Engineering Command Marianas.

Naval Facilities Engineering Command Marianas. (2022). *Monitoring Mariana Fruit Bats on Andersen Air Force Base 2021*. Asan, GU: Naval Facilities Engineering Command Marianas.

Naval Facilities Engineering Command Marianas. (2023). *Monitoring Mariana Fruit Bats on Andersen Air Force Base 2022*. Asan, GU: Naval Facilities Engineering Command Marianas.

R.S. Heffner, G. K., H.E. Heffner. (2006). Hearing in Large (*Eidolon helvum*) and small (*Cynopterus brachyotis*) non-echolocating fruit bats. *Hearing Research 221* 17–25. DOI:doi:10.1016/j.heares.2006.06.008

Ritchie, H., P. Rosado, and M. Roser. (2020). *Greenhouse Gas Emissions*. Retrieved January 31, 2024, from https://ourworldindata.org/greenhouse-gas-emissions.

Rogers, A. D. (1994). The biology of seamounts. *Advances in Marine Biology 30* 305–350.

The President. (1994). Executive Order 12898-Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. *Federal Register 59* 7629–7633.

The President. (1997). Executive Order 13045-Protection of Children from Environmental Health Risks and Safety Risks. *Federal Register 62* (78): 19885–19888.

The President. (2023). Executive Order 14096-Revitalizing Our Nation's Commitment to Environmental Justice for All. *Federal Register 88* (80): 25251–25261.

U.S. Census Bureau. (2020a). *Decennial Census of Island Areas*. Retrieved August 24, 2023, from https://data.census.gov/table?g=040XX00US66&d=DECIA+Guam+Demographic+Profile&tid=DECENNIALDPGU2020.DP1.

U.S. Census Bureau. (2020b). *General Demographic Characteristics*. Retrieved from https://data.census.gov/table?g=040XX00US66_050XX00US66180_060XX00US6601083300_160XX00US6682650&d=DECIA+Guam+Demographic+Profile.

U.S. Census Bureau. (2020c). *Selected Economic Characteristics: Yigo*. Retrieved from https://data.census.gov/table?g=040XX00US66_060XX00US6601083300&d=DECIA+Guam+Demographic+Profile.

U.S. Department of Defense Missile Defense Agency. (2007). *Flexible Target Family Environmental Assessment*. Washington, DC: U.S. Department of Defense.

U.S. Department of Defense Missile Defense Agency. (2017). *Pacific Spaceport Complex Alaska Ballistic Missile Defense Flight Test Support Environmental Assessment*. Fort Belvoir, VA: Missile Defense Agency.

U.S. Department of the Navy. (2015a). *Final Mariana Islands Training and Testing Environmental Impact Statement/Overseas Environmental Impact Statement*. Pearl Harbor, HI: Naval Facilities Engineering Command, Pacific.

U.S. Department of the Navy. (2015b). *Final Supplemental Environmental Impact Statement Guam and Commonwealth of the Northern Mariana Islands Military Relocation (2012 Roadmap Adjustments)*. Washington, DC: Naval Facilities Engineering Command, Pacific.

U.S. Department of the Navy. (2015c). *The Mariana Islands Training and Testing Final Environmental Impact Statement/Overseas Environmental Impact Statement*. Pearl Harbor, HI: U.S. Department of the Navy.

U.S. Department of the Navy. (2018a). *Hawaii-Southern California Training and Testing Final Environmental Impact Statement/Overseas Environmental Impact Statement*. Pearl Harbor, HI: Naval Facilities Engineering Command, Pacific.

U.S. Department of the Navy. (2018b). *U.S. Navy Marine Species Density Database Phase III for the Mariana Islands Training and Testing Study Area* (Naval Facilities Engineering Command Pacific Technical Report). Pearl Harbor, HI: Naval Facilities Engineering Command Pacific.

U.S. Department of the Navy. (2019a). *Integrated Natural Resources Management Plan for Joint Region Marianas*. Tumon, Guam: Naval Facilities Engineering Command, Marianas.

U.S. Department of the Navy. (2019b). *Mariana Islands Training and Testing Biological Assessment to Support Endangered Species Act Section 7 Consultation with the National Marine Fisheries Service*. Pearl Harbor, HI: U.S. Department of the Navy.

U.S. Department of the Navy. (2020). *The Mariana Islands Training and Testing Final Supplemental Environmental Impact Statement/Overseas Environmental Impact Statement*. Pearl Harbor, HI: U.S. Department of the Navy.

U.S. Department of the Navy. (2022a). *Department of the Navy Climate Action 2030*. Washington, DC: U.S. Department of the Navy.

U.S. Department of the Navy. (2022b). *Integrated Natural Resources Management Plan for Joint Region Marianas*. Honolulu, HI: Joint Region Marianas and NAVFAC Marianas.

U.S. Environmental Protection Agency. (1974). *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with and Adequate Margin of Safety*. Washington, DC: Office of Noise Abatement and Control.

U.S. Environmental Protection Agency. (1992). *Procedures for Emission Inventory Preparation*. Washington, DC: U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency. (1999). *Consideration of Cumulative Impacts in EPA Review of NEPA Documents*. Washington, DC: Office of Federal Activities.

U.S. Environmental Protection Agency. (2009). *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2007*. Washington, DC: U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency. (2023a). *2022 Greenhouse Gas Emissions from Large Facilities*. Retrieved from https://ghgdata.epa.gov/ghgp/main.do#/facility/?q=Find%20a%20Facility%20or%20Location&st=&bs=&et=&fid=&sf=11001100&lowE=-20000&highE=23000000&g1=%E2%80%A6%201/2.

U.S. Environmental Protection Agency. (2023b). *Environmental Justice*. Retrieved December 20, 2023, from https://www.epa.gov/environmentaljustice.

U.S. Environmental Protection Agency. (2023c). *Greenhouse Gas Emissions: Understanding Global Warming Potentials*. Retrieved September 1, 2023, from https://www.epa.gov/ghgemissions/understanding-global-warming-potentials#:~:text=The%20Global%20Warming%20Potential%20(GWP,carbon%20dioxide%20(CO2.

U.S. Environmental Protection Agency. (2023d). *Guam Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants*. Retrieved from https://www3.epa.gov/airquality/greenbook/anayo_gu.html.

U.S. Environmental Protection Agency. (2023e). *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2021*. Washington, DC: U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency. (2024). *National Ambient Air Quality Standards Table*. Retrieved April 2, 2024, from https://www.epa.gov/criteria-air-pollutants/naaqs-table.

U.S. Fish & Wildlife Service. (2022). *Draft Recovery Plan for 23 Species in the Mariana Islands*. Portland, OR: U.S. Fish and Wildlife Service.

U.S. Fish and Wildlife Service and National Marine Fisheries Service. (1998). *Endangered Species Act Consultation Handbook*.

United States Air Force. (2006). *Final Environmental Assessment Minuteman III ICBM Extended Range Flight Testing*. Washington, DC: United States Air Force.

United States Air Force. (2020). *Air-Launches Rapid Response Weapon (AARW) Environmental Assesment/Overseas Environmental Assessment*.

Van Kempen, E. E. M. M., H. Kruize, H. C. Boshuizen, C. B. Ameling, B. A. M. Staatsen, and A. E. M. de Hollander. (2002). The association between noise exposure and blood pressure and ischemic heart disease: A meta-analysis. *Environmental Health Perspectives 110* (3): 307–317.

Wiewel, A. S., A. A. Y. Adams, and G. H. Rodda. (2009). Distribution, Density, and Biomass of Introduced Small Mammals in the Southern Mariana Islands. *Pacific Science 63* (2): 205–222.

Yee, S. L., D.J. Welch, and J. Allen. (2004). *Final – Archaeological Overview Survey Report for Andersen Air Force Base, Guam*. Honolulu, Hawaiʻi: International Archaeological Research Institute, Inc.

Yesson, C., M. Clark, M. Taylor, and A. Rogers. (2011). The global distribution of seamounts based on 30 arc seconds bathymetry data. *Deep Sea Research Part 1, Oceanographic Research Papers 58* (4): 442-463. DOI:https://doi.org/10.1016/j.dsr.2011.02.004

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Appendix A Environmental Resources Eliminated from Further Detailed Analysis

Impacts on the following environmental resource areas would be negligible or nonexistent; therefore, they were not analyzed in detail.

A.1 Geology and Soils

The Proposed Action would not involve work that would affect major geological characteristics such as topography, bedrock material, or mineral deposits. The Proposed Action would not include ground disturbance, all activities would occur on previously disturbed land, and there are no significant aquifer recharge features in the vicinity of the project area. Therefore, potential impacts on geology and soils as a result of the Proposed Action are not anticipated.

A.2 Hazardous Materials and Waste Management

All hazardous materials and wastes would be handled and disposed of in accordance with applicable federal, Air Force, and Guam regulations. The Proposed Action would not include the use of existing base utilities for sanitary sewer or power. Sanitary sewer system would be provided using portable facilities, and electrical power would be provided using diesel-fueled generators that are periodically refueled using tank trucks, portable fuel pods, or bladders. All sewer and power systems would be maintained in compliance with all local and federal regulations. All solid propellant in interceptors and targets would be completely burned up prior to boosters and debris falling to the ground or ocean surface. MDA would ensure that a Spill Prevention, Control, and Countermeasure Plan (e.g., training, spill containment and control procedures, clean up, notifications/reporting) is prepared and implemented for all proposed activities. In addition, MDA would ensure personnel are trained in accordance with spill prevention, control, and cleanup methods. Qualified facility personnel would regularly inspect all areas of the proposed project area where industrial materials or activities are exposed to stormwater for ongoing good housekeeping, spill control equipment, and outdoor storage. Therefore, potential impacts from hazardous materials and wase management as a result of the Proposed Action are not anticipated.

A.3 Infrastructure (Utilities)

The Proposed Action would not require any infrastructure improvements inside or outside of Andersen Air Force Base (AAFB). The Proposed Action would have a negligible effect on the overall demand for utility service at AAFB. Therefore, potential impacts on infrastructure as a result of the Proposed Action are not anticipated.

A.4 Land Use

The Proposed Action may result in temporary public and private land access restrictions in the vicinity of AAFB. These temporary restrictions would be rare (one to two times per year) and would be in place for up to four days. Notice of restrictions would be provided well in advance of any necessary land closures, and the Department of Defense would coordinate with affected private landowners to relocate during this time period at no cost to the landowners. The land would not be used for any purpose during the Proposed Action and would only be restricted for safety purposes. Therefore, long-term and permanent impacts on land use as a result of the Proposed Action are not anticipated.

A.5 Socioeconomics

The Proposed Action would not contribute to changes in socioeconomic conditions on Guam. In the weeks prior to, during, and after flight tests or tracking exercises, there would be up to 350 personnel required on-site to support activities associated with the Proposed Action, however not all 350 personnel would be on-site at the same time. According to the visitor arrival statistics provided by the Guam Visitors Bureau, 82,670 people visited Guam in January 2024 (Guam Visitors Bureau, 2024b), and 70,390 people visited Guam in February 2024 (Guam Visitors Bureau, 2024a). The temporary influx of personnel associated with the Proposed Action would be insignificant in comparison to Guam's monthly visitors and would have negligible short-term socioeconomic impacts. Despite this temporary influx, there would be no change in the number of personnel assigned to AAFB and, therefore, there would be no changes in area population or associated demands for housing and support services. Therefore, impacts on socioeconomics as a result of the Proposed Action are not anticipated.

A.6 Transportation

The Proposed Action would not include construction activities inside or outside of AAFB impacting transportation resources. Temporary road closures within the vicinity of AAFB would be rare (one to two times per year) and short in duration (typically less than 8 hours). Therefore, long-term and permanent impacts on transportation resources are not anticipated.

A.7 Water Resources

The Proposed Action would be conducted in accordance with the provisions of the Clean Water Act and all other local and federal policies governing water pollution. There are no surface waters on or near the project area. The potential for contamination of storm water runoff or groundwater from construction and operations is minimized through the implementation of appropriate best management practices. There are no foreseeable impacts on Guam's drinking, recreational, and ecologically sensitive waters. Therefore, potential impacts on water resources as a result of the Proposed Action are not anticipated.

A.8 Wetlands

AAFB is located in an upland area. No wetlands are present within the vicinity of the launch site or flight path. Therefore, potential impacts on wetlands as a result of the Proposed Action are not anticipated.

A.9 Visual Resources/Aesthetics

The Proposed Action would occur on AAFB, and in the broad ocean area of the western Pacific Ocean. The proposed activities would occur one to two times per year and would only potentially affect visual resources during the actual launch. The launcher being utilized is approximately 40 feet tall and would not be visible from outside the AAFB installation boundary. The interceptor would be visible for less than 5 minutes per launch and would have no direct or indirect impact on the aesthetic quality of Guam’s visual resources. Therefore, potential impacts on visual resources are not anticipated as a result of the Proposed Action.

REFERENCES

Guam Visitors Bureau. (2024a). *February 2024 Preliminary Arrival Summary*. Retrieved from https://www.guamvisitorsbureau.com/research/statistics/visitor-arrival-statistics.

Guam Visitors Bureau. (2024b). *January 2024 Preliminary Arrival Summary*. Retrieved from https://www.guamvisitorsbureau.com/research/statistics/visitor-arrival-statistics.

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Appendix B Correspondence

To assist in preparation of the Environmental Assessment/Overseas Environmental Assessment, letters requesting comments on possible issues of concern related to the Proposed Action were sent to federal and Guam agencies with pertinent responsibilities. The Missile Defense Agency is consulting with the following federal agencies on potential impacts associated with the Proposed Action: United States Fish and Wildlife Service, National Marine Fisheries Service, Guam State Historic Preservation Office, and Government of Guam Bureau of Statistics and Plans.

B.1 List of Agencies and Organizations Contacted

- United States Fish and Wildlife Service
- National Marine Fisheries Service
- Guam State Historic Preservation Office
- Government of Guam Bureau of Statistics and Plans

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Appendix C Acronyms and Abbreviations

AAFB	Andersen Air Force Base
AAQS	Ambient Air Quality Standards
AWS	Aegis Weapon System
BMD	Ballistic Missile Defense
BOA	Broad Ocean Area
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CERAP	Center Radar Approach Control
CFR	Code of Federal Regulations
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
CWA	Clean Water Act
dB	Decibel
dBA	A-weighted Decibels
DNL	Day-Night Average Sound Level
DoD	Department of Defense
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EIAMD	Enhanced Integrated Air and Missile Defense
EIS	Environmental Impact Statement
ELTS	Early Launch Tracking System
EME	Electromagnetic Energy
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FEM	Flight Experiment Mission
FONSI	Finding of No Significant Impact
FR	Federal Register
GHG	Greenhouse Gas
GWP	Global Warming Potential
HAP	Hazardous Air Pollutant
HIRF	High-Intensity Radiated Field
H.R.	House of Representatives
IFPC	Indirect Fire Protection Capability
INRMP	Integrated Natural Resources Management Plan
JO	Job Order
LHA	Launch Hazard Area
L_{max}	Maximum Sound Level
MBTA	Migratory Bird Treaty Act
MDA	Missile Defense Agency
MITT	Mariana Islands Training and Testing
MMPA	Marine Mammal Protection Act
MSA	Munitions Storage Area
MSL	Mean Sea Level
MT	Metric Ton
N_2O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NAVFAC	Naval Facilities Engineering Command
NBG	Naval Base Guam
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOTAM	Notice to Air Missions
NOTMAR	Notice to Mariners
NO_x	Nitrogen oxides
NRHP	National Register of Historic Places
NWF	Northwest Field
O_3	Ozone
OEA	Overseas Environmental Assessment
OEIS	Overseas Environmental Impact Statement
PAC-3 MSE	Phased Array Tracking Radar to Intercept of Target Advanced Capability-Three Missile Segment Enhanced
$PM_{2.5}$	Particulate matter less than or equal to 2.5 microns
PM_{10}	Particulate matter less than or equal to 10 microns
RCC	Range Commanders Council
ROI	Region of Influence
SIP	State Implementation Plan
SM	Standard Missile
SO_2	Sulfur Dioxide
SPCS	Space Control Squadron
TFR	Temporary Flight Restriction
THAAD	Terminal High Altitude Area Defense
TTS	Transportable Telemetry System
U.S.	United States
U.S.C.	United States Code
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VOC	Volatile Organic Compounds

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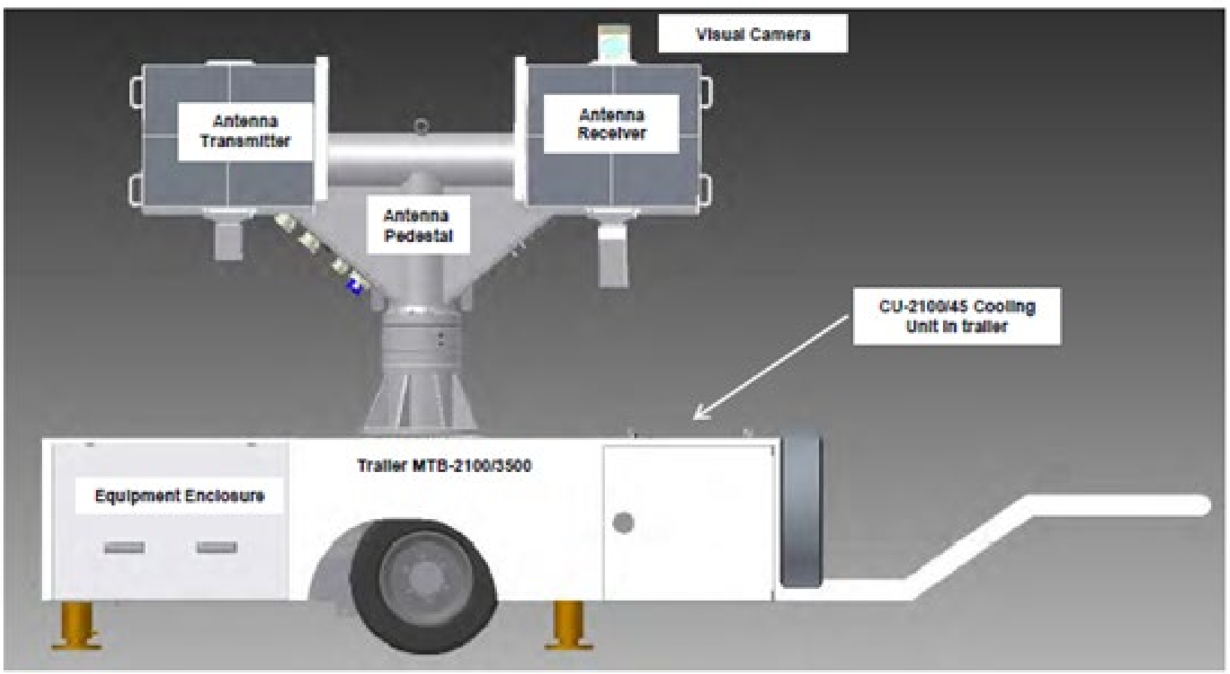
Appendix D Range Safety Asset Descriptions

D.1 Early Launch Tracking System

The Early Launch Tracking System (ELTS) is a mobile, X-band, Doppler radar system designed to support Aegis Ashore flight testing. The system consists of two ELTS radars, a power shelter with one 170-kilowatt (kW) generator, transfer switch, two 40-kilovolt amperes uninterruptible power systems, and a command and control shelter with room for expansion to include communications equipment.

The ELTS radar is an X-band continuous wave radar mounted on the AP-2100/40 antenna pedestal (Figure D-1). The ELTS radar transmits 640 watts of continuous power in the X-band.

Figure D-1: Early Launch Tracking System Layout



The ELTS is a range safety asset that provides two independent data sources to provide valid Standard Missile (SM)-3 track data no later than one second after launch. The ELTS operating band (8,000–12,000 megahertz [MHz]) is within the radar operating characteristics analyzed in the 2005 Mobile Sensors Environmental Assessment (EA) (4,000–12,000 MHz) (Missile Defense Agency, 2005), and the ELTS power requirement (170 kW) is less than the power requirement for radars analyzed in the EA (250–1,500 kW).

The Missile Defense Agency (MDA) prepared the 2005 Mobile Sensors EA to evaluate the potential environmental impacts of the installation and operation of mobile land-based sensors (e.g., radar, telemetry, command and control, and optical systems) and the use of airborne sensor systems (i.e., High Altitude Observatory [HALO]-I and II, and Widebody Airborne Sensor Platform [WASP]). The document considered four land-based radars (TPS-X, FBX-T, Mk-74 and MPS-36) operating in the C-band (4,000–8,000 MHz) or X-band (8,000–12,000 MHz). Power plants associated with these radars range in capacity from 250 kW to 1,500 kW. The Finding of No Significant Impact for the 2005 Mobile Sensors EA documented MDA's determination that there are no potential short-term or long-term effects to the environment or surrounding populations resulting from installation and operation of the types of land-based and airborne sensors analyzed in the EA.

D.2 Transportable Telemetry System

The Transportable Telemetry System (TTS) is a long-range, high data rate telemetry collection, processing, and data transmission system. The TTS is a standalone system capable of supporting flight tests from remote areas with minimal or no test infrastructure (Figure D-2). Over-the-horizon voice and data communications would be provided through a built-in satellite communications system. Each TTS would have a satellite uplink/downlink terminal.

As part of the overall system architecture, a dedicated TTS Earth station would provide connectivity between deployed TTS units and the MDA net or the Defense Research and Engineering Network. The system configuration would consist of two primary telemetry shelters, two 23-foot antennas, two power shelters, and a Satellite Communications antenna and shelter. The Satellite Communications antenna would transmit via C-band or Ku Band, via a highly focused beam. TTS is capable of sea-based operations, as analyzed in the 2004 Mobile Launch Platform EA (Missile Defense Agency, 2004). In a secondary role, TTS would be used to augment existing range assets, either independently or in conjunction with a Range Safety System.

The TTS would be powered by two 100-kW generators. Approximately 625 square meters (25 by 25 meters) would be required to set up the mobile TTS. The transportation of the entire TTS would require either four tractor-trailers or two C-130s or similar aircraft. Once on sight, individual units can be moved via smaller equipment.

Figure D-2: Single Transportable Telemetry System Unit

D.3 Mobile Range Safety System

The Mobile Range Safety System (MRSS) could be used as a standalone telemetry system or as a mobile Range Safety and Telemetry System (RSTS). Figure D-3 shows some of the equipment that would be typical of this system, including two 1-kW transmitters, two telemetry antennas, two Global Positioning System (GPS) antennas, a surveillance radar, an operational shelter measuring 8 by 20 feet (expandable to 20 by 24 feet), and a communication shelter with a satellite terminal providing interactive or receive-only communication. The communications subsystem includes a Very Small Aperture Terminal capable of data transmission, one Inmarsat System for voice and data transmissions, and four Very High Frequency and Ultra High Frequency transceivers. The system would also have its own power generation system, an interface to existing power sources, an automatic power transfer switching system, and an uninterruptible power supply for the sub systems.

Figure D-3: Mobile Range Safety System Equipment

The MRSS would be powered by two 100-kW generators and a 50-kW generator powering the communication shelter. Approximately 280 square meters (16 by 16 meters) would be required to set up the MRSS. The transportation of the MRSS would require either four tractor-trailers or two C-130 or similar aircraft.

D.4 Range Safety and Telemetry System

The RSTS includes two mobile systems that provide range flight safety, command destruct, and telemetry receiving support with GPS. The RSTS provides the range safety and telemetry functions necessary to track and verify a safe rocket flight within prescribed boundaries, as well as the capability to terminate an errant rocket.

Each mobile RSTS consists of a Mobile Operations Center, two high-gain 5.4-meter Mobile Antenna Systems, omni-directional Command Destruct system antennas for short range, and directional antennas (integral with the 5.4-meter auto-tracking antennas) for long-range flight trajectories.

The two mobile RSTS systems can operate in conjunction with each other, or as independent units. Under most circumstances, the one RSTS unit would be located at the launch site, and one would be located at a mission-designated off-axis or down-range site. Under such a scenario, the first system would monitor the initial boost phase of flight, then hand off responsibility to the off-axis or down-range system to avoid limited communication between the rocket and RSTS unit at the launch site.

Each mobile RSTS would be powered by two 100-kW generators and a 50-kW generator powering the Mobile Operations Center. Approximately 280 square meters (16 by 16 meters) would be required to set up each RSTS. The transportation of the RSTS would require either four tractor-trailers or two C-130 or similar aircraft.

References

Missile Defense Agency. (2004). *Mobile Launch Platform (MLP) Environmental Assessment*. Washington, DC: U.S. Department of Defense.

Missile Defense Agency. (2005). *Mobile Sensors Environmental Assessment*. Washington, DC: U.S. Department of Defense.

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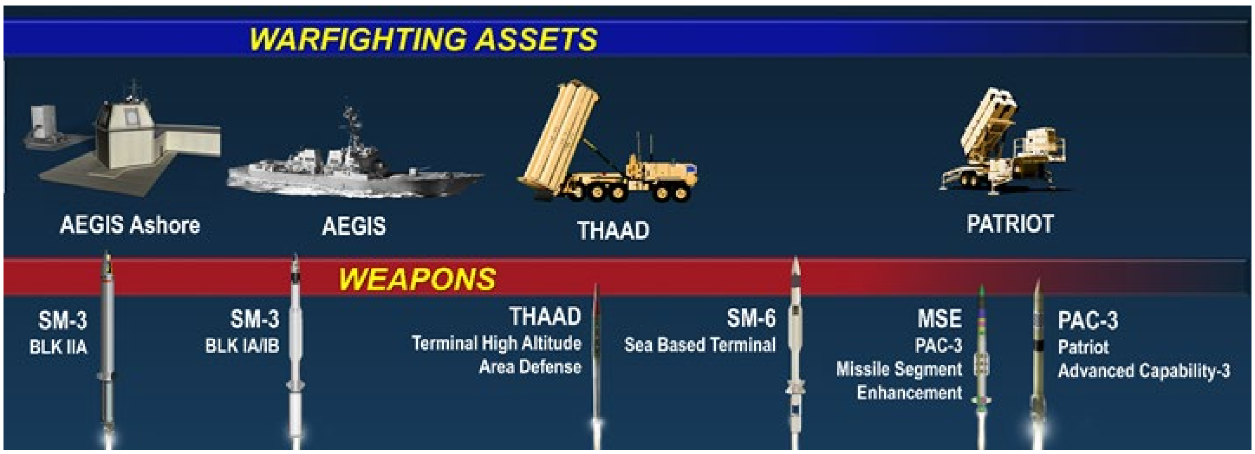
Appendix E Interceptor and Target Weapon System Descriptions

Figure E-1 shows examples on the interceptor systems under consideration in this Environmental Assessment.

Figure E-1: Examples of Interceptor Systems Under Consideration



E.1 Aegis Ashore-Guam Weapon System

Aegis Ashore utilizes the Aegis Ballistic Missile Defense (BMD) System (BMDS) consisting of the Aegis Weapon System (AWS), Standard Missile (SM), and United States (U.S.) Navy control and communication systems intended to address regional ballistic missile threats. The AWS is a centralized, automated, command-and-control and weapons control system that was designed as a total weapon system, from detection to kill using the SM.

The AWS for active missile defense provides protection at sea and ashore against regional ballistic missiles. The United States is testing improved variants of both the Aegis SM-3 and SM-6 missiles, and fielding a new sensor, to significantly increase Aegis missile defense capabilities. Multi-mission Aegis BMD-capable ships are highly maneuverable and survivable and will be surged as needed during crisis and conflict. The combination of increased ship numbers and capability will result in a more flexible and resilient Aegis force with significantly greater missile defense capability.

SM-2 Overview: The SM-2 family was developed to provide air and cruise missile defense as part of the Aegis Combat System on U.S. Navy ships. The SM-2 Blocks III and IV each uses semi-active radar homing and have a blast-fragment warhead with a radar and contact fuse.

The family of SM-2 interceptors are all solid propellent-fueled and tail controlled, designed to launch from either a Mk 41 Vertical Launching System or Mk 26 Guided Missile Launching System. Most versions of the SM-2 are designed to engage high-speed, high-altitude anti-ship cruise missiles with midcourse guidance and radar support from the ship's systems to help illuminate the target during the terminal intercept phase.

The SM-2 Block III is a single stage rocket (Mk 104 Dual Thrust Rocket Motor) which measures 15 feet 6 inches in length, 13.5 inches in diameter, has a wingspan of 3 feet 6 inches, and weighs around 1,558 pounds.

The SM-2 Block IV is a two-stage rocket (Mk 72 Booster and Mk 104 Dual Thrust Rocket Motor) which measures approximately 21 feet 6 inches in length, 21 inches in diameter, has a wingspan of 3 feet 6 inches, and weighs around 3,225 pounds.

The size of the Mk 72 booster and Mk 104 Dual Thrust Rocket Motor is approximately 6 feet long and 2 feet wide, weighing approximately 500 pounds. Booster and rocket motor sizes are consistent across the SM-2, SM-3, and SM-6.

Major components of the propellants include aluminum; ammonium perchlorate; and cyclotetramethylenetetranitramine. Major exhaust components resulting from ignition of the SM-2 solid rocket motors include aluminum chloride, aluminum oxide, ammonia, carbon dioxide, carbon monoxide, ferric chloride, ferric oxide, hydrogen, hydrogen chloride, nitric oxide, nitrogen, and water. Major components of the propellants and exhaust are consistent across the SM-2, SM-3, and SM-6.

SM-3 Overview: The SM-3 is an exo-atmospheric missile defense interceptor used for theater ballistic missile defense. Part of the AWS, it uses a hit-to-kill kinetic kill vehicle to intercept ballistic missiles during the midcourse of their flight path. SM-3s are unique due to being the only SM designed to operate in the vacuum of space. The first Aegis BMD ships fielded SM-3 Block I interceptors in 2005, and the first Block IA interceptors deployed in 2006. All of the current SM-3 variants fire from Mk 41 Vertical Launching System cells on both Aegis-equipped ships and Aegis Ashore sites.

The SM-3 is approximately 21 feet long 21 inches wide weighing approximately 3,000 pounds. SM-3 missile has three-stages, sharing the first two stages of the SM-2 Block IV (Mk 72 Booster and Mark 104 Dual Thrust Rocket Motor) along with a third stage solid-propellant rocket (Mk 136 Third Stage Rocket Motor) to increase velocity at atmospheric exit. The SM-3's three stages contain approximately 2,400 pounds of solid propellant.

SM-6 Overview: The SM-6 is a multi-mission missile capable of antiair warfare, terminal ballistic missile defense, and antiship strike roles. It uses a blast-fragmentation warhead to engage these threats in the endo-atmosphere. The U.S. Navy has also upgraded the SM-6 to perform strike missions. Its tri-mission capability also presents opportunities for the Navy to arrange more efficient weapon loadouts onboard its guided missile ships. In the words of a former Missile Defense Agency director, the versatile SM-6 is likely to be "the workhorse for Navy cruise missile defense and ballistic missile defense for a very, very long time."

The SM-6 measures approximately 21 feet 6 inches long, 1 foot wide, has a wingspan of 3 feet 6 inches, and weighs approximately 3,300 pounds. The body of the SM-6 combines the solid rocket booster and dual thrust rocket motors of the SM-3 series, the airframe of the SM-2 series, and the seeker and nosecone of an Advanced Medium-Range Air-to-Air Missile.

E.2 Ship-Based Aegis Weapon System

The Aegis System was originally developed in the 1970s for defending ships against aircraft, anti-ship cruise missiles, surface threats, and subsurface threats. The system was first deployed by the Navy in 1983 and has been updated many times since. The Navy's Aegis ships include Ticonderoga (CG-47) class cruisers (Figure E-2) and Arleigh Burke (DDG-51) class destroyers (Figure E-3).

The Aegis System was originally designed to primarily intercept theater-range ballistic missiles, meaning short-, medium-, and intermediate-range ballistic missiles (Short Range Ballistic Missile, Medium Range Ballistic Missile, and Intermediate Range Ballistic Missile, respectively). In addition to the capability of intercepting theater-range ballistic missiles, detection and tracking data collected by the Aegis BMD system's radar may be passed to other U.S. BMD systems that are designed to intercept intercontinental ballistic missiles, which may support intercepts of intercontinental ballistic missiles by those other U.S. BMD systems.

Figure E-2: Ticonderoga Class Cruiser

Figure E-3: Arleigh Burke Class Destroyer

E.3 THAAD Weapon System

The Terminal High Altitude Area Defense (THAAD) weapons system is a mobile, land-based missile system designed to intercept and destroy short and medium range ballistic missiles in the endo- and exo-atmosphere and to provide surveillance support to the BMDS against ballistic missiles of all ranges. The BMDS is envisioned as a system of layered, yet independent, defenses that use complementary interceptors, sensors and Command and Control, Battle Management, and Communications (C2BMC) to intercept ballistic missiles of all ranges in all phases of flight. The THAAD element would be integrated as part of the BMDS to provide protection against incoming ballistic missiles in the terminal phase of their flight. Complete with its own radar, launcher and C2BMC, the THAAD missile could operate independently as a BMDS or could be deployed as a sensor to provide surveillance and tracking of target missiles and to communicate data to other elements in the BMDS. The THAAD missile system consists of four principal components: interceptor missiles, truck-mounted launchers, the THAAD radar system, and the THAAD C2BMC. All components of the THAAD missile system, with the exception of certain radar components, can be transported by a C-130 aircraft for deployment by sea, rail, and/or road.

The THAAD missile is approximately 20 feet long, 1 foot wide, and weighs approximately 1,500 pounds. It is intended to intercept and destroy incoming ballistic missiles with ranges of up to 3,000 kilometers (1,860 miles). The missile rounds are comprised of a single-stage booster attached to a kill vehicle. The THAAD kill vehicle includes an infrared seeker that detects and homes in on the target missile to destroy the target by high-speed collision. This hit-to-kill technology uses kinetic energy to eliminate the enemy missile. The kill vehicle consists of a shroud, fore-cone, seeker, divert and attitude control system, and guidance and control electronics. The kill vehicle has an uncooled sapphire window with an infrared seeker mounted on a two-axis stabilized platform.

The missile uses liquid hypergolic propellants for divert and attitude control. The booster is a single-stage solid propellant rocket motor with a flare. The flare consists of overlapping petals that lock into position after deployment. An inter-stage provides a physical interface linking the kill vehicle to the booster. The booster solid propellant is a hydroxyl-terminated polybutadiene composition that is rated as a Class 1.3 explosive. This booster rating includes the additional high-explosive energy associated with the flight termination system. The flight termination system is designed to terminate thrust if unsafe conditions develop during powered flight.

The THAAD mobile launcher transports the interceptors in addition to providing a structure from which to fire them. The launcher consists of an easily reloadable missile round pallet. The pallet is an eight-round container with two tiers of four launch tubes. The launcher uses a modified M-1120 U.S. Army Heavy Expanded Mobility Tactical Truck-Load Handling System Truck to perform the functional requirements of the transporter on both improved and unimproved roads. The pallet can be quickly loaded onto or removed from the transporter using the truck.

The THAAD radar consists of four units: Antenna Equipment Unit, Electronic Equipment Unit, Cooling Equipment Unit, and Prime Power Unit. The Antenna Equipment Unit includes all transmitter and beam steering components as well as power and cooling distribution systems. The Electronic Equipment Unit houses the signal and data processing equipment, operator workstations, and communications equipment. The Cooling Equipment Unit contains the fluid (ethylene glycol)-to-air heat exchangers, pumping system to cool the antenna array and power supplies. The Prime Power Unit, used to power the THAAD radar system, is a self-contained trailer in a noise-dampening shroud that contains a diesel generator, governor and associated controls, a diesel fuel tank, and air-cooled radiators. Each individual unit is housed on a separate trailer interconnected with power and signal cabling, as required. Operation of the Prime Power Unit would require refueling operations. The fuel tank of the Unit would be filled from a fuel truck as necessary.

The basic C2BMC unit, the Tactical Support Group, consists of two tactical shelters mounted on XM-113 High Mobility Multipurpose Wheeled Vehicles; the Tactical Operations Station; and the Launcher Communications Station. There are also two High Mobility Multipurpose Wheeled Vehicle cables and support equipment and towed tactical generators. The C2BMC system manages and integrates all THAAD components by providing instructions, processing sensor data, and communication with the radar and launcher. The C2BMC system also links the THAAD to other missile and air defense systems in the BMDS via the system-wide C2BMC. The C2BMC is connected internally and externally to allow the exchange of data and commands among the various components of the THAAD element. It uses a netted, distributed, and replicated flow of information to ensure uninterrupted execution of engagement operations. Key engagement operations include surveillance, threat evaluation, weapon assignment, engagement control, target engagement, and kill assessment. Missile launch procedures are controlled from separate C2BMC shelters mounted on XM-1113 High Mobility Multipurpose Wheeled Vehicles.

Launch commands to the M-1120 Heavy Expanded Mobility Tactical Truck-Load Handling System Launcher are transmitted via fiber-optic cables.

E.4 PAC-3 MSE Weapon System

The Phased Array Tracking Radar to Intercept of Target (PATRIOT) Advanced Capability-Three (PAC-3) Missile Segment Enhanced (MSE) system is an advanced Surface-to-Air guided missile system capable of conducting multiple engagements in deployed locations. The PAC-3 MSE system could be employed as a single weapon system, or selected elements of the system could demonstrate interoperability with the THAAD Weapon System.

The PAC-3 MSE system consists of a PAC-3 MSE Launching Station, Lower Tier Air and Missile Defense Sensor and the Engagement Operations Center. The generator for the Launching Station is located on the yoke assembly of the trailer and includes an integral 8.6-gallon fuel tank (auxiliary capable). The unit is a diesel engine-driven generator, providing 15-kilowatt, four-wire, 400-Hertz, 120/208-volt power.

The PAC-3 MSE uses PAC-3 and PAC-2 Guidance Enhanced Missiles as interceptors. The PAC-3 interceptor is a hit-to-kill guided missile with an onboard radar seeker and an explosive lethality enhancer. The PAC-2 Guidance Enhanced Missile interceptor is a guided missile with upgraded software to improve guidance of the missile and an onboard radar seeker and an explosive fragmentation warhead that detonates in close proximity to the target.

The PAC-3 missile is smaller than the PAC-2 missile and consists of the seeker assembly, Attitude Control Section, Mid-Section Assembly, solid rocket motor Section, and the Aft Section Assembly. The Attitude Control Section contains a number of small, short duration, solid propellant (aluminum and ammonium perchlorate and hydroxyl-terminated polybutadiene) rocket motors (side thrusters) that enable the PAC-3 missile to maneuver to achieve an intercept of a target in response to the instructions provided by the onboard guidance processor. The Attitude Control Section housing and assembly is a composite material made of aluminum and graphite. The Attitude Control Section also contains one lithium thermal battery. The mid-section assembly contains various guidance, control, and communications electronics and antennas mounted in aluminum and graphite composite housing and assembly. The mid-section assembly also contains a lethality enhancer to further increase the kill probability at intercept. The lethality enhancer contains various standard explosives, standard explosive detonators, two lithium thermal batteries, and a number of steel fragments. The main explosive charge is a low explosive that has been fully qualified for production and operational use. The lethality enhancer also serves as the Missile Destruct System for the PAC-3 missile. In the event that the PAC-3 missile diverges from a safe trajectory, the missile operator in the Engagement Control Station can command the lethality enhancer to detonate, breaking up the airframe of the missile, terminating thrust of the solid rocket motor, and causing it to terminate its flight and fall as debris.

The solid rocket motor section includes the single stage solid rocket motor, fixed fins, pyrotechnic motor initiators, and a graphite composite case. The fixed fins are titanium and are secured to the rocket motor casing by titanium attachments. The solid rocket motor contains approximately 160 kilograms (350 pounds) of solid propellant (aluminum and ammonium perchlorate and hydroxyl-terminated polybutadiene).

The PAC-2 missile is approximately 19 feet long and 2 feet 10 inches wide, and is equipped with four clipped-delta movable control surfaces mounted on the tail. The missile propulsion is furnished by a single-grain solid propellant rocket motor. A high explosive warhead provides target-kill. The PAC-2 missile would consist of the radome, guidance section, warhead section, propulsion section, and the control actuator section.

The radome provides an aerodynamic shape for the missile and microwave window and thermal protection for the Track-via-Missile seeker and electronic components. The guidance section consists of a Modular Digital Airborne Guidance System and is comprised of two parts. The Modular Midcourse Package, which is located in the forward portion of the warhead section, consists of the navigational electronics and a Missile Borne Computer which computes the guidance and autopilot algorithms and provides steering commands in accordance with a resident computer program. The Terminal Guidance section is the Track-via-Missile seeker, which consists of an antenna mounted on an inertial platform, antenna control electronics, a receiver, and a transmitter.

The propulsion section is comprised of the rocket motor, external heat shield, and two external conduits and contains a conventional, case-bonded solid propellant.

The control actuator section is located at the aft end of the missile. It receives commands via the missile autopilot and positions the fins to steer and stabilize missile flight. The fin servo system consists of hydraulic actuators and valves and an electrohydraulic power supply consisting of battery, motor-pump, oil reservoir, gas pressure bottle, and accumulator.

E.5 Indirect Fire Protection Capability Increment 2

The Indirect Fire Protection Capability Increase 2 (IFPC Inc 2) System is a mobile ground-based weapon system designed to defeat cruise missiles; unmanned aircraft systems; and rocket, artillery, and mortars (RAM). IFPC Inc 2 consists of a launcher, an AIM-9X Sidewinder interceptor, and an all-up-round magazine to support the Cruise Missile Defense; Counter-unmanned aircraft systems; and Counter-rocket, artillery, and mortar missions.

The AIM-9X Sidewinder is approximately 9 feet 5 inches long, 5 inches wide, and weighs approximately 190 pounds. The missile's main components are an infrared homing guidance section, an active optical target detector, a high-explosive warhead, and a Mk 36 solid-propellant rocket motor. The solid propulsion rocket motor uses a reduced-smoke hydroxyl-terminated polybutadiene propellant.

The system will use the U.S. Army's Integrated Air and Missile Defense Battle Command System as its Mission Command and will integrate the Sentinel Radar as its sensor. The IFPC Inc 2 launcher would be transported on a Heavy Expanded Mobility Tactical Truck, and other components would be transported by Medium Tactical Vehicle, Joint Light Tactical Vehicle, or High Mobility Multipurpose Wheeled Vehicle.

E.6 Targets Under Consideration

Table E-1 provides information about the target rocket motors under consideration for this EA, including rocket motor type, launch platform, propellant type, propellant class, and propellant quantity (quantity per stage and total quantity metrics).

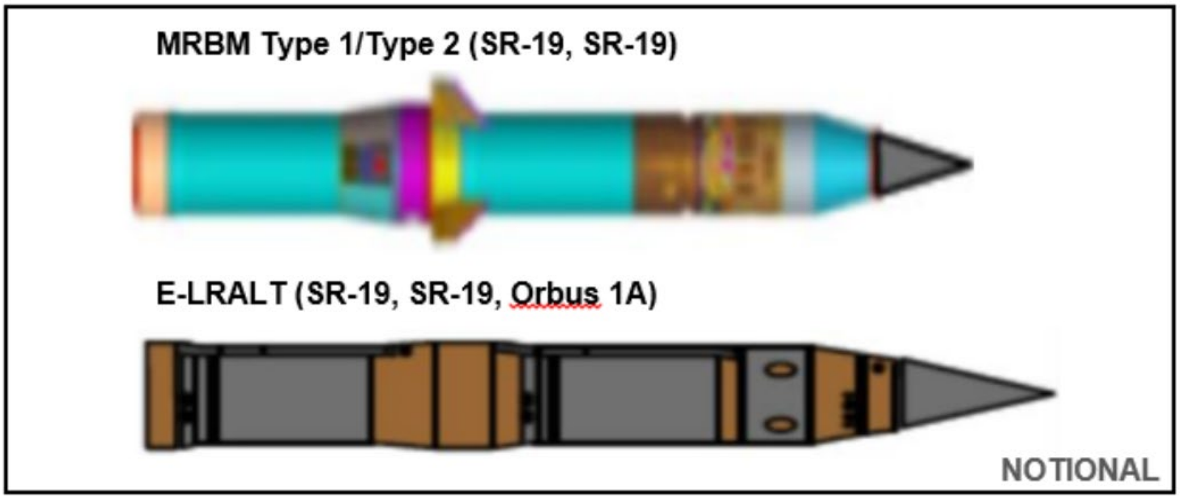
Target systems include launch vehicles, payloads (including surrogate re-entry vehicles and countermeasures), launch support equipment, extensive instrumentation, and flight control stations.

Short-Range Ballistic Missiles (up to 1,000km): The Short-Range Ballistic Missile Target class consists of Type (T)4 Subscale Targets, Pathfinder Zombies and Black Daggers.

Medium-Range Ballistic Missiles (MRBM) (1,000-3,000km): The MRBM T1 and T2 targets are the same design where the T1 provides a simple 1,000-1,700 km target. T2 provides the ability to create a more complex scene for Missile Defense System testing. The T3 is a specialty target in this range class and is designed to replicate a specific threat. In addition to MRBM T1-3, the Agency also has the Subscale MRBM T4 to meet some of the medium range requirements and a T5 advanced target.

The MRBM is a multi-stage target vehicle (Figure E-4) that can be provided in several different configurations with various options depending on mission requirements. Configurations being considered for BMD flight tests include the Extended Long-Range Air-Launched Target and the MRBM Types 1 and 2 (T1/T2); all configurations would be launched from an aircraft.

Figure E-4: MRBM Target Vehicle Example Depiction



The Extended Long-Range Air-Launched Target and MRBM T1/T2 targets are similar in that both employ SR-19 solid propellant rocket motors for the first and second stages. In addition, the Extended Long-Range Air-Launched Target contains a third stage Orbus 1A solid propellant rocket motor. The MRBM T1/T2 and Extended Long-Range Air-Launched Target measure approximately 36 and 40 feet in length, respectively, and 5 feet in diameter. The MRBMs have an approximate weight of 33,000 to 37,000 pounds.

The MRBM is carried aloft and launched by a U.S. Air Force Air Mobility Command C-17 or similar aircraft. The target vehicle would be mounted on a pallet and loaded onto the aircraft through a large aft door that accommodates military vehicles and/or palletized cargo. While in flight, the aft door would be opened, allowing release of the palletized launch vehicle. Following decent by parachute and release from the pallet, the first-stage motor would ignite and begin flight on a pre-set course for intercept over the Broad Operations Area.

The Short Range Air Launched Target is a smaller, single-stage target that consists of a reentry vehicle, a guidance and control module, an interstage assembly, an SR19-AJ-1 solid propellant rocket motor, and an aft skirt assembly. The target vehicle is approximately 33 feet long, has a maximum diameter of approximately 5 feet, and weighs approximately 20,000 pounds. The launch vehicle includes a guidance and control system, an inertial navigation system, a global positioning system receiver, and a telemetry system. The SR19-AJ-1 motor is equipped with a flight termination system to terminate thrust if unsafe conditions develop during powered flight. The Short Range Air Launched Target would be modified to allow for separation of the re-entry vehicle during flight.

Similar to the MRBM targets, the Short Range Air Launched Target is also carried aloft and launched from a C-17 or similar aircraft. A more detailed description on the use and analysis of the Short Range Air Launched Target system may be found in the 1998 Air Drop Target System Program Programmatic Environmental Assessment.

Intermediate-Range Ballistic Missiles and Intercontinental Ballistic Missiles Intermediate (3,000-4,500km) and Intercontinental (>5,500km): The Intermediate-Range Ballistic Missile T1 is a two-stage, air launched target. The Intermediate-Range Ballistic Missile T2 provides the ability to create a more complex scene for Missile Defense System testing. The Intercontinental Ballistic Missile T1 is a ground launched three-stage target and the Intercontinental Ballistic Missile T2 provides the ability to create a more complex scene for Missile Defense System testing.

Table E-1: Target Rocket Motors Under Consideration

	SR19	Castor IVB	SR19 M57	SR19 SR19	SR19 SR73	C-4 First Stage C-4 Second Stage	C-4 First Stage C-4 Second Stage C-4 Third Stage
Common Name						LV-2	LV-3
Launch Platform[1]	L, A, S	L, A, S	L, A, S	L, A, S	L, A, S	L, A	L
Target Range	Short	Intermediate	Intermediate	Intermediate	Intermediate	Long	Long
Existing Target Rocket	Yes	Yes	Yes	Yes	No	No	No
Propellant Type	Solid	Solid	Solid	Solid	Solid	Solid	Solid
First Stage Propellant Class[2]	Class 1.3	Class 1.3	Class 1.3	Class 1.3	Class 1.3	Class 1.1	Class 1.1
First Stage Propellant Quantity, kg (lb.)	6,238 (13,752)	9,975 (21,991)	6,238 (13,752)	6,238 (13,752)	6,238 (13,752)	17,667 (38,949)	17,667 (38,949)
Second Stage Propellant Class	N/A	N/A	Class 1.3	Class 1.3	Class 1.3	Class 1.1	Class 1.1
Second Stage Propellant Quantity, kg (lb.)	N/A	N/A	1,659 (3,657)	6,238 (13,752)	3,111 (6,859)	7,924 (17,469)	17,667 (38,949)
Third Stage Propellant Class	N/A	N/A	N/A	N/A	N/A	N/A	Class 1.1
Third Stage Propellant Quantity, kg (lb.)	N/A	N/A	N/A	N/A	N/A	N/A	7,924 (17,469)

	SR19	Castor IVB	SR19 M57	SR19 SR19	SR19 SR73	C-4 First Stage C-4 Second Stage	C-4 First Stage C-4 Second Stage C-4 Third Stage
Total Propellant Quantity, kg (lb.)	6,238 (13,752)	9,975 (21,991)	7,897 (17,410)	12,476 (27,505)	9,349 (20,611)	25,591 (56,418)	43,258 (95,367)

Source: Missile Defense Agency Flexible Target Family EA (U.S. Department of Defense Missile Defense Agency, 2007)
Notes: kg = kilograms; lb. = pounds, N/A = not applicable
[1]Launch platforms: L=land; S=sea; A=air
[2]Explosives are divided into classes to describe their hazard potential. For example, substances that have a mass explosion hazard are classified as Class 1.1; substances that pose a projection hazard, but not a mass explosion hazard are classified as Class 1.2; and substances that pose a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard, are classified as Class 1.3.

REFERENCES

U.S. Department of Defense Missile Defense Agency. (2007). *Flexible Target Family Environmental Assessment*. Washington, DC: U.S. Department of Defense.

MISSILE DEFENSE AGENCY

Guam Flight Test

Appendix F: Ambient Sound Measurements on or Adjacent to Andersen Air Force Base and Naval Base Guam, Guam

MAY 2024

Department of Defense
Missile Defense Agency
5700 18th Street
Fort Belvoir, VA 22060-5573

Executive Summary

Ambient sound levels were recorded at five locations on or near Andersen Air Force Base August 10–14, 2023, and one location at Naval Base Guam. Professional-grade Larsen Davis Model 831 sound level meters were used to make the sound measurements. Weather conditions during data collection were warm with relatively low wind, intermittent periods of high rates of precipitation, and high humidity. The purpose of this study was to collect data of representative ambient sound levels near potential Missile Defense Agency and U.S. Army flight test launch sites.

Sound measurements collected included A-weighted sound pressure levels and unweighted sound pressure levels. Some periods of elevated broadband sound at the study sites were correlated with high amounts of precipitation or surf noise. Locations nearer off-base roads were dominated by road noise, whereas locations more distant were dominated by environmental (wind/rain/surf) noise.

The results of this study are representative of ambient sound levels near the coast of northern Guam and are similar to ambient levels recorded during previous studies. Because of the weather during data collection, the results of this study may represent higher-than-average ambient sound levels. Periods of calm weather would result in lower ambient levels, especially at locations removed from transportation corridors.

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Acronyms and Abbreviations

Acronym	Definition
°F	degrees Fahrenheit
°C	degrees Celsius
AAFB	Andersen Air Force Base
cm	Centimeter(s)
dB	Decibel
dBA	A-weighted decibel
DNL	Day Night Level
in.	Inch(es)
L90	90 Percent Exceeded Level
Leq	Equivalent Sound Level
MDA	Missile Defense Agency
NBG	Naval Base Guam
SLM	Sound Level Meter
U.S.	United States

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1 Introduction

As part of the United States (U.S.) military validation of the interoperability of multiple sensors and missile interceptor systems, the Missile Defense Agency (MDA), U.S. Navy, and U.S. Army are planning to conduct missile defense system flight tests from land or sea-based launchers at Guam. MDA has identified a location at Northwest Field on Andersen Air Force Base (AAFB) to conduct the initial flight test (FEM-02).

At the time of ambient noise monitoring, Naval Base Guam (NBG) was being considered as an alternate missile flight test launch location and was included in data collection. Subsequently, NBG was removed from consideration for flight tests. The data from the NBG site are retained in this report to provide broad understanding of the ambient noise conditions.

The purpose of this study is to measure representative ambient sound pressure levels at Northwest Field and at various locations (representative for human and biological resources) under typical current conditions to better understand the potential effects of noise associated with the missile flight tests.

2 Methodology

2.1 Devices

Sound level measurements were captured using Larson Davis Model 831 sound level meters (SLMs), Firmware Version 2.403. SLMs were mounted on a tripod in a suitable stable location (Figure 2-1) and were left unattended for the majority of the recording period, with the exception of daily checks of battery levels and verification of data collection. A microphone wind screen that is specifically designed for use with SLMs was also used as it eliminates noise that would occur from wind directly blowing on or across the microphone. Wind sound that is ambient in the environment, such as wind passing through the trees, or rain noise was still measured by the SLM. Each SLM collected continuous noise information and was programmed to calculate hourly and daily sound levels. In addition, each SLM was set to record a .WAV file if the noise level exceeded 65 decibels (dB) for more than 5 seconds. These recordings were analyzed later to identify sound sources at each location that rose above 65 A-weighted decibels (dBA).

Figure 2-1: Typical SLM Setup

2.2 Locations

Six locations were chosen to collect ambient noise levels, five on and near AAFB (Figure 2-2) and one on NBG (Figure 2-3) (Table 2-1). One location was selected as the most proximate to the potential launch location. Three rural locations were chosen near human noise-sensitive receptor locations, and two were located to collect ambient noise near habitat for the Marianas fruit bat (*Pteropus mariannus mariannus*). A noise-sensitive receptor is defined as a land use where people involved in indoor or outdoor activities may be subject to stress or considerable interference from noise. Such locations or facilities often include residential dwellings, hospitals, nursing homes, churches, educational facilities, and libraries. The nearest residential area off-base was identified near Potts Junction, approximately 2.44 miles away from the launch site. The nearest school was identified as Machananao Elementary School (2.89 miles). While not a human noise-sensitive receptor, Mariana fruit bat habitat sites were also selected for ambient recordings. The six locations are described in further detail below.

The first meter (Site 1) was sited at the approximate location of the proposed MDA flight test launch site. This location was on the boundary of cleared and paved areas to the southeast and heavy vegetation to the northeast.

Sites 2 and 3 were located north and east of Site 1 to collect ambient noise recordings in areas potentially occupied by the Mariana fruit bat. Site 2 was located at the north end of the small arms range on AAFB on the boundary of an open/cleared area and heavy vegetation. Site 3 was located at the base of the cliff just north of Tarague Beach in a heavily vegetated area, with the Pacific Ocean immediately east (surf break line was approximately 1,000 feet east of SLM position).

Site 4 was near the boundary of AAFB (Machananao) to collect ambient noise levels near off-base sensitive receptors (residences and schools). Site 4 was placed within vegetation north of Guam Route 9, a regularly transited route for a variety of personal and construction vehicles. This location was approximately 400 feet north of the Machananao Elementary School. In addition to the elementary school, there are numerous residences bordering this route in this rural area.

Site 5 was placed at the southern boundary of Marine Corps Base Camp Blaz at a position approximately 150 feet from Guam Route 3. This site was a cleared area adjacent to an unused softball field and bordered a dense vegetation area to the west. At this location, residences are on the eastern side of Guam Route 3 off-base. Guam Route 3 in this area is regularly transited by a wide variety of vehicles.

The final meter (Site 6) was placed at the southern edge of NBG Guam (Apaca Point) to collect ambient noise levels near off-base receptors. This location was approximately 300 feet from the ocean shoreline, through thick low-lying vegetation. Off-base residences are approximately 4,000 feet from the SLM location.

Table 2-1 presents the SLM number, name, and location coordinates.

Table 2-1: Sound Level Meter Locations

Site Number	Latitude	Longitude
1	13.624110	144.868220
2	13.641892	144.868690
3	13.626120	144.894041
4	13.584931	144.882681
5	13.564709	144.843963
6	13.407824	144.662018

Figure 2-2: SLM Locations on or near Andersen Air Force Base

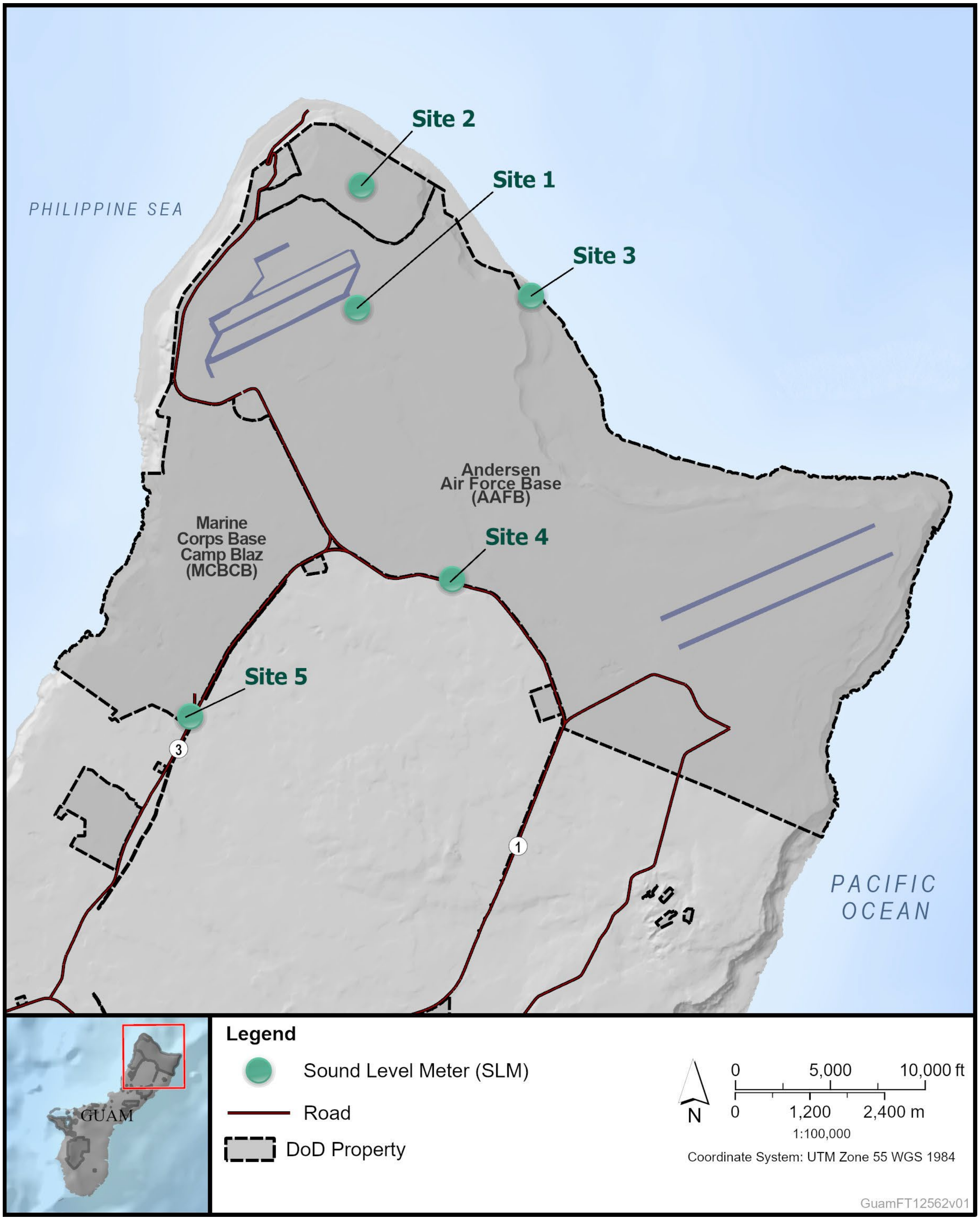


Figure 2-3: SLM Location on Naval Base Guam

2.3 Acoustical Measurements

2.3.1 Basics of Sound

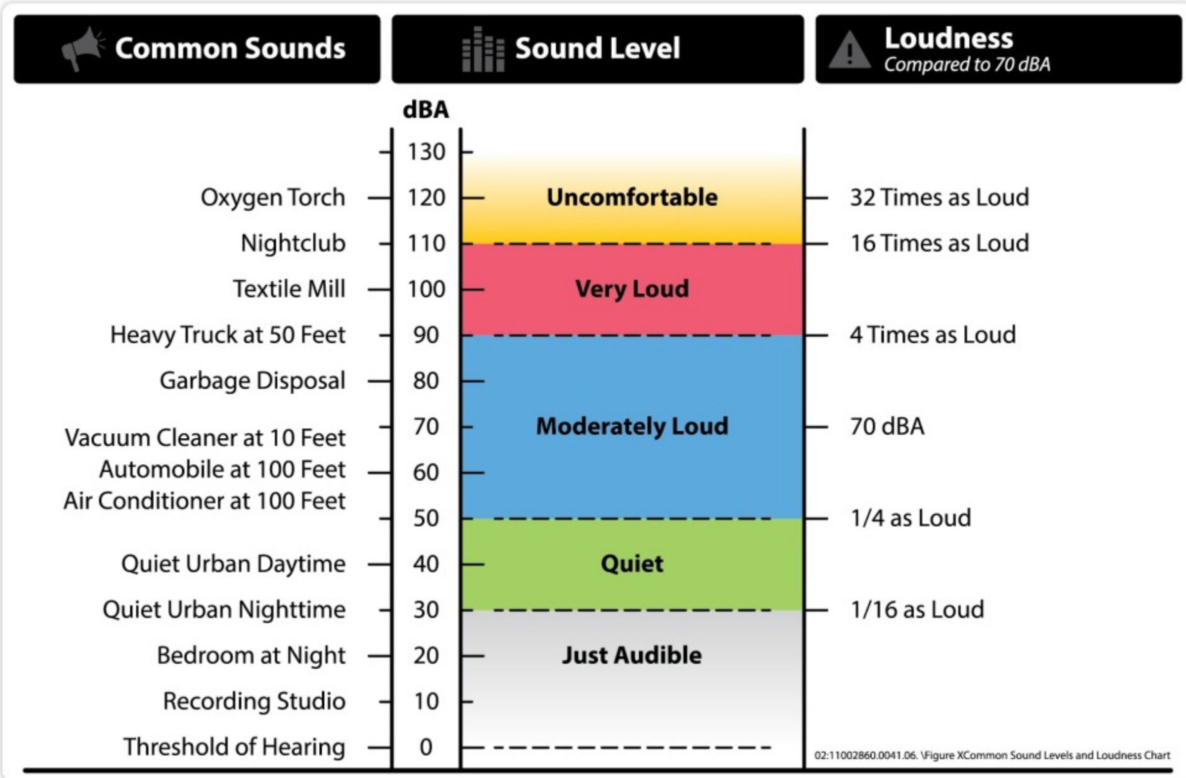
The loudest sounds detected comfortably by the human ear have intensities a trillion times higher than sounds that the ear can barely detect. Therefore, using a linear scale to represent sound intensity is not feasible. The dB is a logarithmic unit used to represent the intensity of a sound, also referred to as the sound level. An increase of 10 dB represents a 10-fold increase in acoustic energy, while 20 dB is 100 times more intense, and 30 dB is 1,000 times more intense.

2.3.2 Noise Metrics

Since noise is a complex physical phenomenon, multiple noise metrics help to more accurately quantify the noise environment. All sounds have a spectral content, which means their magnitude or level changes with frequency, where frequency is measured in cycles per second or hertz. The human ear is not equally sensitive to all sound frequencies within the frequency range of human hearing; the human ear cannot detect lower frequencies as well as it can detect higher frequencies. Thus, the “raw” or “unweighted” sound intensity measured by mechanical devices is selectively weighted—or filtered—to simulate the non-linear response of the human ear. These adjusted sound levels are termed “A-weighted” sound levels, denoted as dB(A) or simply dBA. The A-weighted scale is used internationally in sound standards and regulations. Therefore, dBA is the primary sound metric to be used in analyzing sound effects under environmental consequences because its characteristics are reflective of the human ear’s frequency response. Figure 2-4 provides typical A-weighted noise levels in various indoor and outdoor environments.

Some noise sources (e.g., air conditioner, vacuum cleaner) are measured as continuous sounds that maintain a constant sound level for a period of time. Other sources (e.g., automobile, heavy truck) are measured by the maximum sound produced during an event, such as a vehicle passing by. Other sounds (e.g., urban daytime, urban nighttime) are measured as averages taken over extended periods of time.

Figure 2-4: Typical A-Weighted Environmental Noise Levels



Three additional noise metrics were quantified in this study: day-night average sound level (DNL), equivalent (cumulative) sound level, and N-Percent Exceeded Levels.

2.3.2.1 Day-Night Average Sound Level

The DNL metric is the energy-averaged sound level measured over a 24-hour period, with a 10 dB penalty assigned to noise events occurring between 10 p.m. and 7 a.m. (acoustic night). The A-weighted DNL is the standard noise metric used by the U.S. Department of Housing and Urban Development, Federal Aviation Administration, Environmental Protection Agency, and the Department of Defense (used surrounding air installations). Most people are exposed to sound levels of 50–55 dBA DNL or higher on a daily basis. Noise-sensitive land uses, such as housing, schools, and medical facilities are considered compatible in areas where the DNL is less than 65 dB. Therefore, the 65 dB DNL noise contour is used to determine compatibility of military operations with local land use.

2.3.2.2 Equivalent Sound Level

The Equivalent Sound Level (Leq), measured in dB, is a cumulative noise metric that represents the average sound level (on a logarithmic basis) over a specified period of time. Each meter calculated the hourly Leq for each hour the meter was running.

2.3.2.3 N-Percent Exceeded Level

The n-percent exceeded level is the sound pressure level exceeded for n percent of the time. L10 is the sound pressure level exceeded for 10 percent of the time. For the rest of the time, the sound or noise has a sound pressure level at or below L10. L50 is the level exceeded for 50 percent of the time. L90 is the level exceeded for 90 percent of the time. L90 is generally considered to represent the background or ambient level of a noise environment.

2.3.2.4 Exceedance Noise Events

In addition to collecting ambient recordings over the duration of the recording period, the SLMs were set up to record exceedances. Exceedances were recorded if a fixed threshold (65 dBA) was exceeded for a minimum duration (5 seconds). The threshold of 65 dB and duration of 5 seconds was selected pre-deployment in order to capture noise events that were longer in duration than rapid transient noises one might experience in a vegetated environment (e.g., biological noises/calls, short wind gusts, short-duration vegetation noise).

3 Results

3.1 Data Run Summary

All six SLMs were set up and started recording on August 10, 2023, and ran for a minimum of 74 hours. Full run times were determined dependent on when meters were gathered from the field on August 13, 2023. Table 3-1 shows the start date and time, end date and time, and total run time for each meter.

Table 3-1: SLM Recording Periods

Location	Start Date and Time	End Date and Time	Duration
Site 1	2023-08-10 13:05:16	2023-08-13 15:40:00	74:34:44
Site 2	2023-08-10 11:39:11	2023-08-13 18:39:20	79:00:09
Site 3	2023-08-10 11:59:57	2023-08-13 16:32:54	76:32:57
Site 4	2023-08-10 08:57:11	2023-08-13 16:01:27	79:04:16
Site 5	2023-08-10 09:56:04	2023-08-13 16:47:53	78:51:49
Site 6	2023-08-10 10:39:01	2023-08-13 17:43:53	79:04:52

3.2 Weather

Temperatures on Guam during the recording period ranged from a low of 74°F to a high of 87°F. Temperature gradients can impact sound propagation. Due to the relatively consistent temperatures on Guam, the impact on noise levels and propagation is minimal. The temperature data are presented to reflect the completeness of analysis. During the recording period, a persistent weather pattern associated with Typhoon Lan north of the Northern Mariana Islands impacted weather conditions. The typhoon created intermittent wind and rain throughout the recording period with periods of heavy precipitation. Periods of calm weather were intermittent during the recording period. Table 3-2 presents the minimum and maximum temperatures and precipitation totals for each day of the recording period as recorded at the Guam International Airport.

Table 3-2: Daily Weather Summaries Collected at Guam International Airport

Date	Min Temp (°F/°C)	Max temp (°F/°C)	Precipitation (in./cm)
8/10/2023	77/25	84/28.9	0.56/1.42
8/11/2023	76/24.4	81/27.2	2.04/5.18
8/12/2023	75/23.9	86/30	1.76/4.47
8/13/2023	74/23.3	87/30.6	1.79/4.55

Source: National Centers for Environmental Information (2023)
Notes: °F = degrees Fahrenheit, °C = degrees Celsius, in. = inches, cm = centimeters

3.3 Ambient Acoustic Environment

Table 3-3 presents the minimum and maximum hourly Leq values during each day of recording for each meter/location. The table also presents the minimum 90 percent exceeded noise level (which typically represents the quietest component of ambient noise during that recording period). DNL values are also presented for all meters for August 11 and 12, 2023. These are the 2 days where a full 24-hour period was recorded, and DNL values are based on recorded values.

Table 3-3: Summary Sound Levels (dBA)

Location	10 Aug	11 Aug	12 Aug	13 Aug
Site 1				
1-hour Leq (min)	36.6	42.0	35.0	33.4
1-hour Leq (max)	56.4	65.1	69.3	67.0
1-hour L90 (min)	29.6	37.6	28.0	30.3
DNL	--	60.6	70.6	--
Site 2				
1-hour Leq (min)	46.4	43.5	41.7	40.5
1-hour Leq (max)	75.3	70.2	73.1	66.3
1-hour L90 (min)	34.3	34.5	34.9	34.2
DNL	--	70.6	73.0	--
Site 3				
1-hour Leq (min)	44.3	44.7	44.2	45.4
1-hour Leq (max)	62.5	66.2	61.7	64.4
1-hour L90 (min)	42.2	40.3	41.9	43.1
DNL	--	67.5	64.1	--
Site 4				
1-hour Leq (min)	50.1	45.4	46.1	45.5
1-hour Leq (max)	67.8	70.4	67.7	70.4
1-hour L90 (min)	36.0	36.2	36.6	39.3
DNL	--	69.3	67.8	--
Site 5				
1-hour Leq (min)	56.9	55.2	54.0	51.2
1-hour Leq (max)	70.9	73.6	77.4	73.8
1-hour L90 (min)	48.7	48.5	48.3	46.8
DNL	--	74.9	75.6	--
Site 6				
1-hour Leq (min)	54.7	56.7	53.5	55.5
1-hour Leq (max)	69.6	69.4	70.9	75.1
1-hour L90 (min)	52.8	53.7	52.1	54.1
DNL	--	70.5	69.0	--

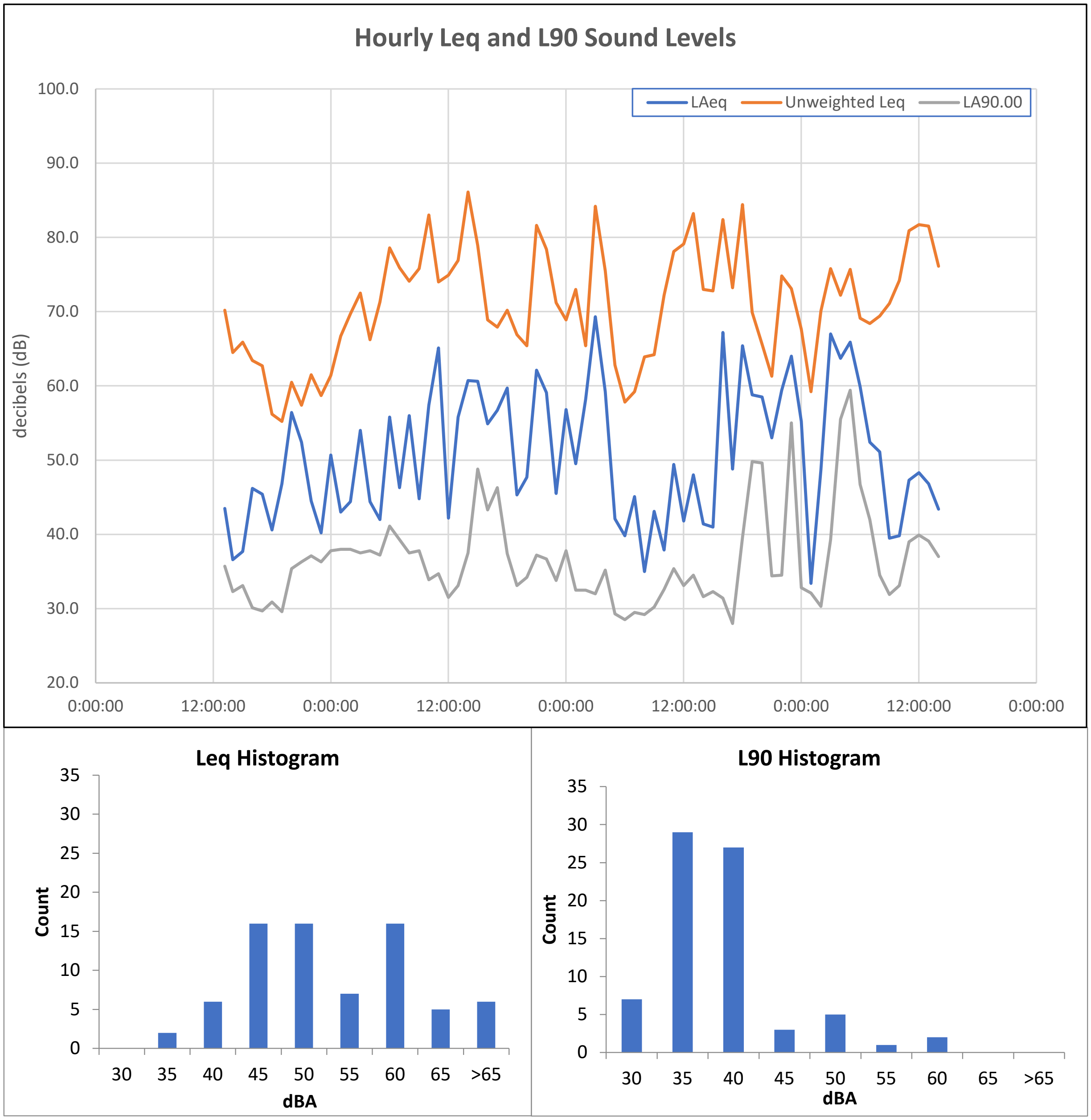
Notes: Leq = Equivalent Noise Level. L90 = 90 percent exceeded level, DNL = Day Night Level, dBA = A-weighted decibels

Of all sites, Site 5 recorded the highest hourly Leq values. Site 1 recorded the lowest hourly Leqs. Site 1 also recorded the lowest hourly L90.

3.3.1 Site 1

As noted in Table 3-3, Site 1 recorded the lowest hourly Leq and L90 values. The range of Leqs at Site 1 was 33.4–69.3 dBA and varied hourly dependent on weather conditions (Figure 3-1). As mentioned in Section 2 (Methodology), there was a persistent weather pattern which resulted in elevated noise levels from rain and wind noise. At this location, there were 282 sound events recorded that triggered the noise recorder (louder than 65 dBA for more than 5 seconds). Five of these recordings were identified as aircraft overflights, and one was identified as a passing truck. The remaining recorded events at this location (276) were identified as wind and rain noise. These events implied that there was a regular source of noise from precipitation, elevating hourly Leq as well as L90 levels. The L90 distribution, however, suggests that ambient levels during times of little or no precipitation ranged from 30 to 40 dBA (Figure 3-1).

Figure 3-1: Site 1 Leq and L90 Sound Levels by Hour and Distribution of Hourly Leqs (A-weighted and unweighted) and L90 Sound Levels



3.3.2 Site 2

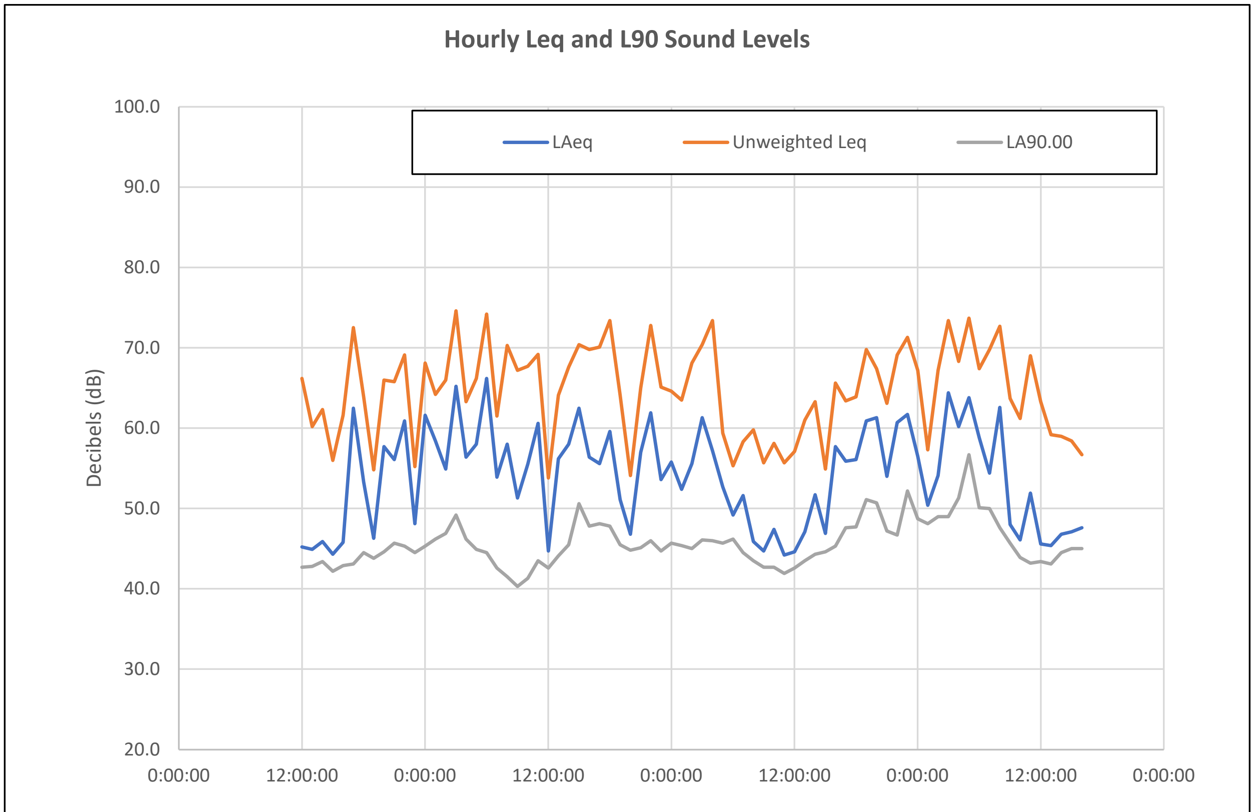
The range of Leqs at Site 2 was 40.5–75.3 dBA and varied hourly dependent on weather conditions (Figure 3-2). At this location, there were 1,087 sound events recorded. Five of these recordings were identified as aircraft overflights (maximum sound levels ranging from 67.2 to 80.5 dBA), and one was identified as a passing truck. The remaining recorded events at this location were identified as wind and rain noise. Similar to Site 1, precipitation was a regular source of noise, elevating hourly Leq as well as L90 levels. The L90 distribution suggests a slightly higher low level ambient level, ranging from 40 to 55 dBA (Figure 3-2).

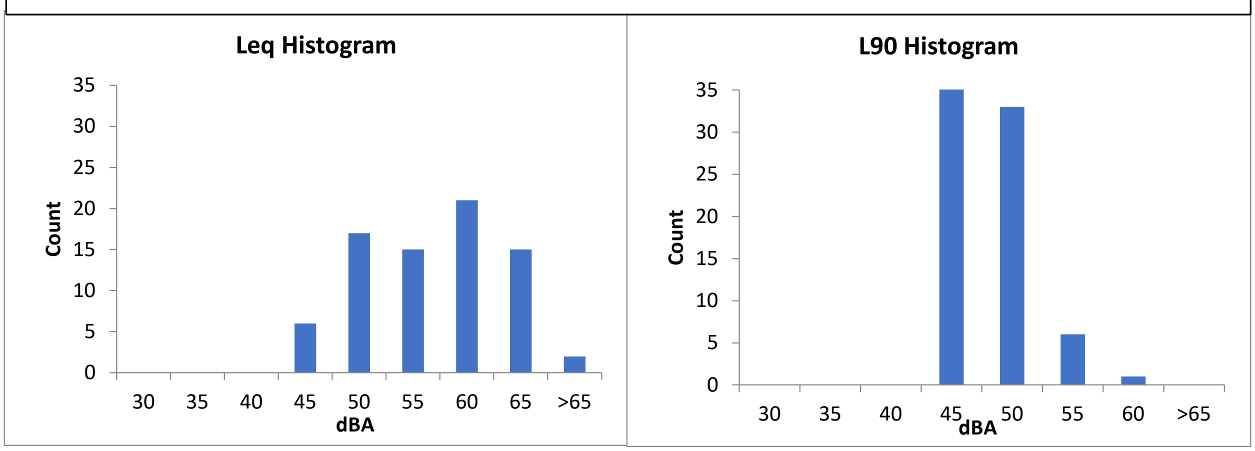
Figure 3-2: Site 2 Leq and L90 Sound Levels by Hour and Distribution of Hourly Leqs (A-weighted and unweighted) and L90 Sound Levels

3.3.3 Site 3

The range of Leqs at Site 3 was 44.2–66.2 dBA, with the main distribution of hourly Leqs between 50 and 65 dBA (Figure 3-3). At this location, there were 318 sound events that were recorded. Four of these recordings were identified as aircraft overflights, and three were from a speaker system (playing ”The Star-Spangled Banner,” bugle calls, and a severe weather warning broadcast). The remaining recorded events at this location were identified as surf and rain noise. While many events contained noise from rain, a number of events had an audible background level of surf noise. The contribution of surf noise is shown in elevated ambient L90 levels, concentrated between 45 and 50 dBA (Figure 3-3).

Figure 3-3: Site 3 Leq and L90 Sound Levels by Hour and Distribution of Hourly Leqs (A-weighted and unweighted) and L90 Sound Levels

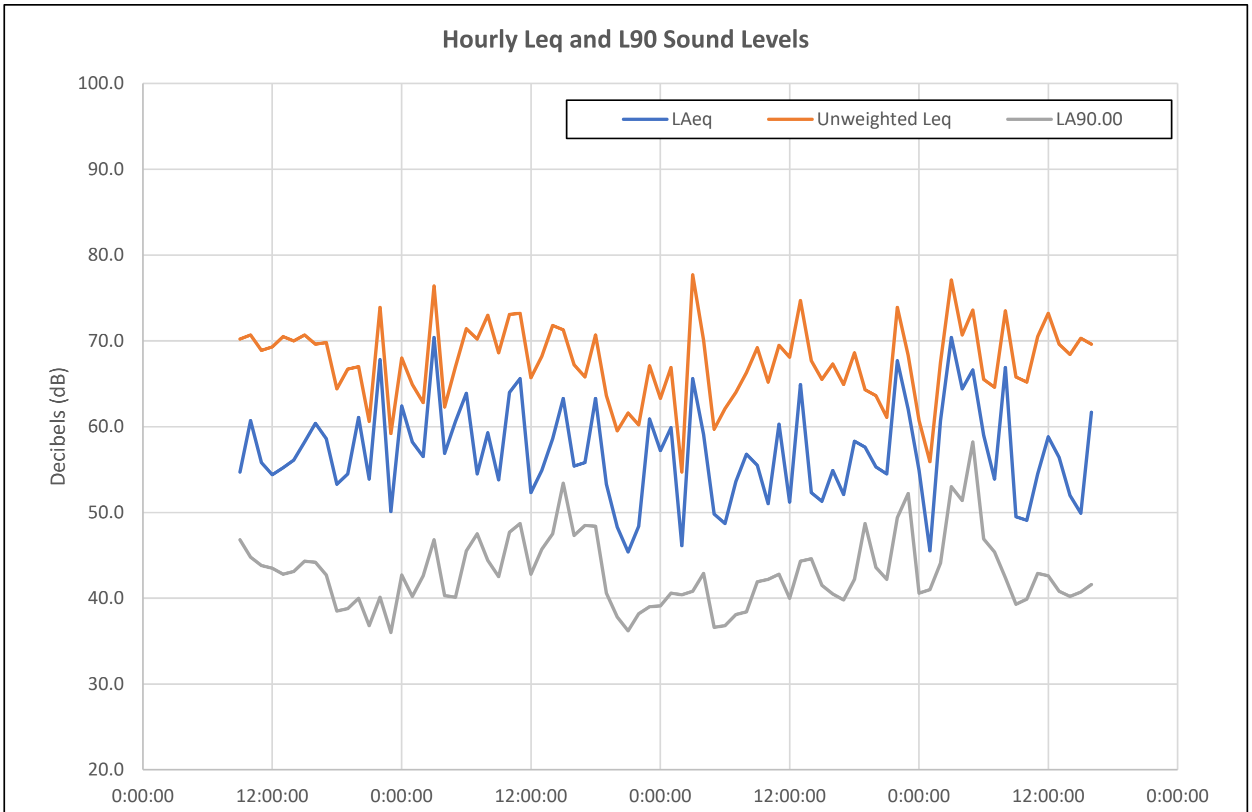


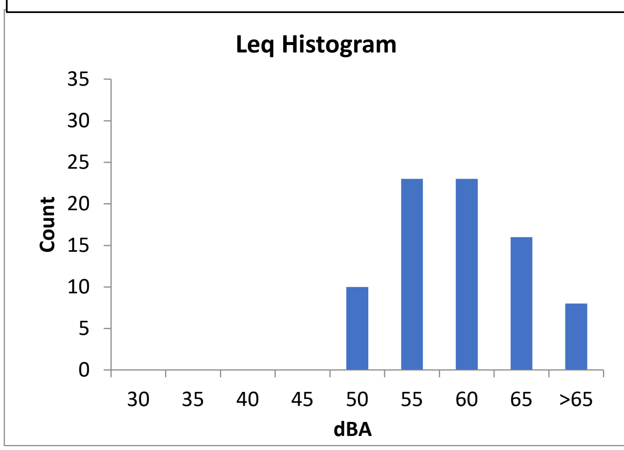


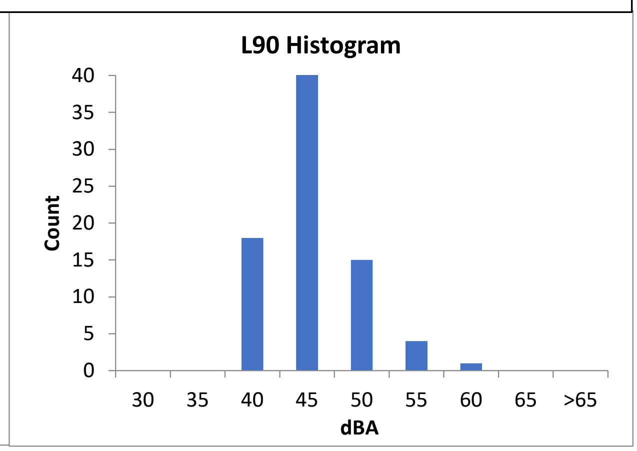
3.3.4 Site 4

The range of Leqs at Site 4 was 45.4–70.4 dBA (Figure 3-4). The elevated Leqs at this location were driven primarily by road noise (Route 9 is regularly used by a variety of vehicles and at all hours), aircraft overflights, and environmental noise (rain). There were 453 sound events that were recorded. Sixty-one of these recordings were identified as vehicles, and 29 were identified as aircraft overflights. Vehicles passing these locations had maximum sound levels ranging from 65.9–83 dBA. Aircraft overflights at these locations had maximum sound levels ranging from 66.2–84.3 dBA. The contribution of road noise is shown in consistent L90 levels, concentrated between 40 and 50 dBA (Figure 3-4).

Figure 3-4: Site 4 Leq and L90 Sound Levels by Hour and Distribution of Hourly Leqs (A-weighted and unweighted) and L90 Sound Levels



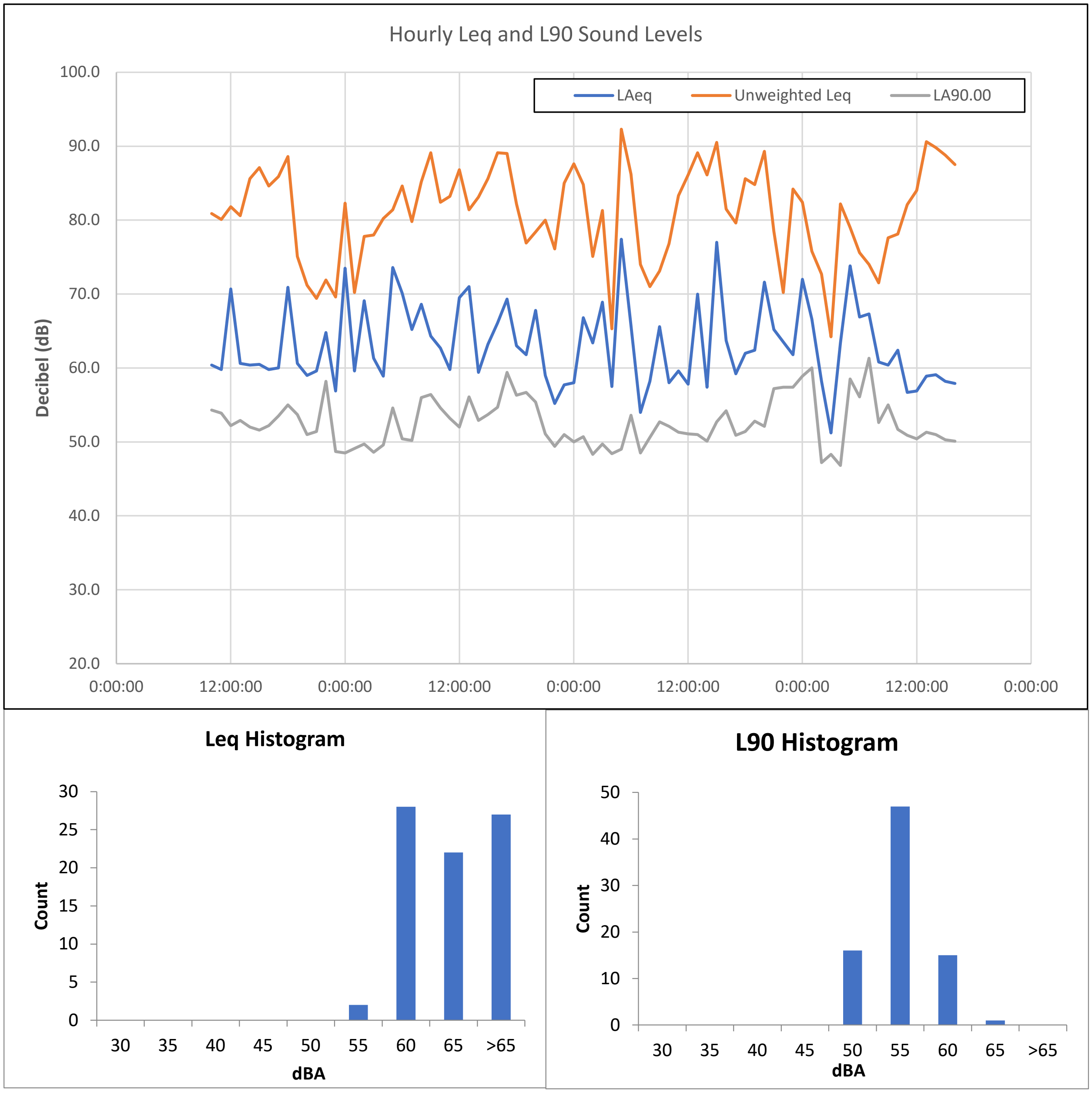




3.3.5 Site 5

The range of Leqs at Site 5 was 51.2–77.4 dBA, with the main distribution of hourly Leqs between 60 and 70 dBA (Figure 3-5), primarily from road noise from vehicle use on Guam Route 3. At this location, there were 1,319 sound events recorded, with the vast majority (1,187) being events associated with road usage. Vehicles passing these locations had maximum sound levels ranging from 65.2 to 92.7 dBA. Both the Leq and L90 levels are higher than at the other four SLM locations in the northern region. The contribution of road noise is shown in elevated ambient L90 levels, concentrated between 50 and 60 dBA (Figure 3-5).

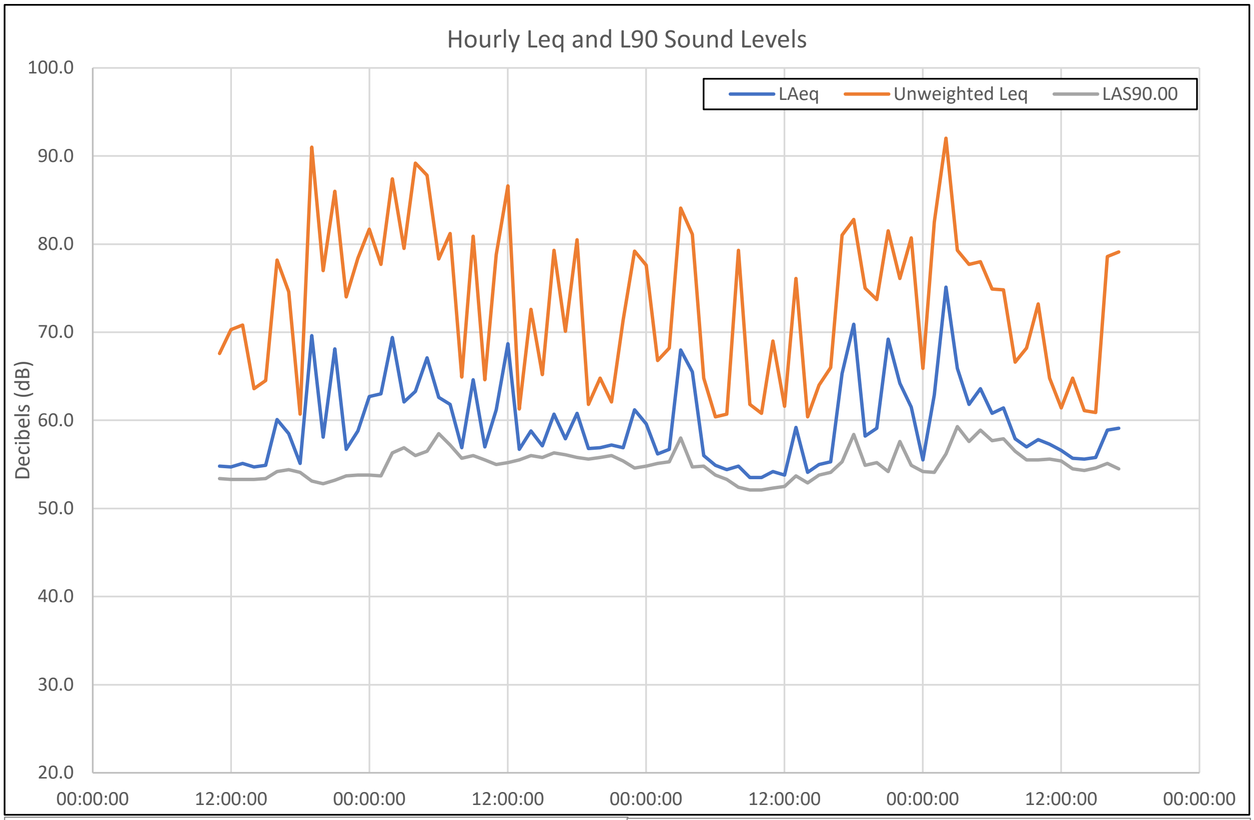
Figure 3-5: Site 5 Leq and L90 Sound Levels by Hour and Distribution of Hourly Leqs (A-weighted and unweighted) and L90 Sound Levels

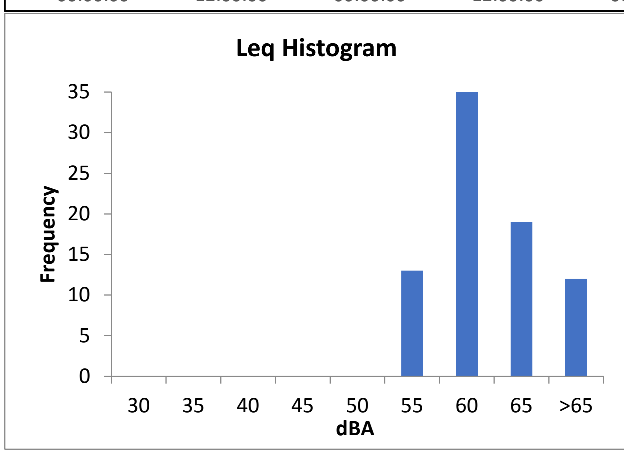


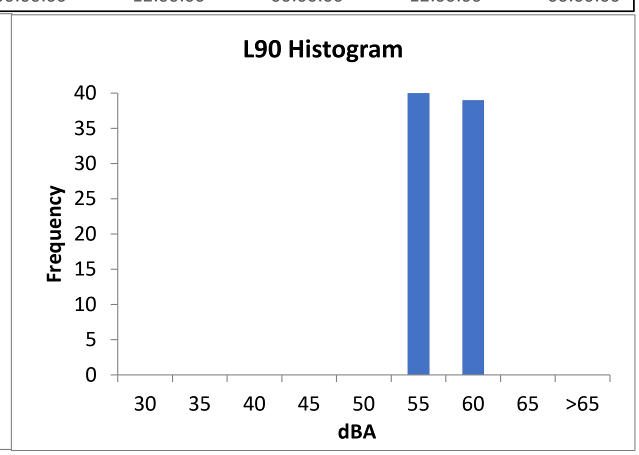
3.3.6 Site 6

The range of Leqs at Site 6 was 53.5–75.1 dBA, with the main distribution of hourly Leqs between 60 and 70 dBA (Figure 3-6). At this location, there were 245 sound events recorded. Twenty events were identified as passing vehicles (maximum sound levels ranging from 69.2 to 91 dBA), and 14 were identified as mechanical noise from a nearby electrical building (maximum sound levels ranging from 66.7 to 72.3 dBA). The remaining recorded events at this location were identified as surf and rain noise. While many events contained noise from rain, a number of events had an audible background level of surf noise. The contribution of surf noise is shown in elevated ambient L90 levels, concentrated between 55 and 60 dBA (Figure 3-6).

Figure 3-6: Site 6 Leq and L90 Sound Levels by Hour and Distribution of Hourly Leqs (A-weighted and unweighted) and L90 Sound Levels







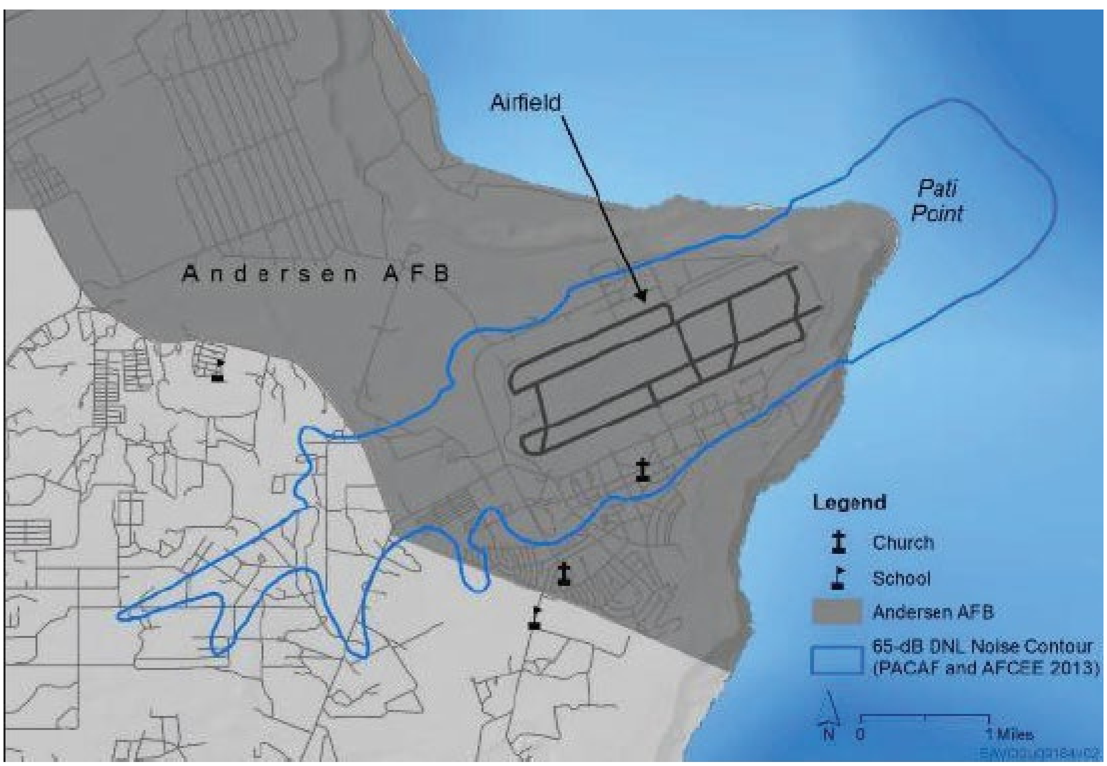
4 Discussion

4.1 Comparison with Previously Collected Noise Data

Noise levels collected during this study were similar to past ambient recordings near Ritidian Point. Noise levels recorded in 2015 at Northwest Field (U.S. Department of the Navy, 2015) identified A-weighted Leq values during calm environmental conditions ranging from 43.4 to 56.1 dBA. The lowest Leq recorded in this study at Site 2 (the site closest to the 2015 location) was 40.5, but the higher maximum Leq was 75.3. Environmental conditions during the 2015 study were calm with little wind or rain, and the authors noted that their recording sites would likely demonstrate greater levels of ambient sound if recorded when precipitation or wind levels were higher, which was observed during this ambient field survey.

Community noise levels in the area surrounding AAFB (Federal Aviation Administration, 2021) show noise contours above 65 dBA extending to the northeast and southwest past the boundaries of AAFB (Figure 4-1). Site 4 from this study is located outside of this boundary.

Figure 4-1: Andersen Air Force Base 65 dBA DNL Contour



During this study, Site 4 had hourly Leqs ranging from 45.4 to 70.4 dBA, with DNLs of 69.3 and 67.8 dBA. As noted above, only 29 of the 453 noise events recorded during this study's recording period were aircraft. During the study period, noise levels at Site 4 were more influenced by local events (road noise, rain/wind) rather than activities associated with AAFB. It was noted that AAFB was at a low activity level during this period. As such, during a period of higher activities, Site 4 could be more heavily influenced by aircraft overflights.

4.2 Summary

Ambient sound levels were recorded at five locations on or near AAFB August 10–14, 2023, and one location at NBG. L90 levels ranged between a low of 30 dBA (Site 1) and a high of 65 dB (Site 5). At locations away from transportation corridors, the ambient levels were more influenced by environmental conditions (rain, wind, or surf) rather than noise from human activities. This is reinforced by the higher noise floor at Site 5, which was very close to a heavily utilized transportation corridor; and Site 6, which was close to the beach during a period of high surf.

5 References

Federal Aviation Administration. (2021). *Final Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) for Issuing a Launch Operator License to Virgin Orbit, LLC (VO) for LauncherOne Operations from Andersen Air Force Base (AFB), Guam*. Washington, DC: Federal Aviation Administration.

Federal Interagency Committee on Urban Noise. (1980). *Guidelines for Considering Noise in Land Use Planning and Control*. Washington, D.C.: U.S. Environmental Protection Agency, U.S. Department of Transportation, U.S. Department of Housing and Urban Development, U.S. Department of Defense, and Veterans Administration.

National Centers for Environmental Information. (2023). *Daily Summaries Station Details*. Retrieved January 2, 2024, from https://www.ncei.noaa.gov/cdo-web/datasets/GHCND/stations/GHCND:GQW00041415/detail.

U.S. Department of the Navy. (2015). *Final Supplemental Environmental Impact Statement Guam and Commonwealth of the Northern Mariana Islands Military Relocation (2012 Roadmap Adjustments)*. Washington, DC: Naval Facilities Engineering Command, Pacific.

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Appendix G Supporting Marine Biological Information

G.1 Seamounts

Seamounts are undersea mountains that rise steeply from the ocean floor to elevations above the seafloor greater than 1,000 meters above the ocean basin (U.S. Department of the Navy, 2015). To be conservative, this analysis considers seamounts with summits that are 2,000 meters or shallower from the sea surface to fit varying definitions and the Navy's Essential Fish Habitat consultation. Seamounts form by vertical tectonic activity along converging plate margins (Rogers, 1994). Seamount topography is a striking contrast to the flat, sediment-covered abyssal plain, and the effect seamounts can impart on local ocean circulation resulting in upwelling can supply nutrients to surface water (Rogers, 1994; U.S. Department of the Navy, 2015). This upwelling creates centers of biodiversity for fish, marine mammals, sea turtles, sea birds, and invertebrates in an otherwise biologically desolate abyssal plain. For more information regarding seamounts, refer to the 2015 Mariana Islands Training and Testing (MITT) Final Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS).

G.1.1 Deep Sea Invertebrates

Deep sea invertebrates would be in the region of influence (ROI) in the largest densities around seamounts. These organisms consist of suspension feeders such as stony corals, gorgonian corals, black corals, sea anemones, sea pens, hydroids, sponges, sea squirts, and crinoids (Rogers, 1994).

G.2 ESA-Listed Fishes

G.2.1 Scalloped Hammerhead Shark (Indo-West Pacific DPS)

The scalloped hammerhead shark is listed as threatened under the Endangered Species Act (ESA) (79 Federal Register [FR] 38214, July 3, 2014). Scalloped hammerheads are moderately large coastal pelagic sharks found worldwide in coastal warm temperate and tropical seas in the Atlantic, Pacific, and Indian Oceans between 46°N and 36°S (Miller et al., 2014). The shark occurs in all temperate to tropical waters from the surface to depths of 512 meters (1,600 feet) and possibly deeper (Miller et al., 2014). Scalloped hammerhead sharks may also be found in waters near volcanic islands and seamounts (Ketchum et al., 2014). Scalloped hammerhead sharks spend most of their time inshore, moving offshore at night to forage (Miller et al., 2014). Females move inshore to birth, with litter sizes anywhere between 1 and 41 live pups. Parturition, however, does not appear to vary by region and may be partially seasonal, with neonates present year round but abundance peaking during the spring and summer months (Duncan & Holland, 2006; National Marine Fisheries Service, 2020a). Scalloped hammerhead sharks are found over continental shelves and the shelves surrounding islands, as well as adjacent deep waters, but are seldom found in waters cooler than 22° Celsius (National Marine Fisheries Service, 2020a). They range from the intertidal and surface to depths of up to 450–512 meters, with occasional dives to even deeper waters (National Marine Fisheries Service, 2020a). Scalloped hammerhead sharks have also been documented entering enclosed bays and estuaries. Neonates and juveniles inhabit nearshore nursery habitats for up to one year or more, as these areas provide valuable refuge from predation (Duncan & Holland, 2006). Scalloped hammerhead sharks are high trophic level, opportunistic predators whose diet includes crustaceans, fish, and cephalopods (National Marine Fisheries Service, 2020a).

Scalloped hammerhead sharks appear to prefer areas with strong currents, high turbidity, and high sedimentation and nutrient flow. Wells et al., 2018 found habitat suitability for scalloped hammerhead sharks was predicted to be high on the mid-to-outer continental shelf inside the 200-meter isobath. Modeling results highlighted the use of continental shelf waters with high occurrence at close proximities to both artificial and hardbottom habitat, combined with low chlorophyll a concentrations (approximately 0–4 milligrams) and moderate salinities (33–35.5). Scalloped hammerhead sharks are also known to occur in bays and estuaries. In a study of tagged scalloped hammerhead sharks in the eastern Tropical Pacific, Nalesso et al. (2019) found that oceanic islands and seamounts represent important habitat for this species. Scalloped hammerhead sharks formed large aggregations at several locations around Cocos Island, similar to Galapagos, Malpelo, and other oceanic islands in the eastern Tropical Pacific. Results of this study suggest that these aggregations are fluid, such that individuals do not remain at the island constantly throughout the year, but rather associate with the island mostly during daytime hours, and returned to the same island after absences of nine months or greater (Nalesso et al., 2019).

Until recently, the presence of the scalloped hammerhead shark had not been recorded in nearshore areas off Guam since 1971. In 2021, the presence of the scalloped hammerhead shark in nearshore areas off Guam was detected using Environmental DNA survey methods (Budd et al., 2021). Sightings of this species have also been recorded on Guam within Apra Harbor, Sasa Bay, along the Orote Peninsula, Piti Bat, Tarague Beach, Pago Bay, and the Yling River Mouth (U.S. Department of the Navy, 2019).

The Indo-West Pacific Distinct Population Segment (DPS) range covers a very large area, and abundance estimates for the entire DPS are unavailable. However, documented trends in abundance in particular areas suggest significant depletions of local populations, due to incidental capture in fishing gear and netting near recreational beaches. Based on a combination of fisheries dependent and fisheries independent data, it is estimated that hammerhead shark populations have experienced drastic population declines, in excess of 90 percent, in several parts of their global range (National Marine Fisheries Service, 2020a). Evidence of heavy fishing pressure by industrial, commercial, and artisanal fisheries; reports of significant illegal, unreported, unregulated fishing, especially off the coast of Australia; and high at-vessel mortality rates have likely led to overutilization of the Indo-West Pacific DPS. Coupled with inadequate regulatory measures, especially in the western Indian Ocean and Indonesian waters, and habitat degradation, the present and future threats facing this DPS indicate it is approaching a level of abundance and productivity that places its current and future persistence in question (Miller et al., 2014).

G.2.2 Oceanic Whitetip Shark

The oceanic whitetip shark is listed as threatened under the ESA (83 FR 4153, January 30, 2018). Oceanic whitetip sharks occur worldwide and typically inhabit warm, offshore waters within the top 656 feet (200 meters) of the surface, but they are known to occur as deep as 3,549 feet (1,082 meters) (National Oceanic and Atmospheric Administration, 2016). Oceanic whitetip sharks are distributed throughout open ocean waters, the outer continental shelf, and around oceanic islands, primarily from 10° North to 10° South, but up to 30° North and 35° South (National Marine Fisheries Service, 2020a). They can be found at the ocean surface and down to at least 152 meters deep, but most frequently stay between depths of 25.5 and 50 meters (National Marine Fisheries Service, 2020a). They display a preference for water temperatures above 20° Celsius, but can be found in waters between 15° and 20° Celsius, and can briefly tolerate waters as cold as 7.75° Celsius during dives to the mesopelagic zone (National Marine Fisheries Service, 2020a). Although the species is considered highly migratory and capable of making long-distance movements, tagging data provides evidence that this species also exhibits a high degree of philopatry (i.e., site fidelity) in some locations. Juveniles seem to be concentrated in equatorial latitudes, while specimens in other maturational stages are more widespread (National Marine Fisheries Service, 2020a). Oceanic whitetip sharks are regarded as opportunistic feeders, eating teleosts (bony fish) and cephalopods. Large pelagic fish species commonly found in the stomachs of oceanic whitetips include blackfin tuna, white marlin, and barracuda (National Marine Fisheries Service, 2020a).

Oceanic whitetip shark populations in the Pacific Ocean have declined an estimated 80–95 percent since the mid-1990s, due to commercial fishing pressures (National Marine Fisheries Service, 2022). The species appears to display a high degree of philopatry to certain sites, with females giving birth on one side of a basin or the other, indicating little if any mixing with individuals of other regions (National Marine Fisheries Service, 2020a).

There is no range-wide abundance estimate available for oceanic whitetip sharks. However, the species was once one of the most abundant sharks in the ocean. Catch data from individual ocean basins indicate that the populations have undergone significant declines (National Marine Fisheries Service, 2020a).

G.2.3 Giant Manta Ray

The giant manta ray is listed as threatened under the ESA (83 FR 2916, January 12, 2018). In 2023, the National Marine Fisheries Service revised the scientific name of *Manta birostris* to *Mobula birostris,* effective January 22, 2024 (88 FR 81351). Giant manta rays occur in tropical, subtropical, and temperate coastal waters around the world. Giant manta rays are migratory, capable of undertaking migrations of up to 1,500 kilometers, although some tagged individuals have been observed staying in the same location (National Marine Fisheries Service, 2020a). Giant manta rays have been observed in aggregations of 100 to 1,000 individuals at particular sites (National Marine Fisheries Service, 2020a). These sites are thought to be feeding or cleaning locations, or where courtships take place. Giant manta rays are planktivores, using gill plates (also known as gill rakers) to feed on zooplankton. They conduct night descents to between 200 and 450 meters and can even dive to depths of over 1,000 meters. During the day, they can also be found feeding in shallow waters (less than 10 meters) (National Marine Fisheries Service, 2020a). There is not a great deal of information on the population structure of the giant manta ray, and data on population trends globally are largely unavailable (National Marine Fisheries Service, 2020a). However, landings have decreased up to 95 percent in the Indo-Pacific, though these declines have not been observed in other subpopulations such as Mozambique and Ecuador (National Marine Fisheries Service, 2020a).The species can dive to depths over 1,000 meters (Miller & Klimovich, 2016).

Giant manta rays are commonly found offshore in oceanic waters but are sometimes found in shallow waters (less than 10 meters) during the day (Miller & Klimovich, 2016). The most significant threat to giant manta ray populations is commercial fishing. Giant manta rays are a targeted species for the mobuild gill raker market. Gills from mobuilds (i.e., rays of the genus *Mobula*, including *Manta spp.*) are dried and sold in Asian dried seafood and traditional Chinese medicine markets (National Marine Fisheries Service, 2020a)

Giant manta rays are visitors to productive coastlines including oceanic island shores, pinnacles, and seamounts (U.S. Department of the Navy, 2019). Although they are a migratory species, they do not cross ocean basins.

G.3 ESA-Listed Sea Turtles

G.3.1 Green Sea Turtle (Central West Pacific and East Indian-West Pacific DPS)

In 2016, the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS) reclassified green sea turtles into 11 DPSs, some of which are listed as endangered, and some as threatened, under the ESA. These DPSs maintains federal protections while providing a more tailored approach for managers to address specific threats facing different populations (81 FR 20058, April 6, 2016). Based on pre-consultation with NMFS, only the endangered Central West Pacific and the threatened East Indian-West Pacific DPSs are likely to be present in the ROI.

Green sea turtles nest on the beaches of the Mariana Islands, feeding and migrating throughout the waters of the Action Area (U.S. Department of the Navy, 2015). When they leave the nesting beach, hatchlings swim offshore, where they develop in the open ocean for approximately 1–3 years (Hirth, 1997). Upon reaching the juvenile stage, they move to coastal areas that are rich in seagrass and algae (National Marine Fisheries Service, 2024a). The optimal habitats for late juveniles and adults are warm, quiet, and shallow (10–33 feet [3.05–10.1 meters]) waters, with seagrasses and algae that are near reefs or rocky areas used for resting (Makowski et al., 2006). This habitat is where they will spend most of their lives (National Marine Fisheries Service, 2020a). A small number of green turtles appear to remain in the open ocean for extended periods, perhaps never moving to coastal feeding sites, though the reasons for this behavior are not yet understood (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2007a; Pelletier et al., 2003). For green sea turtles, breeding may occur on nesting beaches, foraging grounds, or in the open ocean along migration routes (National Marine Fisheries Service, 2024a).

Green turtles are highly migratory throughout their lives. They may travel thousands of kilometers between their juvenile developmental grounds and adult breeding and nesting grounds (National Marine Fisheries Service, 2024a). When they reach adulthood, green turtles begin migrating every 2–5 years between feeding grounds and nesting grounds (National Marine Fisheries Service, 2024a). Green sea turtles migrations between breeding and feeding grounds can be hundreds to thousands of kilometers (National Marine Fisheries Service, 2024a).

In the western Pacific BOA, green sea turtle (all DPSs) densities are estimated to be 0.00039 individuals/square kilometer (Hanser et al., 2018).

In the open ocean, Hatase et al. (2006) observed that green sea turtles dove to a maximum of 265 feet (80.8 meters), although typically no greater than 131 feet (39.9 meters). Green sea turtles migrating between the northwestern and main Hawaiian Islands reached a maximum depth greater than 445 feet (135.6 meters) at night (the deepest dives ever recorded for a green sea turtle), with a mean maximum night dive depth of 115 to 164 feet (35 to 50 meters) but only 14.1 feet (4.3 meters) during the day (Rice & Balazs, 2008).

The green sea turtle is the only sea turtle that is mostly herbivorous (Mortimer, 1995), although its diet changes throughout its life. Adult green sea turtles feed primarily on seagrasses, macroalgae, and reef-associated organisms (National Marine Fisheries Service, 2024a)

Anthropogenic threats for all DPSs include fishing bycatch, nesting predation, loss and degradation of nesting habitat, vessel strikes, disease, climate change, and ocean pollution/debris (National Marine Fisheries Service, 2024b). In nearshore areas, degradation of seagrass beds eliminates important food sources for the species. Fishing bycatch can include entanglement in lines, trawls, gillnets, longlines, hooks, and traps. Bycatch is currently the greatest threat to green sea turtles in the open ocean (National Marine Fisheries Service, 2024a).

G.3.2 Hawksbill Sea Turtle

The hawksbill sea turtle is listed as endangered under the ESA (35 FR 8491, June 2, 1970). The hawksbill sea turtle is the most tropical of the world's sea turtles, rarely occurring beyond 30°

North or 30° South in the Atlantic, Pacific, and Indian Oceans (Lazell, 1980). Hawksbill sea turtles inhabit oceanic waters as post-hatchlings and small juveniles (approximately 1–5 years of age), where they are sometimes associated with driftlines and floating patches of vegetation (National Oceanic and Atmospheric Administration, 2024b). After the oceanic phase, juvenile hawksbill sea turtles settle into coastal waters, where they will live the majority of their lives (National Oceanic and Atmospheric Administration, 2024b). In the western Pacific BOA, hawksbill sea turtle densities are estimated to be 0.000024 individuals/square kilometer (Hanser et al., 2018). Although no historical records of abundance are known, hawksbill sea turtles are considered to be severely depleted due to the fragmentation and low use of current nesting beaches (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2007b). Hawksbills, like other sea turtles, face predation primarily by sharks and to a lesser extent by killer whales (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2013). Compared to other species of sea turtles, hawksbill sea turtles are not considered deep divers (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2013). Hawksbill foraging dive durations are often a function of turtle size, with larger turtles diving deeper and longer. Hawksbill sea turtles eat both animals and plants in coral and rocky reefs (National Marine Fisheries Service, 2020a). Older juveniles and adults are more specialized, feeding primarily on sponges, which comprise as much as 95 percent of their diet in some locations, although the diet of adult hawksbill sea turtles in the Indo-Pacific region includes other invertebrates and algae (Meylan, 1988; Witzell, 1983).

Fishing bycatch and entanglement is one of the main threats to hawksbill sea turtles. Similar to green sea turtles, entanglement in fishing gear such as longlines, trawls, or hooks can lead to injury or death of an individual. Other anthropogenic threats include shell and egg harvesting, habitat degradation, vessel strikes, and climate change (National Oceanic and Atmospheric Administration, 2024b).

G.3.3 Loggerhead Sea Turtle (North Pacific Ocean DPS)

In 2011, NMFS and USFWS listed five loggerhead sea turtle DPSs as endangered and kept four as threatened under the ESA (76 FR 58868, September 22, 2011). Only the North Pacific Ocean DPS, which is listed under the ESA as endangered, occurs within the ROI. The loggerhead sea turtle is found in habitats ranging from coastal estuaries to the open ocean (Dodd, 1988). The species may be found hundreds of miles out to sea, as well as in nearshore areas such as bays, lagoons, salt marshes, creeks, ship channels, and the mouths of large rivers. In the western Pacific BOA, loggerhead sea turtle densities are estimated to be 0.000022 individuals/square kilometer (Hanser et al., 2018). Loggerhead sea turtles foraging in the nearshore habitat dive to the seafloor (average depth 165–490 feet [50.3–149.4 meters]), and those in the open-ocean habitat dive in the 0–80 feet (0–24.4 meter) depth range (Hatase et al., 2007).

In both open ocean and nearshore habitats, loggerhead sea turtles are primarily carnivorous, although they also consume some plant matter (National Marine Fisheries Service, 2020a). Both juveniles and adults forage in coastal habitats, where they feed primarily on the bottom, although they also capture prey throughout the water column (Bjorndal, 2003; National Oceanic and Atmospheric Administration, 2024d).

Commercial fishing entanglement is one of the primary anthropogenic threats to loggerhead sea turtles (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2023). Shrimp trawl fisheries account for the highest number of loggerhead sea turtle fishery mortalities; they are also captured and killed in trawls, traps and pots, longlines, and dredges.

G.3.4 Olive Ridley Sea Turtle

The olive ridley sea turtle is listed under the ESA as threatened (43 FR 32800, July 28, 1978). They are found in tropical waters of the south Atlantic, Indian, and Pacific Oceans. Most olive ridley sea turtles lead a primarily open-ocean life, where they forage, mate, develop, and migrate (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2020) (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2014). Outside of the breeding season, olive ridley sea turtles disperse. Neither males nor females migrate to one specific foraging area, and olive ridley sea turtles tend to roam and occupy a series of feeding areas in the open ocean. 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. Both adult and juvenile olive ridley sea turtles typically inhabit offshore waters, foraging from the surface to a depth of 500 feet (152.4 meters) (National Oceanic and Atmospheric Administration, 2024e). As with all marine turtles, sharks are likely to be major predators of all age classes at sea (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2014).

Olive ridley sea turtles forage in the open ocean to depths up to 500 feet (152.4 meters) (National Oceanic and Atmospheric Administration, 2024e). Olive ridley sea turtles are omnivorous. They consume a variety of prey in the water column and on the seafloor, including snails, clams, lobster, fish, fish eggs, crabs, oysters, sea urchins, shrimp, and jellyfish (National Oceanic and Atmospheric Administration, 2024e). The principal cause of the historical, worldwide decline of the olive ridley sea turtle is long-term collection of eggs and killing of adults on nesting beaches (Abreu-Grobois & Plotkin, 2008). The current largest threat to olive ridley sea turtles is fishing bycatch and entanglement in fishing gear. Similar to the green sea turtle and hawksbill sea turtle, olive ridley sea turtles are at risk of injury and death from fishing lines, hooks, and nets from commercial fishing (National Oceanic and Atmospheric Administration, 2024e).

G.3.5 Leatherback Sea Turtle

The leatherback sea turtle is listed as a single population and classified as endangered under the ESA (35 FR 8491, June 2, 1970). This species is occasionally encountered in the deep, pelagic waters of the Marianas archipelago, although only a few occurrences have been recorded (Eckert et al., 1999). Satellite tracking of leatherback sea turtles departing from regional nesting habitats in Malaysia, Indonesia, the Solomon Islands, and the Philippines occasionally show that leatherback sea turtles transit through the western Pacific BOA (Benson et al., 2007). In the western Pacific BOA, leatherback sea turtle densities are estimated to be 0.000022 individuals/square kilometer (Hanser et al., 2018). The leatherback sea turtle is the deepest diving sea turtle, with a recorded maximum depth of 4,200 feet (1,280 meters), although most dives are much shallower (usually less than 820 feet [250 meters]) (Dodge et al., 2014; Doyle et al., 2008; Hays et al., 2004; Houghton et al., 2008; National Oceanic and Atmospheric Administration, 2024c). Diving activity (including surface time) is influenced by a suite of environmental factors (e.g., water temperature, availability and vertical distribution of food resources, bathymetry) that result in spatial and temporal variations in dive behavior (James et al., 2006; Sale et al., 2006). While transiting, leatherback sea turtles make longer and deeper dives (James et al., 2006; Jonsen et al., 2007). It is suggested that leatherback sea turtles make scouting dives while transiting as an efficient means for sampling prey density and perhaps also to feed opportunistically at these times (James et al., 2006; Jonsen et al., 2007).

Leatherback sea turtles lack the crushing and chewing plates characteristic of hard-shelled sea turtles that feed on hard-bodied prey (National Oceanic and Atmospheric Administration, 2024c). Instead, they have pointed tooth-like cusps and sharp-edged jaws that are perfectly adapted for a diet of soft-bodied prey, such as jellyfish and salps (planktonic tunicate) (National Oceanic and Atmospheric Administration, 2024c). Leatherback sea turtles feed from the surface as well as at depth, potentially diving up to 4,035 feet (1,230 meters) (National Oceanic and Atmospheric Administration, 2024c) (Eckert et al., 1989; Eisenberg & Frazier, 1983; Grant & Ferrell, 1993).

Leatherback sea turtles are affected by multiple human activities, including fisheries interactions, entanglement in fishing gear (e.g., gillnets, longlines, lobster pots, weirs), direct harvest, egg collection, the destruction and degradation of nesting and coastal habitat, boat collisions, and ingestion of marine debris (National Marine Fisheries Service, 2016).

G.4 ESA-Listed Marine Mammals

G.4.1 Humpback Whale (Western North Pacific DPS)

The Western North Pacific humpback whale (*Megaptera novaeangliae*) is listed as endangered under the ESA (81 FR 62259, September 8, 2016). Humpback whales are distributed worldwide in all major oceans. They are typically found during the summer at high latitude feeding grounds and during the winter in the tropics and subtropics around islands, including the Marianas, over shallow banks, and along continental coastlines. Humpbacks exhibit a wide range of foraging behaviors and feed on a range of prey types, including small schooling fish, euphausiids, and other large zooplankton (National Marine Fisheries Service, 2020a). Humpback whales are generally believed to fast while migrating and at breeding grounds, but some individuals apparently feed while in low-latitude waters normally believed to be used exclusively for reproduction and calf-rearing (National Marine Fisheries Service, 2020a). Humpback whales have been sighted in the Action Area during the months of January through March, and male humpback songs have been recorded from December through April. Humpback whale sounds were infrequently detected at Tinian during June to October (National Marine Fisheries Service, 2020a). The detected winter presence of humpback whales in the Mariana Islands is consistent with the ROI as a plausible migratory destination for humpback whales from Alaska. Researchers now believe that the Mariana Islands are not only used as a breeding area, but also as a winter calving area for humpback whales, as individual females have been recorded returning to the islands (National Marine Fisheries Service, 2020a).

Wintering (breeding and calving) habitat for humpback whales occurs in depths between 0 and 200 meters (Hill et al., 2016). Humpback whales frequently traverse up to 5,000 miles through deep oceanic waters during migration (National Marine Fisheries Service, 1991). Humpback whales are found in the tropical and surrounding waters of Guam during spring, fall, and winter seasons (U.S. Department of the Navy, 2019). Limited systematic sightings data do not allow for a humpback whale density estimation within the ROI. In the absence of study-area-specific data, the Navy used a humpback whale density estimate of 0.00089 animals/square kilometer derived from a TAIGER NSF survey conducted in waters around Taiwan (National Marine Fisheries Service, 2020a). This estimate was used to characterize humpback whale density in both the MITT and associated transit corridor study areas for fall, winter, and spring. Humpback whales are likely absent from low-productivity tropical waters in the summer; therefore, a density of zero was used for that season (National Marine Fisheries Service, 2020a).

Whales that winter off the Mariana Archipelago, Ogasawara, and other areas not yet identified and then migrate to summer feeding areas off the Commander Islands, and to the Bering Sea and Aleutian Islands comprise the Marianna/Ogasawara-Northern Pacific Unit Humpback Whale Northern Pacific Stock (National Marine Fisheries Service, 2020a). Vessel strikes, climate change, and entanglement from fishing gear pose the greatest threat to the species.

The current abundance of the Western North Pacific DPS is an estimated 1,107, with a minimum population size estimate of 865 (National Marine Fisheries Service, 2020a). A population growth rate is currently unavailable for this DPS. Within the Action Area, the abundance of humpback whales are estimated to be approximately 938 animals based on extrapolated data from a regional survey off the Philippines (National Marine Fisheries Service, 2020a).

G.4.2 Blue Whale

The blue whale (*Balaenoptera musculus*) is listed under the ESA as endangered (35 FR 18319, December 2, 1970). Blue whales inhabit all major oceans in nearshore and deep oceanic waters. Overall, little is known about the distribution, migration, and habitat use of blue whales in the central and western North Pacific Ocean. While they can be found in coastal waters, they are thought to prefer waters further offshore. Blue whales belonging to the Central Pacific Stock feed in the summer south of the Aleutian Islands and in the Gulf of Alaska, then migrate to lower latitudes in the winter (National Oceanic and Atmospheric Administration, 2024a). However, with the exception of humpback whales, marine mammal populations around the Marianas have not been assigned to stocks. The recovery plan for blue whales indicates that some populations of blue whales do not migrate (National Marine Fisheries Service, 2020b).

Blue whales' diet comprises mostly of krill. Whales forage in small groups at depths up to 100 meters, although some whales forage around 250 to 300 meters (National Marine Fisheries Service, 2020b). They are considered lunge-feeders and filter large quantities of seawater (as much as 70 percent of their body weight with every feeding lunge) to capture prey in their baleen. Sustaining swim speeds with the increased drag required by this feeding behavior is energetically expensive and may explain typical dive times (approximately 10 minutes) being much shorter than would otherwise be predicted based on body size (National Marine Fisheries Service, 2020b). In support of this hypothesis, blue whales spend more time recovering from foraging dives compared to shallower non-foraging dives (National Marine Fisheries Service, 2020b). However, Goldbogen et al. (2013) suggested that a large body size enables relatively high feeding efficiency because blue whales have a slow metabolism and consume large quantities of rapidly filtered prey with each feeding event. Blue whales forage almost exclusively on krill and can eat approximately 3,600 kilograms daily (National Marine Fisheries Service, 2020a). Feeding aggregations are often found at the continental shelf edge, where upwelling produces concentrations of krill at depths of 90–120 meters (National Marine Fisheries Service, 2020a). Blue whales spend more than 94 percent of their time underwater, diving 5–20 times at 12–20 second intervals before a deep dive of 3–30 minutes (National Marine Fisheries Service, 2020a).

Blue whales travel through deep oceanic waters during migration periods (spring, fall, winter). As such, blue whales are most likely to occur within the ROI during winter months, but in low numbers (U.S. Department of the Navy, 2019). Blue whales can be found in all major oceans, with the exception of the Arctic. The Pacific Island Fisheries Science Center has deployed several passive acoustic monitoring devices to monitor marine mammals and ambient noise levels in U.S. Exclusive Economic Zone waters off the Mariana Islands. Blue whales were positively identified at both Saipan and Tinian between 2010 and 2013, although calls were rare across all years of the study (National Marine Fisheries Service, 2020a). In the absence of study area-specific density data, and consistent with recommendations from scientists at the Pacific Island Fisheries Science Center, the line-transect estimate derived for Hawaiian waters was used to represent the best available estimate for the MITT Action Area. The resulting density estimate of 0.00005 individuals/square kilometer was used for the MITT Action Area and associated transit corridor for fall, winter, and spring (zero presence in summer) (National Marine Fisheries Service, 2020a).

Blue whales were subject to intensive commercial whaling, with over 380,000 blue whales taken between 1868 and 1978, mostly from Antarctic waters (National Marine Fisheries Service, 2020b). The global mature population size in 1926 was around 140,000. The current global mature population size is uncertain but estimated to be in the range of 5,000–15,000 mature individuals (National Marine Fisheries Service, 2020b). This current mature population is between 3 and 11 percent of the 1926 level (National Marine Fisheries Service, 2020b). Although still depleted compared to historical abundance, blue whale populations around the world show signs of growth. Intensive whaling operations between 1868 and 1978 sharply decreased species abundance (National Marine Fisheries Service, 2020b). Current population estimates for the species is approximately 10,000 to 25,000 total individuals, with 5,000 to 15,000 mature individuals globally (National Marine Fisheries Service, 2020b).

G.4.3 Fin Whale

The fin whale (*Balaenoptera physalus*) is listed as endangered under the ESA (35 FR 18319 December 2, 1970). Fin whales are commonly found in deep, oceanic waters and are most abundant in temperate and polar oceans (National Oceanic and Atmospheric Administration, 2023). Fin whales are less abundant in tropical oceans and typically not expected south of 20 degrees latitude (National Oceanic and Atmospheric Administration, 2023). As such, fin whales would be considered rare within the ROI. They mostly inhabit deep, offshore waters of all major oceans. They winter at low latitudes, where they calve and nurse, and summer at high latitudes, where they feed, although some fin whales appear to be residential to certain areas. Fin whales eat pelagic crustaceans (mainly euphausiids or krill) and schooling fish such as capelin, herring, and sand lance (National Marine Fisheries Service, 2020a). Fin whales may use the ROI during migration and feeding (National Oceanic and Atmospheric Administration, 2023). There are no comprehensive or reliable population estimates of fin whales. The density estimate in the western Pacific is approximately 0.00006 individuals/square kilometer (U.S. Department of the Navy, 2018).

In the 20th century, commercial whaling highly impacted fin whales (U.S. Department of the Navy, 2019). Prior to commercial whaling, hundreds of thousands of fin whales existed. Fin whale populations declined, due largely to direct harvest, by more than 70 percent from 1929 to 2007 (National Marine Fisheries Service, 2020a). The rough global estimate in 2000 was about 53,000 fin whales. Fin whales may still be killed under “aboriginal subsistence whaling” in Greenland under Japan’s scientific whaling program and Iceland’s formal objection to the International Whaling Commission’s ban on commercial whaling. Additional threats include vessel strikes, reduced prey availability due to overfishing or climate change, and sound (National Marine Fisheries Service, 2020a). The greatest current threat to fin whales is entanglement in fishing gear (National Oceanic and Atmospheric Administration, 2023). Today, species abundance is in the tens of thousands distributed across major ocean basins and hemispheres. This level of abundance and extent of distribution indicates that whales have a low probability of experiencing the deleterious effects of small population size, such as depensatory processes and random biological or environmental variation (National Marine Fisheries Service, 2020a). Increasing populations in the North Pacific indicate that reproduction is exceeding mortality (National Marine Fisheries Service, 2020a).

G.4.4 Sei Whale

The sei whale (*Balaenoptera borealis*) is listed under the ESA as endangered (35 FR 18319 December 2, 1970). Sei whales are found in ocean basins worldwide. Stocks that have a total population size of 2,000 to 2,500 individuals or greater provide for maintenance of genetic diversity resulting in long-term persistence and protection from substantial environmental variance and catastrophes. Stocks that have a total population 500 individuals or less may be at a greater risk of extinction due to genetic risks resulting from inbreeding. Stock populations at low densities (less than 100) are more likely to suffer from the "Allee" effect, where inbreeding and the heightened difficulty of finding mates reduces the population growth rate in proportion with reducing density. All stocks of sei whales within U.S. waters are estimated to be below 600 individuals, indicating they may be at risk of extinction due to inbreeding (National Marine Fisheries Service, 2020a).

Sei whales spend the summer feeding in high, subpolar latitudes and return to lower latitudes to calve in winter (Horwood, 1987). Sei whales are most often found in deep, 3,164–9,322 meters (10,381–30,583 feet), continental shelf and slope waters far from the coastline (National Marine Fisheries Service, 2020a). Most sei whale sightings are associated with steep bathymetric relief (e.g., steeply sloping areas), including sightings adjacent to the Chamorro Seamounts east of the Commonwealth of the Northern Mariana Islands (Fulling et al., 2011). A 2007 systematic survey identified 16 sightings, with a resulting abundance estimate of 166 individuals in the waters of Guam and the Commonwealth of Northern Marianas Islands (Fulling et al., 2011). Sei whales were estimated to have been reduced to 20 percent (8,600 out of 42,000) of their pre-whaling abundance in the North Pacific (Tillman, 1977). Now, only a few individuals are taken each year by Japan; however, Iceland has expressed an interest in targeting sei whales. Current threats include vessel strikes, fisheries interactions (including entanglement), climate change (habitat loss and reduced prey availability), and anthropogenic sound. Given the species' overall abundance, they may be somewhat resilient to current threats. No data on the current population trend are available; however, the population in the North Pacific is expected to have increased since sei whales began receiving protection in 1976 (Carretta, 2013). However, the possible effects of continued unauthorized takes, vessel strikes, and gillnet mortality make this increasing trend uncertain (Carretta et al., 2019).

Norris et al., 2012 reported sei whale encounters occurred primarily in the central and southern region of the MITT study area, ranging from the island of Tinian to the southeast corner of the study area. A higher concentration was found in the southeast corner and along the Mariana Trench (Norris et al., 2012). A sei whale was also detected with sonobuoys on the January to February 2010 Oscar Elton Sette Cruise from Hawaii to Guam. However, the information did not determine if detection occurred in the western Pacific BOA (National Marine Fisheries Service, 2020a). Density estimates of sei whales in the western Pacific Ocean are approximately 0.00029 individuals/kilometer (U.S. Department of the Navy, 2018).

G.4.5 Sperm Whale

The sperm whale (*Physeter macrocephalus*) is listed as endangered under the ESA (35 FR 18319, December 2, 1970). Sperm whales are widely distributed throughout oceans worldwide and are most often found in deep waters, with female sperm whales found far from land, only in waters deeper than 1,000 meters (Whitehead, 2009). Sperm whales mostly inhabit areas with a water depth of 600 meters or more and are uncommon in waters less than 300 meters deep (National Marine Fisheries Service, 2020a). During a 2007 survey, sperm whales were observed in waters 2,670–32,584 feet (809–9,874 meters) deep (Fulling et al., 2011). Sperm whales winter at low latitudes where they calve and nurse, and summer at high latitudes where they feed primarily on squid; other prey includes octopus and demersal fish (including teleosts and elasmobranchs)(National Marine Fisheries Service, 2020a). The sperm whale is the most abundant of the large whale species, with total abundance estimates between 200,000 and 1,500,000. The most recent estimate indicated a global population of between 300,000 and 450,000 individuals (Whitehead, 2009).

The sperm whale is endangered as a result of past commercial whaling. Although the aggregate abundance worldwide is probably at least several hundred thousand individuals, the extent of the depletion and the degree of recovery of populations is uncertain (National Marine Fisheries Service, 2020a). Density of sperm whales in the western Pacific BOA is approximately 0.00291 individuals/square kilometer (U.S. Department of the Navy, 2018).

G.5 <u>ESA-Listed Seabirds</u>

G.5.1 Short-Tailed Albatross

Short-tailed albatross spend most of their lives at sea, only coming to land to breed on remote islands in the western Pacific Ocean. Their at-sea distribution includes the entire north Pacific Ocean north of about 20° North latitude (U.S. Fish and Wildlife Service, 2008). Short-tailed albatross feed on prey seized from the water surface, including squid, shrimp, fish, fish eggs, and crustaceans (U.S. Fish and Wildlife Service, 2023). Threats to the species include entanglement from commercial fishing nets and gear, habitat destruction, and environmental contaminants. In 2020, estimate for the species is approximately 7,365 individuals (U.S. Fish and Wildlife Service, 2023).

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REFERENCES

Abreu-Grobois, A. and P. Plotkin. (2008). Lepidochelys olivacea. In:. *IUCN Red List of Threatened Species Version 2012.2*.

Benson, S. R., K. A. Forney, J. T. Harvey, J. V. Carretta, and P. H. Dutton. (2007). Abundance, distribution, and habitat of leatherback turtles (*Dermochelys coriacea*) off California, 1990–2003. *Fishery Bulletin 105* (3): 337–347.

Bjorndal, K. A. (2003). Roles of loggerhead sea turtles in marine ecosystems. In A. B. Bolten & B. E. Witherington (Eds.), *Loggerhead Sea Turtles* (pp. 235–254). Washington, DC: Smithsonian Books.

Budd, A. M., M. K. Cooper, A. e. Le Port, T. Schils, M. S. Mills, M. E. Deinhart, R. Huerlimann, and J. M. Strugnell. (2021). First detection of critically endangered scalloped hammerhead sharks (*Sphyrna lewini*) in Guam, Micronesia, in five decades using environmental DNA. *Ecological Indicators 127* (2021): 107649 (107614 pages).

Carretta, J., V. Helker, M. Muto, J. Greenman, K. Wilkinson, D. Lawson, J. Viezbicke, and J. Jannot. (2019). *Sources of Human-Related Injury and Mortality for U.S. Pacific Coast Marine Mammal Stock Assessments, 2013–2017*. La Jolla, CA: National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center, Marine Mammal and Sea Turtle Division.

Carretta, J. V. (2013). *A Review of Sperm Whale (Physeter macrocephalus) Bycatch in the California Swordfish and Thresher Shark Drift Gillnet Fishery*. La Jolla, CA: Southwest Fisheries Science Center.

Dodd, C. K., Jr. (1988). *Synopsis of the Biological Data on the Loggerhead Sea Turtle, Caretta caretta (Linnaeus 1758)*. Washington, DC: U.S. Fish and Wildlife Service.

Dodge, K. L., B. Galuardi, T. J. Miller, and M. E. Lutcavage. (2014). Leatherback Turtle Movements, Dive Behavior, and Habitat Characteristics in Ecoregions of the Northwest Atlantic Ocean. *PLoS ONE 9* (3): e91726.

Doyle, L. R., B. McCowan, S. F. Hanser, C. Chyba, T. Bucci, and E. J. Blue. (2008). Applicability of information theory to the quantification of responses to anthropogenic noise by southeast Alaskan humpback whales. *Entropy 10* 33–46. DOI:10.3390/entropy-e10020033

Duncan, K. M. and K. N. Holland. (2006). Habitat use, growth rates and dispersal patterns of juvenile scalloped hammerhead sharks, *Sphyrna lewini,* in a nursery habitat. *Marine Ecology Progress Series 312* 211–221. DOI:10.3354/meps312211

Eckert, K. L., K. A. Bjorndal, F. A. Abreu-Grobois, and M. Donnelly, (Eds.). (1999). *Research and Management Techniques for the Conservation of Sea Turtles*. Washington, DC: Marine Turtle Specialist Group Publication.

Eckert, K. L., S. A. Eckert, T. W. Adams, and A. D. Tucker. (1989). Inter-nesting migrations by leatherback sea turtles (*Dermochelys coriacea*) in the West Indies. *Herpetologica 45* (2): 190–194.

Eisenberg, J. F. and J. Frazier. (1983). A leatherback turtle (*Dermochelys coriacea*) feeding in the wild. *Journal of Herpetology 17* (1): 81–82.

Fulling, G. L., P. H. Thorson, and J. Rivers. (2011). Distribution and Abundance Estimates for Cetaceans in the Waters off Guam and the Commonwealth of the Northern Mariana Islands. *Pacific Science 65* (3): 321–343. DOI:10.2984/65.3.321

Goldbogen, J. A., A. S. Friedlaender, J. Calambokidis, M. F. McKenna, M. Simon, and D. Nowacek. (2013). Integrative Approaches to the Study of Baleen Whale Diving Behavior, Feeding Performance, and Foraging Ecology. *BioScience 63* (2): 90–100. DOI:10.1525/bio.2013.63.2.5

Grant, G. S. and D. Ferrell. (1993). Leatherback turtle, *Dermochelys coriacea* (Reptilia: *Dermochelidae*): Notes on near-shore feeding behavior and association with cobia. *Brimleyana 19* 77–81.

Hanser, S., E. Becker, and M. Zickel. (2018). *U.S. Navy Marine Species Density Database Phase III for the Mariana Islands Training and Testing Study Area*.

Hatase, H., K. Omuta, and K. Tsukamoto. (2007). Bottom or midwater: Alternative foraging behaviours in adult female loggerhead sea turtles. *Journal of Zoology 273* (1): 46–55.

Hatase, H., K. Sato, M. Yamaguchi, K. Takahashi, and K. Tsukamoto. (2006). Individual variation in feeding habitat use by adult female green sea turtles (*Chelonia mydas*): Are they obligately neritic herbivores? *Oecologia 149* 52–64. DOI:10.1007/s00442-006-0431-2

Hays, G. C., J. D. R. Houghton, C. Isaacs, R. S. King, C. Lloyd, and P. Lovell. (2004). First records of oceanic dive profiles for leatherback turtles, *Dermochelys coriacea*, indicate behavioural plasticity associated with long-distance migration. *Animal Behaviour 67* 733–743. DOI:10.1016/j.anbehav.2003.08.011

Hill, M. C., A. L. Bradford, A. D. Ligon, A. C. U, J. Rivers, R. K. Uyeyama, R. L. Brownell, Jr., and E. M. Oleson. (2016). *Are Humpback Whales (Megaptera novaeangliae) Breeding and Calving in the Mariana Islands?* Cambridge, United Kingdom: International Whaling Commission.

Hirth, H. F. (1997). *Synopsis of the Biological Data on the Green Turtle Chelonia mydas (Linnaeus 1758)*. Washington, DC: U.S. Fish and Wildlife Service.

Horwood, J. (1987). *The Sei Whale: Population Biology, Ecology, and Management*. New York, NY: Croom Helm.

Houghton, J. D. R., T. K. Doyle, J. Davenport, R. P. Wilson, and G. C. Hays. (2008). The role of infrequent and extraordinary deep dives in leatherback turtles (Dermochelys coriacea). *The Journal of Experimental Biology 211* 2566–2575.

James, M. C., J. Davenport, and G. C. Hays. (2006). Expanded thermal niche for a diving vertebrate: A leatherback turtle diving into near-freezing water. *Journal of Experimental Marine Biology and Ecology 335* 221–226. DOI:10.1016/j.jembe.2006.03.013

Jonsen, I. D., R. A. Myers, and M. C. James. (2007). Identifying leatherback turtle foraging behaviour from satellite telemetry using a switching state-space model. *Marine Ecology Progress Series 337* 255–264.

Ketchum, J. T., A. Hearn, A. P. Klimley, E. Espinoza, C. Penaherrera, and J. L. Largier. (2014). Seasonal changes in movements and habitat preferences of the scalloped hammerhead shark (*Sphyrna lewini*) while refuging near an oceanic island. *Marine Biology 161* (4): 755–767.

Lazell, J. D., Jr. (1980). New England waters: Critical habitat for marine turtles. *Copeia 1980* (2): 290–295.

Makowski, C., J. A. Seminoff, and M. Salmon. (2006). Home range and habitat use of juvenile Atlantic green turtles (*Chelonia mydas* L.) on shallow reef habitats in Palm Beach, Florida, U.S.A. *Marine Biology 148* 1167–1179. DOI:10.1007/s00227-005-0150-y

Meylan, A. (1988). Spongivory in hawksbill turtles: A diet of glass. *Science 239* (4838): 393–395.

Miller, M. H., J. Carlson, P. Cooper, D. Kobayashi, M. Nammack, and J. Wilson. (2014). *Status Review Report: Scalloped Hammerhead Shark (Sphyrna lewini)*. Silver Spring, MD: National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

Miller, M. H. and C. Klimovich. (2016). *Endangered Species Act Status Review Report: Giant Manta Ray (Manta birostris) and Reef Manta Ray (Manta alfredi).* Silver Spring, MD: National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

Mortimer, J. A. (1995). Feeding ecology of sea turtles. In K. A. Bjorndal (Ed.), *Biology and Conservation of Sea Turtles* (Revised ed., pp. 103–109). Washington, DC: Smithsonian Institution Press.

Nalesso, E., A. Hearn, O. Sosa-Nishizaki, T. Steiner, A. Antoniou, A. Reid, and S. Bessudo. (2019). Movements of scalloped hammerhead sharks (*Sphyna lewini*) at Cocos Island, Costa Rica and between oceanic islands in the Eastern Tropical Pacific. *PLoS ONE 14* (3). DOI:https://doi.org/10.1371/journal.pone.0213741

National Marine Fisheries Service. (1991). *Final recovery plan for the humpback whale (Megaptera novaeangliae)*. Silver Spring, MD: National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources.

National Marine Fisheries Service. (2016). *Species in the Spotlight: Pacific Leatherback 5-Year Action Plan*. Silver Spring, MD: National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

National Marine Fisheries Service. (2020a). *Biological Opinion on (1) United States (U.S.) Navy Mariana Islands Training and Testing Activities; and (2) the National Marine Fisheries Service's promulgation of regulations and issuance of a letter of authorization pursuant to the Marine Mammal Protection Act for the U.S. Navy to "take" marine mammals incidental to Mariana Islands Training and Testing activities from August 2020 through August 2027*. National Marine Fisheries Service.

National Marine Fisheries Service. (2020b). *Recovery Plan for the Blue Whale (Balaenoptera musculus) - First Revision*. Silver Spring, MD: National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources.

National Marine Fisheries Service. (2022). *Oceanic Whitetip Shark Carcharhinus longimanus*. Retrieved January 18, 2023, from https://www.fisheries.noaa.gov/species/oceanic-whitetip-shark.

National Marine Fisheries Service. (2024a). *Green Turtle*. Retrieved January 15, 2024, from https://www.fisheries.noaa.gov/species/green-turtle.

National Marine Fisheries Service. (2024b). *Species Directory*. Retrieved January 15, 2024, from https://www.fisheries.noaa.gov/species-directory/threatened-endangered.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. (2007a). *Green Sea Turtle (Chelonia mydas) 5-year Review: Summary and Evaluation*. Silver Spring, MD: National Marine Fisheries Service.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. (2007b). *Hawksbill Sea Turtle (Eretmochelys imbricata) 5-year Review: Summary and Evaluation*. Silver Spring, MD: National Marine Fisheries Service.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. (2013). *Hawksbill Sea Turtle (Eretmochelys imbricata) 5-Year Review: Summary and Evaluation*. Silver Spring, MD: Office of Protected Resources.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. (2014). *Olive Ridley Sea Turtle (Lepidochelys olivacea) 5-Year Review: Summary and Evaluation*. Silver Spring, MD and Jacksonville, FL: National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources; and U.S. Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Services Field Office.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. (2020). *Endangered Species Act status review of the leatherback turtle (Dermochelys coriacea)* (Report to the National Marine Fisheries Service Office of Protected Resources and U.S. Fish and Wildlife Service). Silver Spring, MD: National Oceanic and Atmospheric Administration, National Marine Fisheries Service; and the U.S. Fish and Wildlife Service.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. (2023). *Loggerhead Sea Turtle (Caretta caretta) Northwest Atlantic Ocean DPS 5-Year Review: Summary and Evaluation*. Silver Spring, MD and Jacksonville, FL: National Marine Fisheries Service, Office of Protected Resources, and U.S. Fish and Wildlife Service, Southeast Region, Florida Ecological Services Office.

National Oceanic and Atmospheric Administration. (2016, January 12). *Oceanic Whitetip Shark (Carcharhinus longimanus)*. Retrieved July 21, 2016, from https://www.fisheries.noaa.gov/species/oceanic-whitetip-shark.

National Oceanic and Atmospheric Administration. (2023). *Fin Whale*. Retrieved 9/20/2023, 2023, from https://www.fisheries.noaa.gov/species/fin-whale.

National Oceanic and Atmospheric Administration. (2024a). *Blue Whale*. Retrieved 3/12/2024, 2024, from https://www.fisheries.noaa.gov/species/blue-whale.

National Oceanic and Atmospheric Administration. (2024b). *Hawksbill Turtle*. Retrieved 3/12/2024, 2024, from https://www.fisheries.noaa.gov/species/hawksbill-turtle.

National Oceanic and Atmospheric Administration. (2024c). *Leatherback Turtle*. Retrieved 3/12/2024, 2024, from https://www.fisheries.noaa.gov/species/leatherback-turtle.

National Oceanic and Atmospheric Administration. (2024d). *Loggerhead Turtle*. Retrieved 3/14/2024, 2024, from https://www.fisheries.noaa.gov/species/loggerhead-turtle.

National Oceanic and Atmospheric Administration. (2024e). *Olive Ridley Turtle*. Retrieved 3/12/2024, 2024, from https://www.fisheries.noaa.gov/species/olive-ridley-turtle.

Norris, T. F., J. Oswald, T. Yack, E. Ferguson, C. Hom-Weaver, K. Dunleavy, S. Coates, and T. Dominello. (2012). *An Analysis of Acoustic Data from the Mariana Islands Sea Turtle and Cetacean Survey (MISTCS)*. Encinitas, CA: Bio-Waves, Inc.

Pelletier, D., D. Roos, and S. Ciccione. (2003). Oceanic survival and movements of wild and captive-reared immature green turtles (*Chelonia mydas*) in the Indian Ocean. *Aquatic Living Resources 16* 35–41. DOI:10.1016/S0990-7440(03)00005-6

Rice, M. R. and G. H. Balazs. (2008). Diving behavior of the Hawaiian green turtle (*Chelonia mydas*) during oceanic migrations. *Journal of Experimental Marine Biology and Ecology 356* (1–2): 121–127. DOI:10.1016/j.jembe.2007.12.010

Rogers, A. D. (1994). The biology of seamounts. *Advances in Marine Biology 30* 305–350.

Sale, A., P. Luschi, R. Mencacci, P. Lambardi, G. R. Hughes, G. C. Hays, S. Benvenuti, and F. Papi. (2006). Long-term monitoring of leatherback turtle diving behaviour during oceanic movements. *Journal of Experimental Marine Biology and Ecology 328* 197–210. DOI:10.1016/j.jembe.2005.07.006

Tillman, M. F. (1977). Estimates of population size for the North Pacific sei whale. *Report of the International Whaling Commission Special Issue 1* 98–106.

U.S. Department of the Navy. (2015). *The Mariana Islands Training and Testing Final Environmental Impact Statement/Overseas Environmental Impact Statement*. Pearl Harbor, HI: U.S. Department of the Navy.

U.S. Department of the Navy. (2018). *U.S. Navy Marine Species Density Database Phase III for the Mariana Islands Training and Testing Study Area* (Naval Facilities Engineering Command Pacific Technical Report). Pearl Harbor, HI: Naval Facilities Engineering Command Pacific.

U.S. Department of the Navy. (2019). *Mariana Islands Training and Testing Biological Assessment to Support Endangered Species Act Section 7 Consultation with the National Marine Fisheries Service*. Pearl Harbor, HI: U.S. Department of the Navy.

U.S. Fish and Wildlife Service. (2008). *Short-Tailed Albatross Recovery Plan*. Anchorage, AK: U.S. Fish and Wildlife Service.

U.S. Fish and Wildlife Service. (2023). *Short-tailed Albatross*. Retrieved September 19, 2023, from https://www.fws.gov/species/short-tailed-albatross-phoebastria-albatrus.

Wells, R. J. D., T. C. TinHan, M. A. Dance, J. M. Drymon, B. Falterman, M. J. Ajemian, G. W. Stunz, J. A. Mohan, E. R. Hoffmayer, W. B. Driggers, and J. A. McKinney. (2018). Movement, behavior, and habitat use of a marine apex predator, the scalloped hammerhead. *Frontiers in Marine Science 5*. DOI:10.3389/fmars.2018.00321

Whitehead, H. (2009). Sperm whale, *Physeter macrocephalus*. In W. F. Perrin, B. Wursig, & J. G. M. Thewissen (Eds.), *Encyclopedia of Marine Mammals* (2nd ed., pp. 1091–1097). Cambridge, MA: Academic Press.

Witzell, W. N. (1983). *Synopsis of biological data on the hawksbill turtle, Eretmochelys imbricata (Linnaeus, 1766)*. Rome, Italy: United Nations Environment Programme, Food and Agriculture Organization of the United Nations.

Missile Defense Agency

Guam Flight Test Environmental Assessment

Appendix H: Air Quality Impact Study

May 2024

Department of Defense
Missile Defense Agency
5700 18th Street
Fort Belvoir, VA 22060-5573

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Acronyms and Abbreviations

Acronym	Definition
°C	degrees Celsius
°F	degrees Fahrenheit
AAFB	Andersen Air Force Base
AQIS	Air Quality Impact Study
BOA	Broad Ocean Area
CAA	Clean Air Act
CFR	Code of Federal Regulations
CO	Carbon monoxide
EA	Environmental Assessment
EO	Executive Order
EPA	Environmental Protection Agency
HAP	Hazardous Air Pollutants
MDA	Missile Defense Agency
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NO_2	Nitrogen dioxide
NWF	Northwest Field
O_3	Oxides
OEA	Overseas Environmental Assessment
Pb	Lead
PM_{10}	Particulate matter less than or equal to 10 microns
$PM_{2.5}$	Particulate matter less than or equal to 2.5 microns
PSD	Prevention of Significant Deterioration
ROI	Region of Influence
SIP	State Implementation Plan
SM	Standard Missile
SO_2	Sulfur dioxide
THAAD	Terminal High Altitude Area Defense
tpy	Tons per year
U.S.	United States
USEPA	U.S. Environmental Protection Agency

1.0 Introduction

Guam is a United States (U.S.) territory and a key strategic location for sustaining and maintaining U.S. influence, deterring adversaries, and responding to crises across the Pacific theater. Commander of the U.S. Indo-Pacific Command assesses that its posture in Guam requires modernization and enhancement to provide an operationally resilient and sustainable force that aligns with national guidance and enables the implementation of international agreements.

Within the Department of Defense, the Missile Defense Agency (MDA) is responsible for developing, testing, and fielding a missile defense system to defend the U.S., its deployed forces, allies, and friends against all ranges of enemy ballistic missiles in all phases of flight. To meet the mission outlined by U.S. Indo-Pacific Command, MDA is working on Guam to provide a comprehensive missile defense system. Flight tests are an important component of this defense system. Conducting missile defense system flight tests from Guam and at sea from a U.S. Navy ship would validate the interoperability of multiple sensors and missile interceptor systems from MDA, U.S. Army, and U.S. Navy (the Services) that will become a "system of systems" (or the backbone) of a missile defense system developed to protect Guam. These tests and tracking exercises are needed to facilitate research and increase our understanding of the ability of a missile defense system. This includes the Terminal High Altitude Area Defense (THAAD); Standard Missile (SM); Phased Array Tracking Radar to Intercept on Target (PATRIOT) missile interceptor; Indirect Fire Protection Capability (IFPC) system; and other sensors to counter the threat presented by short-, mid-, and long-range ballistic missiles; cruise missiles; and hypersonic weapon systems in a realistic environment.

The Proposed Action (PA) is to deploy, test, and conduct up to two flight tests or tracking exercises per year over a ten-year period from Andersen Air Force Base (AAFB) and/or from a U.S. Navy ship underway in the broad ocean area (BOA) of the western Pacific Ocean. A flight test represents a target missile flight, an interceptor missile flight, or an intercept of a target missile, or a test of sensors independent of missile flight. For a single flight test, multiple interceptors and targets may be utilized. A tracking exercise involves using sensors to scan and track a target with no interceptor. The target would be air launched from a C-17 or similar aircraft at an altitude greater than 20,000 feet mean sea level approximately 800 nautical miles (1,483 kilometers) from Guam. The interceptor missile for flight tests would launch from Northwest Field, AAFB on Guam or from a U.S. Navy ship underway in the Western Pacific BOA, which is defined as the open ocean area beyond 12 nautical miles offshore from land. Tracking exercises could involve both land and seaborne sensors.

MDA, in cooperation with the U.S. Air Force, U.S. Army, U.S. Navy, U.S. Coast Guard, and Federal Aviation Administration, is preparing an Environmental Assessment/Overseas

1.0 Introduction

Environmental Assessment (EA/OEA) to evaluate the potential environmental impacts from proposed flight tests, target missile intercepts, and sensor tracking exercises.

This Air Quality Impact Study (AQIS) describes the regulatory framework, emission sources, emissions calculation methodologies, approach for assessing the potential air quality impacts, and the air impacts from the PA. The AQIS will be updated with refined data for each version of the EA/OEA.

2.0 Regulatory Framework

Under the National Environmental Policy Act (NEPA), an EA or Environmental Impact Statement evaluates air quality concerns associated with a PA. Air pollution damages the health of people, plants, animals, and water bodies as well as the exteriors of buildings, monuments, and statues. It also creates haze or smog that reduces visibility and interferes with aviation.

2.1 Clean Air Act

Congress passed the Clean Air Act (CAA) in 1970, and its amendments in 1977 and 1990, to improve air quality and reduce air pollution. It set regulatory limits on air pollutants and helped to ensure basic health and environmental protection from air pollution. The CAA applies to U.S. land mass and coastal waters within 3 nautical miles of shore.

2.1.1 Criteria Pollutants

A region's air quality is influenced by many factors, including the type and amount of pollutants emitted into the atmosphere, the size and topography of the air basin, and the local meteorological conditions. To protect the health or welfare of the public or environment, the CAA required the U.S. Environmental Protection Agency (USEPA) to establish National Ambient Air Quality Standards (NAAQS) for six major pollutants of concern, called "criteria pollutants":

- Carbon monoxide (CO)
- Lead (Pb)
- Nitrogen dioxide (NO_2)
- Ozone (O_3)
- Sulfur dioxide (SO_2)
- Particulate matter (with an aerodynamic size less than or equal to 10 microns [PM_{10}] and with an aerodynamic size less than or equal to 2.5 microns [$PM_{2.5}$].

2.1.2 Ambient Air Quality Standards

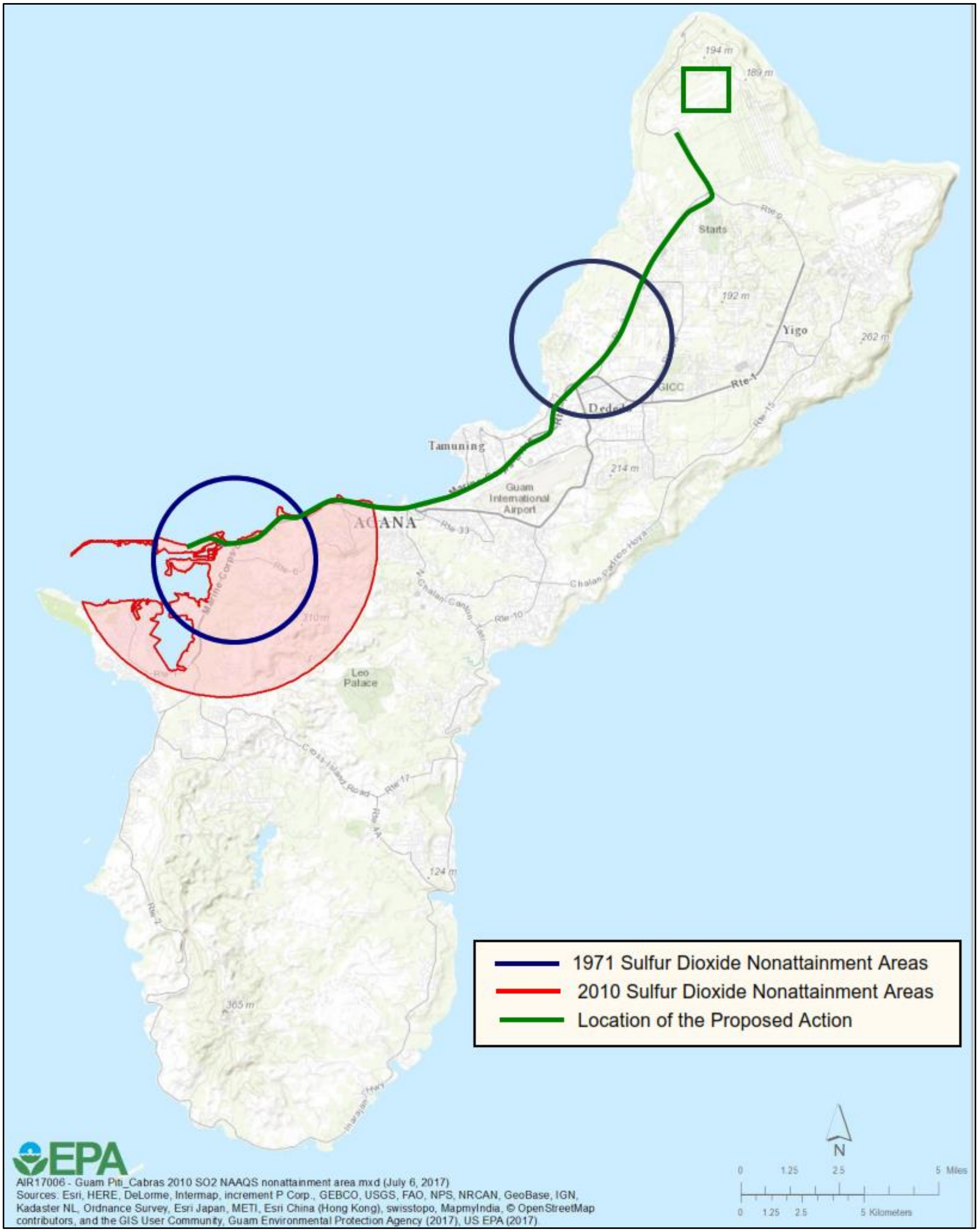
The NAAQS set specific concentration limits for criteria pollutants in the outdoor air. The concentration limits were developed because the criteria pollutants are common in outdoor air, considered harmful to public health and the environment, and come from numerous and diverse sources. Concentration limits are designed to protect public health and the environment. The USEPA classifies air quality in a region according to whether the concentrations of criteria pollutants in ambient air exceed the NAAQS. Areas are therefore designated as either "attainment," "nonattainment," "maintenance," or "unclassifiable" for each of the six criteria pollutants. Attainment means the air quality is better than the NAAQS; nonattainment indicates criteria pollutant levels exceed NAAQS; maintenance indicates an area was previously designated nonattainment but is now attainment; and an unclassifiable air quality designation means there is not enough information to appropriately classify an area, so the area is considered attainment. Table 2-1 presents the current National and Guam Ambient Air Quality Standards for criteria pollutants and Guam's attainment status with respect to the NAAQS. Figure 2-1 presents the Guam nonattainment areas and location of the PA.

Table 2-1: National and Guam Ambient Air Quality Standards

Pollutant	Averaging Time	Primary Standard		Secondary Standard
		Federal	Guam	
CO	8-hour (1)	9 ppm (10 µg/m^3)	Same as Federal	None
	1-hour (1)	35 ppm (40 µg/m^3)	Same as Federal	None
Pb	Rolling 3-month average (2)	.15 µg/m^3 (3)	None	Same as Primary
	Calendar Quarter	None	1.5 µg/m^3	Same as Primary
NO_2	Annual (4)	53 ppb (5)	Same as Federal	Same as Primary
	1-hour (6)	100 ppb	None	None
PM_{10}	24-hour (7)	150 µg/m^3	Same as Federal	Same as Primary
	Annual	None	50 µg/m^3	Same as Primary
$PM_{2.5}$	Annual (8)	9 µg/m^3	None	15 µg/m^3
	24-hour (6)	35 µg/m^3	None	Same as Primary
O_3	8-hour (9)	0.070 ppm (10)	None	Same as Primary
	1-hour	None	0.12 ppm	Same as Primary
SO_2	1-hour (11)	75 ppb (12)	None	None
	3-hour (1)	None	None	1300 ug/m^3 (0.5 ppm)
	24-hour	0.14	365 µg/m^3 (0.14 ppm)	None
	Annual mean	0.03	80 µg/m^3 (0.03 ppm)	None

Sources: (U.S. Environmental Protection Agency, 2024), (U.S. Environmental Protection Agency, 2023b)
Notes: Parenthetical values are approximate equivalent concentrations. ppm = parts per million; ppb = parts per billion; mg/m^3 = milligrams per cubic meter; µg/m^3 = micrograms per cubic meter
(1) Not to be exceeded more than once per year.
(2) Not to be exceeded.
(3) Final rule signed October 15, 2008. The 1978 standard for Pb (1.5 µg/m^3 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. The USEPA designated areas for the new 2008 standard on November 8, 2011.
(4) Annual mean.
(5) The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of cleaner comparison to the 1-hour standard.
(6) 98th percentile, averaged over 3 years.
(7) Not to be exceeded more than once per year on average over 3 years.
(8) Annual mean, averaged over 3 years.
(9) Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years.
(10) Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) O_3 standards are not revoked and remain in effect for designated areas. Additionally, some areas may have certain continuing implementation obligations under the prior revoked 1-hour (1979) and 8-hour (1997) O_3 standards.
(11) 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years.
(12) Final rule signed June 2, 2010. The 1971 annual (0.03 ppm) and 24-hour (0.14 ppm) SO_2 standards were revoked in that same rulemaking. These standards, however, remain in effect until 1 year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.

Figure 2-1: Guam Sulfur Dioxide Nonattainment Areas and Location of PA



2.1.3 General Conformity Rule

Section 176(c)(1) of the CAA, commonly known as the General Conformity Rule, requires federal agencies to ensure that their actions conform to applicable implementation plans for achieving and maintaining the NAAQS for criteria pollutants for nonattainment and maintenance areas. Federal actions are required to conform with the approved State Implementation Plan for those areas of the United States designated as nonattainment or maintenance areas for any criteria air pollutants under the CAA (40 Code of Federal Regulations [CFR] Parts 51 and 93 Subpart B). The purpose of the General Conformity Rule is to ensure that applicable federal activities do not cause or contribute to new violations of the NAAQS, do not worsen existing violations of the NAAQS, and do not delay attainment of the NAAQS.

A conformity evaluation must be completed for every applicable federal action that generates emissions in a nonattainment or maintenance area to determine and document whether a PA complies with the General Conformity Rule.

2.1.4 Prevention of Significant Deterioration and Nonattainment New Source Review Permitting

Prevention of Significant Deterioration (PSD) applies to new major stationary sources or major modifications for pollutants where the area the source is located is in attainment or unclassifiable with the NAAQS. PSD permitting requires Best Available Control Technology, an air quality analysis, additional impacts analyses, and public involvement. For certain categories of sources, such as steam power plants and refineries, a new PSD major source is one with the potential to emit more than 100 tons per year (tpy) for any one regulated pollutant. For all other sources, including military installations, the major source threshold is 250 tpy of any one regulated pollutant. For an existing major source, PSD review/permit is required if the net emissions increase from a permit modification exceeds the PSD significant emission rates that varies from 0.6 tpy to 100 tpy depending on the pollutant. On Guam, PSD permits are issued by USEPA.

Nonattainment New Source Review applies to new major stationary sources or major modifications at existing sources for pollutants where the area the source is located is in nonattainment with the NAAQS. Major Source Thresholds vary depending on the attainment status of an area. For the Guam nonattainment areas, the criteria pollutant major stationary source threshold is 100 tpy for SO_2.

2.1.5 Title V Operating Permit

Title V of the CAA Amendments of 1990 requires states and local agencies to permit major sources. The Title V operating permit combines all federally enforceable requirements into a single document to improve compliance. USEPA has federal oversight on major/Title V source permits issued on Guam.

2.1.6 New Source Performance Standard and National Emission Standards for Hazardous Air Pollutants

Section 111 of the CAA lists stationary source categories that are subject to new source performance standards if the applicable equipment is constructed, reconstructed, or modified after specified dates. Section 112 of the CAA lists hazardous air pollutants (HAPs) and identifies stationary source categories that are subject to emissions control or work practice requirements. These requirements apply to affected emission units and processes even if the emission unit or process is permit-exempt.

2.1.7 Infrastructure State Implementation Plan

Under CAA sections 110(a)(1) and 110(a)(2), each state is required to submit a State Implementation Plan (SIP) that provides for the implementation, maintenance, and enforcement of a revised primary or secondary NAAQS within 3 years of USEPA issuing the standard. This type of SIP submission is commonly referred to as an infrastructure SIP. Guam has an approved Infrastructure SIP for the 1971 SO_2 NAAQS. Guam, however, has not fulfilled the SIP submittal requirements for the 2010 SO_2 NAAQS (U.S. Environmental Protection Agency, 2023c). Guam's approved Infrastructure SIP includes a permitting program for minor sources that is implemented by Guam EPA.

2.1.8 Hazardous Air Pollutants

In addition to the six criteria pollutants, the USEPA currently regulates 188 substances as HAPs under the federal CAA. HAPs are air pollutants known or suspected to cause cancer or other serious health effects, or adverse environmental and ecological effects (U.S. Environmental Protection Agency, 2023c). NAAQS are not established for these pollutants; however, the USEPA has developed rules and control standards that limit emissions of HAPs from specific stationary and mobile sources. The stationary source HAP regulations are called National Emissions Standards for Hazardous Air Pollutants (40 CFR Parts 61 and 63). The Mobile Source Air Toxics rules reduce HAPs emitted by mobile sources, such as cars and trucks. HAP emissions are typically one or more orders of magnitude smaller than concurrent emissions of criteria air pollutants. To assess risk from exposure to toxics, USEPA has tabulated long-term (chronic) and short-term (acute) dose-response assessments that could be used for risk assessments of HAPs (U.S. Environmental Protection Agency, 2023c).

2.2 <u>Executive Order 12114–Environmental Effects Abroad of Major Federal Actions</u>

Executive Order 12114, *Environmental Effects Abroad of Major Federal Actions*, issued on January 4, 1979, establishes internal procedures for federal agencies to consider the significant effects of their actions on the environment outside the U.S., its territories, and possessions. The categories of major federal actions abroad include actions that significantly affect the global environment outside the jurisdiction of any nation, such as the oceans and the atmosphere; actions that significantly affect the environment of a foreign nation that is not involved in the action; and actions that significantly affect the environment of a foreign nation by producing an emission or effluent, which is prohibited or strictly regulated by federal law, in the U.S., because its toxic effects on the environment create a serious public health risk. Executive Order (EO) 12114 applies to coastal waters and foreign lands beyond 12 nautical miles of the U.S. coastline.

2.3 Guam Air Pollution Control Standards and Regulations

Under Guam's Air Pollution Control Act, Air Pollution Control Standards and Regulations have been adopted to comply with the requirements of the Federal CAA, including a permitting program, and promulgate laws enacted by the Guam Legislature. The Guam EPA is responsible for implementing and enforcing these standards and regulations codified in Title 22 of the Guam Administrative Rules, Division 1, Chapter 1.

Guam EPA issues air permits for minor and major/Title V sources (under USEPA oversight). The criteria pollutant thresholds for major source/Title V are 100 tons per year for CO, NO_x, Volatile Organic Compounds, $PM_{2.5}$, PM_{10}, and SO_2. The purpose of operating permits is to improve compliance by clarifying all the requirements that apply to a source in a single, federally enforceable document. Guam EPA regulations also require air pollution emission source comply with all applicable requirements of 40 CFR Part 60, Standards of Performance for New Stationary Sources, and the National Emission Standards for Hazardous Air Pollutants, codified in 40 CFR parts 61 and 63.

Title 22 of the Guam Administrative Rules (Chapter 1, Article 3, section 1302) sets ambient quality standards for Guam to protect the public health, safety, and welfare of the population. Most of the standards are the same as the NAAQS. See Table 2-1 and Figure 2-1 (Section 2.1.2, Ambient Air Quality Standards) for current National and Guam Ambient Air Quality Standards for criteria pollutants and Guam nonattainment areas relative to the Proposed Candidate Sites, respectively.

3.0 Approach to Analysis

This Air Quality Impact Study comprises three analyses: (1) the CAA General Conformity Analysis; (2) an analysis under NEPA; and (3) an analysis under EO 12114. The generated air emissions would be evaluated in the identified analysis categories, based on the geographical and spatial locations where emissions occur and CAA air quality status (nonattainment, maintenance, or attainment) of those respective locations, as well as pollutants emitted, type of emission source, and levels of emissions.

3.1 General Conformity Evaluation

General Conformity evaluation encompasses the entire process from the applicability analysis through the conformity determination. The applicability analysis determines whether the PA can be exempt from completing a conformity determination. A conformity determination is required for each criteria pollutant or precursor where the net change of direct and indirect emissions of the criteria pollutant or precursor in a nonattainment or maintenance area caused by a federal action would equal or exceed any of the emissions thresholds called *de minimis* levels. If the emissions are below *de minimis* thresholds, then a conformity determination is not required, and the federal action conforms to the applicable implementation plan and meets the requirements of 40 CFR Part 93, subpart B.

3.2 National Environmental Policy Act

Analysis of health-based air quality impacts under NEPA includes estimates of total direct and indirect criteria air pollutants and HAPs emissions released at or below 3,000 feet above ground/mean sea level (MSL) within 12 nautical miles of U.S. coastline from all activities, including aircraft, vessels, missiles, and targets. Total direct and indirect emissions consider all emission increases and decreases that are reasonably foreseeable and are possibly controllable. The analysis considers the future emissions in the area with the action versus the future emissions without the action (i.e., the Baseline Condition/Affected Environment).

The air quality impact analysis presents a summary of emissions estimated for each alternative and provides a qualitative discussion of short-term and long-term impacts of the emissions to air quality and how these impacts affect attainment with CAA Ambient Air Quality Standards (AAQS) and contribution to human health risk from HAP exposure. The location and initial dispersion of emissions, duration of exposure, meteorological conditions, wind patterns, buoyancy of pollutants, and other relevant factors are considered and discussed as part of the analysis.

3.3 EO 12114–Environmental Effects Abroad of Major Federal Actions

The analysis of health-based air quality impacts under EO 12114 includes emissions released at or below 3,000 feet above MSL and beyond 12 nautical miles of the U.S. coastline from all activities, including aircraft, vessels, missiles, and targets; and a qualitative discussion of impacts of the emissions to air quality and how these impacts affect attainment with AAQS and contribution to human health risk from HAP exposure.

HAP emissions from the PA will be quantified, and localized events and HAP (i.e., toxics) exposure to sensitive receptors will be qualitatively discussed. For the PA, HAPs are primarily generated, in addition to criteria air pollutants, by combustion of fuels.

3.4 Affected Environment

The Region of Influence (ROI) for air quality depends on the type of pollutant, emission rates of the pollutant source, proximity to other emission sources, and local and regional meteorology. For photochemical pollutants (i.e., made, or changed by exposure to sunlight) such as O_3, the impact area may extend much farther (e.g., miles) downwind. The maximum effect of precursors on O_3 levels tends to occur several hours after the time of emission during periods of high solar load (i.e., sunlight) and may occur many miles from the source. Ozone and ozone precursors transported from other regions can also combine with local emissions to produce high local O_3 concentrations.

The ROI for the PA includes the areas within and the area surrounding AAFB and the BOA of the western Pacific Ocean.

AAFB is located in Yigo at the northern tip of Guam and covers approximately 15,400 acres. The main operations area of the Base is in the eastern third of the Installation. This area includes the main active airfield and an array of operations, maintenance, and community support facilities. The central third of the Installation is a Munitions Storage Area. The western third is Northwest Field (NWF), which is used for helicopter training and various field exercises. No publicly accessible areas are near the NWF, including two active hunting areas located south of NWF. AAFB tenant commands that are not associated with the PA are located approximately 0.3 miles to the west of NWF.

AAFB operates under Title V Permit No. FO-001R1, issued by Guam EPA. The stationary sources covered by the Title V Permit include internal and external combustion engines, landfill emissions, field operations, fuel storage and transfers, and an asphalt batch plant.

3.5 Existing Conditions

Guam is in attainment with all NAAQS, except that areas near Piti and Tanguisson power plants are in nonattainment for the 1971 SO_2 NAAQS (U.S. Environmental Protection Agency, 2023b), and the Piti-Cabras area is in nonattainment for the 2010 sulfur dioxide NAAQS (U.S. Environmental Protection Agency, 2023b). Although no recent ambient air quality data are available for Guam, the island is expected to have the same attainment/nonattainment status for Guam's AAQS as for the NAAQS for the same pollutant. As shown in Figure 2-1, the ROI for the PA includes the SO_2 nonattainment areas where, following each flight test, assets are transported via a truck from NWF to the Port of Guam.

Currently, there are no air monitoring stations operating on Guam, and ambient air quality data has not been collected for the island since 1991. However, a conservative indication of expected air quality conditions on Guam is to consider observations on a more populated island, Oahu, Hawaii, which operates six monitoring stations to monitor concentrations of criteria pollutants. The 2021 monitoring data show no violation of the PM_{10}, $PM_{2.5}$, O_3, CO, or SO_2 NAAQS on Oahu (Hawaii Department of Health, 2022). It is expected that air quality on Guam would also have concentrations of criteria pollutants that are well below the applicable standards. Guam EPA is in the process of developing an annual emissions inventory for Guam; currently, no air emissions inventory information is available for the island.

USEPA's 2019 Air Toxics Screening Assessment (AirToxScreen) provides emissions, ambient concentrations, and exposure estimates for 181 HAPs plus diesel particulate matter (diesel PM). For HAP/air toxics with health data based on long-term exposure, the assessment estimates cancer risks, the potential for noncancer health effects, or both, including noncancer health effects for diesel PM. The AirToxScreen assessment is not currently available for Guam. However, the assessment for Hawaii can be used as an indication of potential HAPs of concern on Guam. The 2019 AirToxScreen data for Hawaii show that the top contributors to cancer risk are formaldehyde, carbon tetrachloride, acetaldehyde, benzene, 1,3-butadiene, naphthalene, ethylbenzene, chromium vi (hexavalent), and nickel compounds.

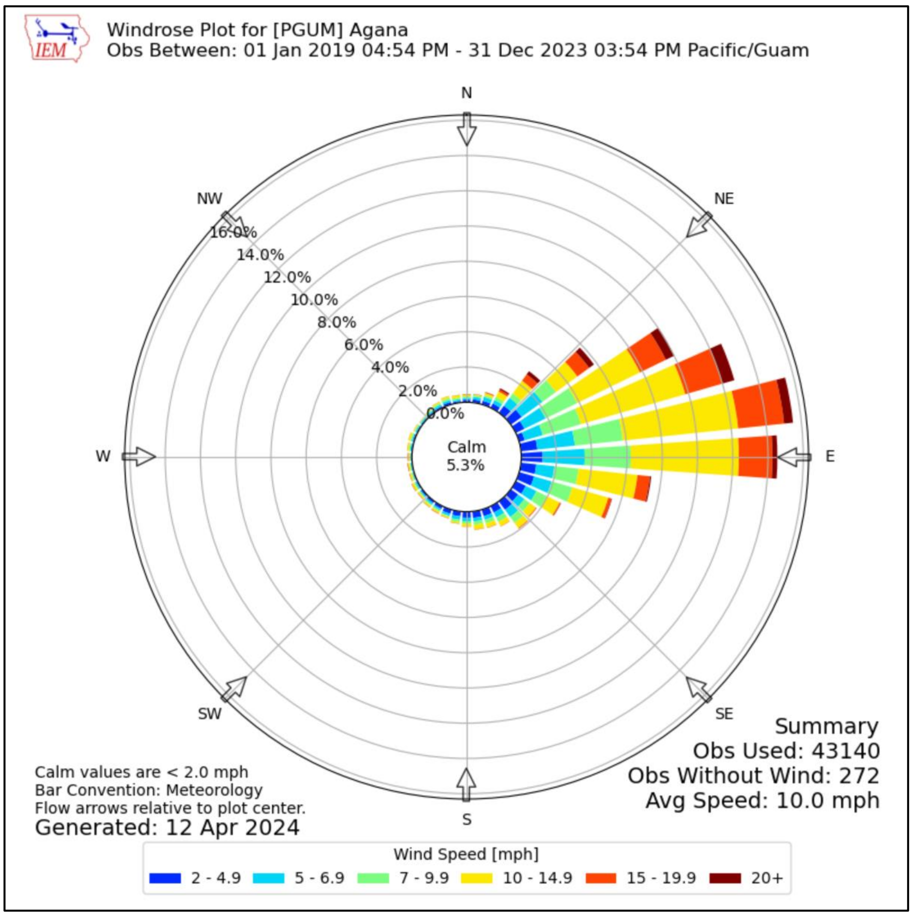
Ambient air quality conditions where AAFB is located are affected by a combination of on-base mobile sources including aircraft and aircraft ground support equipment; on-road and non-road vehicles; construction equipment; and stationary sources, such as internal combustion engines. According to the 2022 Annual Air Emissions and Fee Report, submitted by AAFB to Guam EPA, in 2022, AAFB emitted a total of 14 tons of criteria pollutants and 0.177 tons of HAPs. Most of the emissions were from emergency engines and fuel storage and transfer activities.

Ambient air quality conditions in the BOA of the western Pacific Ocean are affected by the transport of emissions from the islands in the BOA and movement of commercial ships and aircraft in the area.

Meteorological conditions affect the dispersion and transport of air pollutants and the resulting air quality. The climate of Guam is influenced by its location in the western Pacific Ocean. The climate is tropical marine, characterized by warm temperatures, high humidity, and distinct wet and dry seasons. The dry season typically begins in December and extends through June. The rainy season falls within the remaining months. Temperatures in Guam are generally warm and consistent throughout the year. Average temperatures range from around 77°F (25°C) in the cooler months to 86°F (30°C) in the warmer months. During the dry season, the prevailing winds (tradewinds) from the east and northeast intensify and tend to transport pollutants released from the west shoreline toward the ocean. During the warmest months from March through August, the tradewinds still blow steadily from the east or northeast.

Figure 3-1 depicts wind rose data, for the January 2019 to December 2023 period, collected by the weather station (PGUM) located at Antonio B. Won Pat International Airport. The wind rose represents the directions around a compass, and the length of the petal or spoke indicates wind direction and frequency toward the center point. Individual segments of the spoke represent the frequency of winds for defined wind speed categories, with the slowest winds closest to and the fastest winds furthest from the center of the diagram. The average hourly wind speed in Guam has significant seasonal variation over the course of the year.

Figure 3-1: Guam Wind Rose



4.0 Emission Sources and Assumptions

The air quality impact study analyzes direct and indirect criteria pollutants and HAP emissions associated with the PA. Direct emissions are those emissions caused by the PA and that occur at the same time and place as the action. This includes emissions from all mobile, area and stationary sources. Indirect emissions are those emissions that are caused by the PA, but that may occur later in time or may be farther removed in distance from the action itself but that are still reasonably foreseeable. No construction activities are planned as part of the PA. Personnel commute to the site is anticipated to be the only source of indirect emissions. Personnel who may travel to Guam in support of the PA are expected to arrive via regular commercial flights or accompany equipment that is flown onto the island. Therefore, emissions due to personnel travel to Guam are not separately analyzed. The shipment of the launcher and range safety equipment at the conclusion of the flight test, from the island to the Port of Los Angeles, would occur via commercial carriers that would regularly complete this trip. Therefore, emissions from this activity are not analyzed.

The PA is to conduct up to two flight tests or tracking exercises per year beginning the first quarter of Fiscal Year 2025. The interceptor missile for flight tests would launch from AAFB NWF or from a U.S. Navy ship underway in the Western Pacific BOA. Test duration could last up to 8 hours per test, and pre-launch activities would occur up to 12 weeks prior to the flight test. Up to 350 personnel could be needed for each flight test.

Most of the air emissions associated with the PA are expected to occur at distances greater than 12 nautical miles from the shore.

4.1 Test Site Preparations

The PA does not include any construction. Test site preparation activities were addressed separately as a NEPA Categorical Exemption for the Initial Deployment. Emissions from these activities are not included in the EA/OEA.

4.2 Range Safety Activities

This activity includes transportation, setup, and checkout of range safety, test assets, and support equipment (including personnel trailers and stationary diesel-fueled generators) in previously disturbed areas at or adjacent to NWF at AAFB. Assume these activities would occur twice per year. Emissions from this activity include the following:

- Aircraft emissions within 3,000 feet above ground level from transport of the range safety equipment from White Sands Missile Range, New Mexico, or other test ranges, to AAFB. Assume a C-17 aircraft would be used for air transport. Emissions from landing and takeoff at the initial departure location are included.

4.0 Emission Sources and Assumptions

- Truck emissions, including particulate emissions from traveling on paved and unpaved roads, to transport the safety assets to a location adjacent to AAFB NWF and test launcher. Assume five heavy-duty trucks would travel 10 miles roundtrip from the main airfield to the NWF. Assume this activity would occur twice per year.
- Emissions from transportation of support assets. Assume five heavy-duty trucks would travel 10 miles roundtrip from the main airfield to the NWF to deliver up to five trailers.
- Emissions from stationary diesel-fueled generator sets that provide electrical power for the flight test equipment and power for up to 350 personnel. Four prime diesel-fired Tier 4 engines and one emergency backup Tier 3 diesel-fired engine would be used for this activity. Emissions are based on the information provided in the July 2023 Synthetic Minor, Noncovered Source Permit Application for Defense of Guam Initial Deployment and Flight Test, submitted by MDA to the Guam Environmental Protection Agency.

4.3 Target Interceptor Systems Activities

This activity covers transportation, storage, and placement of the interceptor in the launcher in previously disturbed areas. Assume these activities would occur twice per year. Emissions from this activity include the following:

- Aircraft emissions within 3,000 feet above ground level from transport of the interceptor systems from Redstone Arsenal, Alabama, via C-17 or other cargo planes, or barges, to AAFB. Assume a C-17 aircraft would be used for air transport. Emissions from landing and takeoff at the initial departure location are included.
- Emissions from the transport of SM-3 interceptor missile by aircraft from Redstone Arsenal, Alabama, to Guam. Assume a C-17 aircraft would be used for the transport. Emissions from landing and takeoff at the initial departure location are included.
- Truck emissions to transport the interceptor systems to a location adjacent to AAFB NWF and test launcher. Assume five heavy-duty trucks would travel 10 miles roundtrip from the main airfield to the NWF.
- The interceptors would be staged in a C-17 parked at an ordnance holding pad on AAFB for 3–5 days before the flight test. The C-17 would be climate controlled using two diesel-fueled air conditioning units until the test event. Assume two, 100-Brake Horsepower, Tier 3 diesel-fired engines would be required to power the units continuously for 5 days.

4.4 Transportation and Staging of Target Missiles

This activity covers transportation and placement of the target missiles. Assume this activity would occur twice per year. Emissions from this activity include the following:

- Aircraft emissions within 3,000 feet above ground level from transport of the target missiles from Cape Canaveral, FL, to AAFB with a refueling stop at either Hill Air Force Base, Utah, or Edwards Air Force Base, California. Assume a C-17 aircraft would be used for air transport. Emissions from landing and takeoff at the initial departure location and from the refueling stop are included.

- Emissions from this activity include aircraft and truck emissions associated with transporting the target missiles. Assume five heavy-duty trucks would travel 10 miles roundtrip from the main airfield to the NWF. Assume this activity would occur twice per year.
- The target would be staged in a C-17 parked at an ordnance holding pad on AAFB for 3–5 days before the flight test. The C-17 would be climate controlled using two diesel-fueled air conditioning units until the test event. Assume three, 100-Brake Horsepower, Tier 3 diesel engines would be required to power the units continuously for 5 days. Assume this activity is the same as the air conditioning units that provide climate control for the interceptor systems prior to the test event.

4.5 Execution of Flight Test or Tracking Exercise

This activity includes the air launch of a target; range safety, air, land, or space-based sensors tracking the target; an interceptor launch (land- or sea-based); and use of test assets to determine whether the target was destroyed. The duration of a typical flight test would be approximately eight hours. Emissions from this activity include the following:

- Aircraft activity within 3,000 feet above ground level in support of target launches. Assume a C-17 aircraft would be used for this activity. The C-17 would leave from AAFB and fly to the designated target drop zone. The targets are launched at elevations well above 3,000 feet. Assume this activity would occur twice per year.
- Vessel emissions associated with the sea-based interceptor launch: The only vessel activity near Guam would be when a Navy ship is involved with the at-sea interceptor launch. A vessel in the area would travel to Naval Base Guam specifically for the Flight Test crew to conduct a mission brief with the MDA team prior to and potentially after the test. No loitering, maneuvering, or operations within 12 nautical miles are anticipated. The rest of the vessel activities occur beyond 12 nautical miles by a vessel that is already in the area, during the test event, which is expected to take approximately 8 hours. This activity is anticipated to occur once per year.
- Emissions due to detonation of the Standard Missile (SM) ordnance section. Assume the weapon system would launch an SM-3 missile to intercept an air-launched target and would be tracked by land-based sensors on Naval Base Guam. The SM-3 is a four-stage, solid-propellant, vertically launched interceptor missile capable of engaging targets in the exo-atmosphere using hit-to-kill technology (kinetic warheads without explosives) at long ranges. The SM-3 interceptor’s four stages contain approximately 2,400 pounds of solid propellant. Assume this activity would occur twice per year.
- Emissions due to the target launch occur in elevations greater than 3,000 feet above MSL and are not included in the air quality analysis.

4.0 Emission Sources and Assumptions

- Emissions from diesel-fueled generator sets that provide electrical power in support of range safety and flight test operations. Assume this activity would occur twice per year.
- Emissions from fuel delivery to the site for the generators to be used during the flight tests.

4.6 Post-Flight Activities

This activity includes post-flight inspection, launch site debris removal, asset disposal or storage, and shipment of assets to Minnesota for refurbishment. To retrieve the first stage interceptor booster, a small team would approach the booster on foot and prepare it for extraction. The first stage interceptor booster would likely fall on land east of the launch site inside the AAFB installation boundary. Emissions from this activity include the following:

- Emissions from an MH-60S Seahawk from the U.S. Navy's HSC-25, which is forward deployed to AAFB. The helicopter would hover over the booster approximately 80–100 feet above ground level, and utilizing its cargo hook capacity of 6,000 pounds, would extract the booster and airlift it back to AAFB. Total flight time would be approximately 20 minutes, including no more than 5 minutes of hovering over the booster. Flight time includes engine start, plane captain checks, taxi, flight from AAFB to the recovery area, hover, return flight from the recovery area to AAFB, taxi, and shutdown. No dust emissions are anticipated since the helicopter activity would occur over dense foliage, and rotor downwash of the helicopter in a hover would be less than 35 miles per hour.
- Emissions (combustion and dust) from one vehicle driving on existing roads to the nearest point of the booster, at which point the team would continue on foot. Assume the team would drive 30 miles roundtrip from/to the airport in a heavy-duty truck to the booster drop zone.
- Emissions due to operating a backhoe that would be used to retrieve the booster if it lands within a previously developed or disturbed area, were estimated, and deemed to be negligible.
- Transport of the launcher and range safety equipment, at the conclusion of the flight test, by three trucks, from NWF to the Port of Guam. Assume a one-way distance of 21 miles.
- Emissions from shipment of the launcher and range safety equipment, at the conclusion of the flight test, by three trucks, from Port of Los Angeles to Minnesota for refurbishment.

Indirect emissions are those emissions that are caused by the PA, but that may occur later in time or may be farther removed in distance from the action itself but that are still reasonably foreseeable. Typically, indirect emissions include two types: (1) emissions from mobile sources that are associated with the PA but are privately owned, such as employee/contractor vehicles and delivery trucks; and (2) emissions from the actions of private entities under a lease, permit, or approval. For the PA, personnel commute to the site is anticipated to be the only source of indirect emissions. Assume up to 350 personnel would travel 40 miles roundtrip, in a mix of personal cars and trucks, to support the flight test activities for each event. This distance is based on the location of lodging areas relative to AAFB and the assumption that most Flight Test personnel would travel to Guam and stay in hotels. Personnel arriving from off island are expected to arrive via commercial flights that regularly travel to Guam.

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5.0 Calculation Methodologies

For each alternative, criteria air pollutant and HAP emissions were estimated for diesel-fueled generator/engine sets, vessels, aircraft, ordnance, mobile sources such as trucks and cars, and all other pollutant-emitting activities associated with the alternatives. Emissions will be quantified for both the set up and operational phase of the PA.

Diesel generator emissions were estimated based on the information provided in the July 2023 Synthetic Minor, Noncovered Source Permit Application for Defense of Guam Initial Deployment and Flight Test, submitted by MDA to the Guam Environmental Protection Agency. Emissions from Range Safety and Test Asset generators are included in the EA/OEA.

C-17 aircraft and MH-60S Seahawk helicopter emissions were estimated based on June 2023 Air Emissions Guide for Air Force Mobile Sources, Table 2-9 Aircraft Engine Emission Factors for Criteria Pollutants (Air Force Civil Engineer Center, 2023). Emissions were estimated for takeoffs and landings for the C-17 aircraft only since the rest of the aircraft operation would occur over 3,000 feet above ground level. Emissions from the associated C-17 flights ground support equipment were also included. HAP emissions were estimated based on June 2023 Air Emissions Guide for Air Force Mobile Sources, Table 2-10 (Volatile Organic Compound and HAP Emission Factors for Select Engines) (Air Force Civil Engineer Center, 2023).

DDG-51 emissions were estimated using the Microsoft Access-based Navy and MSC Engine Emissions Calculator, Version January 2024 (Naval Sea Systems Command, 2024). Emissions from 0 to 3 nautical miles from shore, from 0-12 nautical miles from shore, and beyond 12 nautical miles were calculated. HAP emissions were estimated based on speciation data in the USEPA Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions (U.S. Environmental Protection Agency, 2022).

Mobile source emissions, including personnel commute, were modeled for each alternative using the U.S. Air Force’s Air Conformity Applicability Model. The Air Conformity Applicability Model calculates the annual net change in total direct and indirect emissions of pollutants of concern associated with a PA using estimating methodologies, algorithms, and emission factors from current U.S. Air Force guidance (Air Force Civil Engineer Center, 2023). Emission modeling is based on the AP-42 empirical emission factor model where emissions are a function of activity rate, emissions factor, and overall mission reduction efficiency (U.S. Environmental Protection Agency, 2023a); and USEPA’s MOtor Vehicle Emission Simulator, which estimates emissions for mobile sources at the national, county, and project level for criteria air pollutants, greenhouse gases, and air toxics.

Emissions due to detonation of the SM-3 ordnance were quantified based on the emission constituents for the SM-1 launch as analyzed in the EA/OEA for Standard Missile (Naval Ordnance Missile Test Station, 1992).

5.0 Calculation Methodologies

All references, assumptions, sources of supporting data used in emission calculations, and detailed emission calculations are presented in Attachment B. The Air Conformity Applicability Model results are presented in Attachment C.

6.0 Air Quality Impact Analysis

Table 6-1 describes the criteria used to determine whether the PA would result in less than significant impact or significant impact on air quality.

Table 6-1: Criteria for Determining the Significance of PA Stressors on Air Quality

Impact Descriptor	Level of Impact	Significance Conclusions
Negligible	Impacts would be temporary (lasting up to several hours). Measurable or anticipated degree of change would not be detectable or would be only slightly detectable. Impacts are not expected to cause a violation, or contribute to a new violation, or contribute to an ongoing violation of the NAAQS or cause appreciable risks to populations, including sensitive receptors, resulting from the exposure to HAPs	Less than significant impact
Minor	Impacts would be temporary or short-term (lasting several days to several weeks). Measurable or anticipated degree of change would have a slight effect, causing a slightly noticeable change compared to existing conditions. Impacts are not expected to cause a violation, or contribute to a new violation, or contribute to an ongoing violation of the NAAQS or cause appreciable risks to populations, including sensitive receptors, resulting from the exposure to HAPs.	
Moderate	Impacts would be short-term or long-term (lasting several months or longer). A measurable or anticipated degree of change is readily apparent, appreciable, and would be noticed by most people. However, the impacts are low enough that would not result in a measurable impact to air quality or cause a violation, or contribute to a new violation, or contribute to an ongoing violation of the NAAQS or cause appreciable risks to populations, including sensitive receptors, resulting from the exposure to HAPs.	
Major	Measurable or anticipated degree of change would be substantial, causing a highly noticeable change compared to existing conditions. Impacts are expected to cause a violation, or contribute to a new violation, or contribute to an ongoing violation of the NAAQS. Exposure to HAP emissions would cause significant and unacceptable health impacts to populations, including sensitive receptors.	Significant impact

This section discusses the General Conformity Evaluation and the potential short term and long-term effects to air quality, under NEPA and Executive Order 12114 that could result from implementation of the PA. Effects on air quality are based on estimated direct and indirect emissions associated with the action alternatives.

6.1 General Conformity Evaluation

A General Conformity Evaluation is triggered for the PA under both alternatives because the transport routes from NWF to Port of Guam and from Port of Los Angeles to Minnesota pass through some NAAQS nonattainment and maintenance areas. Table 6-2 summarizes the total emissions for this activity and compares the emissions to the lowest applicable *de minimis* threshold for each pollutant. As shown, the total emissions are well below all applicable thresholds. As such, a conformity determination is not required for the PA. A signed Record of Non-applicability (RONA) is presented in Attachment A.

Table 6-2: Alternative 1 and 2 Total Criteria Pollutant Emissions for Post Launch Transport of Assets

Emissions	Total Emissions, ton/year					
	NO_x	SO_x	CO	VOC	PM_{10}	$PM_{2.5}$
Truck Transport, Post-Flight Test, from NWF to Port of Guam and from Port of Los Angeles to Minnesota	0.02	0.00	0.00	0.00	1.04	0.11
Lowest *de minimis* threshold	10	100	100	10	70	70
Exceeds threshold?	**No**	**No**	**No**	**No**	**No**	**No**

6.2 Impact Analysis – NEPA

Emissions are expected to begin in the first quarter of Fiscal Year 2025. Up to two flight tests or tracking exercises could be conducted per year. Each test could last up to 8 hours. The typical duration to setup, calibrate, and execute each test is 45 days.

6.2.1 Alternative 1

Alternative 1 would implement the use of land-based launch systems for interceptor launch with land-based sensor integration. All emissions, criteria pollutant and HAP, under this alternative are released at 3,000 feet or less above ground level over land and out to 3 nautical miles of shore. No emissions occur between 3 and 12 nautical miles from shore. Table 6-3 presents a summary of Alternative 1 criteria pollutant emissions for each activity including those generated within 3 nautical miles from shore. For the PA, HAPs are primarily generated, in addition to criteria air pollutants, by combustion of fuels. Tables 6-4 through 6-6 present the estimated emissions for HAPs of concern, grouped based on their potential cancer, non-cancer chronic and non-cancer acute health impacts, which would be emitted under Alternative 1.

Table 6-3: Alternative 1 Criteria Pollutant Emissions Generated on Land and Within 3 Nautical Miles from Shore

Emissions	Total Emissions, ton/year					
	NO_x	SO_x	CO	VOC	PM_{10}	$PM_{2.5}$
Aircraft	8.96	0.37	0.92	0.06	1.11	1.00
Truck Transport, Flight Test	0.03	0.00	0.02	0.00	44.88	4.49
Truck Transport, Post-Flight Test, from NWF to Port of Guam and from Los Angeles to Minnesota	0.02	0.00	0.00	0.00	1.04	0.11
Test Assets and Range Safety Generators	1.00	3.14	12.10	3.70	0.05	0.05
Climate Control Generators	0.15	0.00	0.20	0.01	0.01	0.01
Missile Launch			0.63		1.17	1.17
Personnel Commute to the Site	1.70	0.03	34.00	2.07	3.40	0.85
Total	**11.86**	**3.54**	**47.87**	**5.84**	**51.66**	**7.67**

Note: Numbers may not add up exactly due to rounding.

Table 6-4: Alternative 1 Estimated Carcinogenic HAP Emissions Generated on Land and Within 12 Nautical Miles from Shore

Pollutant	Total, ton/year	Main Contributing Activity
Naphthalene	0.002	Personnel Commute
Propanal (Propionaldehyde)	0.002	Personnel Commute
1,3 Butadiene	0.030	Personnel Commute
Formaldehyde	0.094	Personnel Commute, Test Assets and Range Safety Generators
Benzene	0.133	Personnel Commute, Test Assets and Range Safety Generators
Ethylbenzene	0.053	Personnel Commute
Acetaldehyde	0.040	Personnel Commute, Test Assets and Range Safety Generators

Table 6-5: Alternative 1 Estimated Non-Cancer Chronic HAP Emissions Generated on Land and Within 12 Nautical Miles from Shore

Pollutant	Total, ton/year	Main Contributing Activity
Toluene	0.265	Personnel Commute
Styrene	0.042	Personnel Commute
Hexane	0.050	Personnel Commute
Methylethylbenzene	0.050	Personnel Commute
Ethylbenzene	0.053	Personnel Commute
Phenol	0.0001	Aircraft

Pollutant	Total, ton/year	Main Contributing Activity
Xylenes	0.213	Personnel Commute
Benzene	0.133	Personnel Commute, Test Assets and Range Safety Generators
Hydrochloric Acid	0.630	Missile Launch
Formaldehyde	0.094	Personnel Commute, Test Assets and Range Safety Generators
Acetaldehyde	0.040	Personnel Commute, Test Assets and Range Safety Generators
Propanal	0.002	Personnel Commute
Naphthalene	0.002	Personnel Commute
Acrolein	0.009	Personnel Commute

Table 6-6: Alternative 1 Estimated Non-Cancer Acute HAP Emissions Generated on Land and Within 12 Nautical Miles from Shore

Pollutant	Total, pound/ hour	Main Contributing Activity
Propanal (Propionaldehyde)	0.02	Personnel Commute
Hexane	0.53	Personnel Commute
Xylenes	2.26	Personnel Commute
Styrene	0.45	Personnel Commute
Phenol	0.00	Aircraft
Toluene	2.80	Personnel Commute
Hydrochloric Acid	630	Missile Launch
Acetaldehyde	0.42	Personnel Commute, Test Assets and Range Safety Generators
Formaldehyde	1.00	Personnel Commute, Test Assets and Range Safety Generators
Benzene	1.29	Personnel Commute, Test Assets and Range Safety Generators
Methylethylbenzene	0.52	Personnel Commute
2,2,4-Trimethylpentane	0.89	Personnel Commute

<u>Flight Test Setup and Preparation</u>

Set up and flight test preparation activities include transport of the range safety equipment, interceptor systems, target missiles, and interceptor missile by aircraft from various continental United States locations to Guam. Following arrival in Guam, the equipment is transported by trucks to a location adjacent to AAFB NWF. In addition, diesel-fueled air conditioning units would be used at the main airfield for aircraft climate control while parked at the airfield until the flight test event begins.

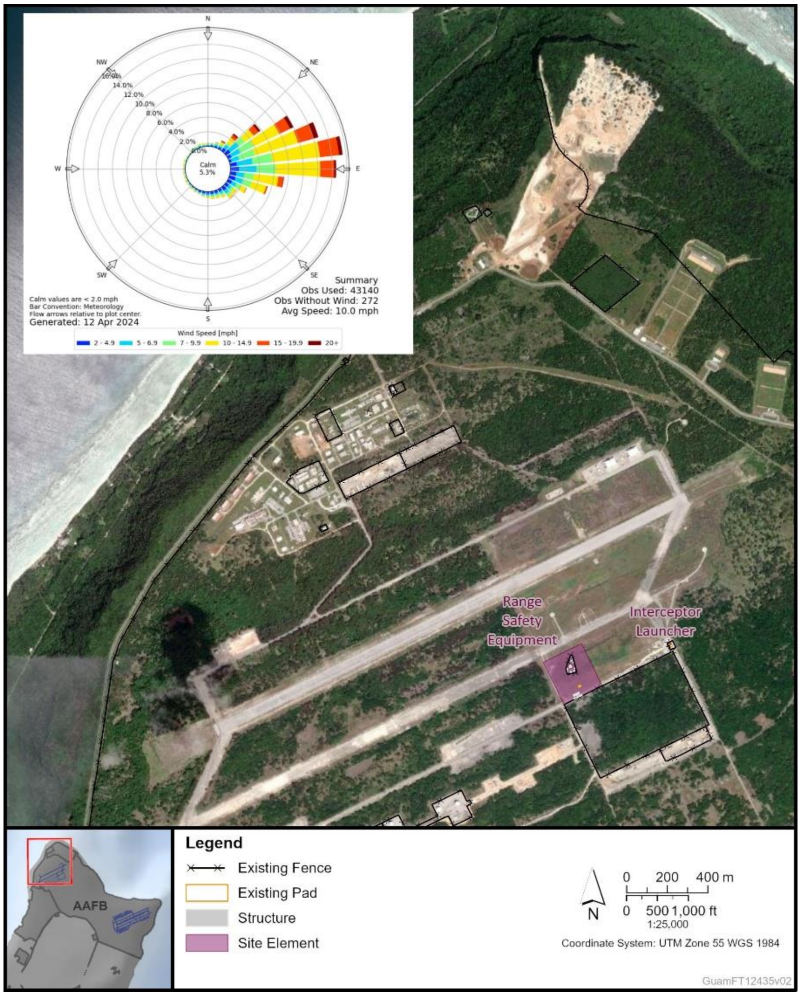
Aircraft criteria pollutant and HAP emissions that occur at elevations below the 3,000 feet above ground level limit would be from takeoff and landing operations as the aircraft approaches, lands, takes off and departs the main active airfield at AAFB. These intermittent emissions would be released along their 3,000+ feet flight path. Aircraft emission plumes have directional momentum opposite to the thrust of the aircraft that is expected to overcome buoyancy from the exhaust gas temperature of the aircraft engine. Aircraft emission plumes form behind the aircraft along its flight path and transported downwind. The takeoff and landing criteria pollutant emissions are relatively minor and short-term; any resulting pollutant concentration increases are expected to dissipate within 24 hours. Therefore, these emissions are not expected to interfere with the attainment of AAQS. The small quantities of HAPs emitted along the runway and the flight path below 3,000 feet above ground level are not expected to result in appreciable concentrations at any nearby receptors. Therefore, the potential for exposure is very low, and the health risk presented by the emissions is similarly very low.

The criteria pollutant and HAP emissions from the diesel-fueled air conditioning units used for aircraft climate control would also occur at the airfield. These emissions are expected to occur continuously for approximately 5 days after arrival until transport and staging of the missiles for the flight test prior to each launch, resulting in long-term (i.e., greater than 24 hours) emissions. However, given the size of the units and the engine tier (Tier 3 or higher), the total emissions are relatively low. Due to expected downwash of plumes released from short exhaust stacks typically built into these types of units, pollutant concentrations would increase in the immediate vicinity downwind of the stacks.

Vehicle criteria pollutant and HAP emissions are due to the transport of equipment to the site. The emissions are short-term (i.e., lasting less than 24 hours), relatively small, and occur along the path from the main airfield to NWF. In preparation and set up for each test, five trucks would be used for each transport activity, traveling 30 miles roundtrip, 5 days per month for 2 months, resulting in 4,500 vehicle miles traveled for pre-launch truck activities per test. Emissions are expected to initially rise in the immediate vicinity of the activity; however, wakes diffuse drastically depending on wind velocity. Wakes developed from wind flowing past the equipment body or equipment in motion cause downwash of exhaust plume. Downwash is expected to overcome any plume rise that could have resulted from buoyancy and momentum and increase ground-level concentrations.

As shown in Figure 6-1, prevailing easterly winds would help to disperse the emissions generated at the main airfield and across the path to NWF downwind to west of the airfield and NWF where AAFB personnel and tenants are sparsely present. Occasional northerly wind could transport these emissions from the airfield to on-base locations such as the commissary and the fitness track. Due to the relatively low criteria pollutant and HAP emissions, occurring infrequently and given the distance to downwind receptors (i.e., greater than 0.5 miles), these emissions are not expected to interfere with the attainment of AAQS or contribute to human health risks from HAP exposure in areas where public presence is expected.

Figure 6-1: Prevailing Winds in the PA Area



Flight Test Execution

Aircraft criteria pollutant and HAP emissions would occur during the Flight Test in support of target launches. Most of this activity would occur at elevations greater than 3,000 feet above ground level/MSL. Aircraft takeoff and landing would occur at the active airfield at AAFB. The takeoff and landing emissions are infrequent, relatively minor and short-term; any resulting pollutant concentration increases are expected to dissipate within 24 hours. The small quantities of HAPs emitted along the runway and the flight path below 3,000 feet above ground level are not expected to result in appreciable concentrations at any nearby receptors. Therefore, the potential for exposure is very low, and the health risk presented by the emissions is similarly very low.

Within the project site at the NWF, generator emissions, vehicle emissions from personnel travel to the site, and emissions due to the detonation of the interceptor missile would contribute to the overall emissions and temporary increases in pollutant concentrations downwind of the activity.

Diesel generators are required since grid power is not available in locations where the PA would occur. All prime power generators would be equipped with Tier 4 Final engines to minimize emissions of criteria pollutants and HAPs. The prime generators would operate continuously and result in long-term emissions. Backup generators would be equipped with Tier 3 engines that would only run when one of the prime generators is down. Operational activities would comply with Guam Air Pollution Control Standards and Regulations, including obtaining all approvals required to operate the generators. In July 2023, MDA submitted a Synthetic Minor Noncovered Source Air Permit Application to the Guam EPA to obtain the permits for the diesel-fueled generators. HAP emissions from the proposed diesel generators were previously quantified by MDA in the July 2023 Synthetic Minor Noncovered Source Air Permit Application and shown to be relatively small.

NWF is at least two miles away from any offsite receptors. AAFB and their tenant activities that are not associated with the PA are located to the west of the NWF. Figure 6-1 shows that wind directions are mostly from the east, which would transport emissions away from public areas most of the time; southerly winds are infrequent. The easterly winds could transport emissions to areas where human exposure could occur; however, the nearest tenant commands are approximately 0.3 miles away and given the magnitude of emissions, are expected to be impacted at a minor level of impacts limited to the duration and frequency of the flight tests.

Vehicle criteria pollutant and HAP emissions from personnel travel to the site would occur over an estimated 20-mile distance to NWF from various locations on the island. It is conservatively estimated that, for each test event, 350 personnel would commute 40 miles roundtrip to the site, 7 days per week for 3 months, resulting in 1.2 million vehicle miles traveled per test. Emissions are expected to initially rise in the immediate vicinity of the activity; however, wakes developed from wind flowing past the equipment body or equipment in motion cause downwash of exhaust plume. Downwash is expected to overcome any plume rise that could have resulted from buoyancy and momentum and increase ground-level concentrations. Total particulate emissions from the entire activity, expressed in tons per year, are predominantly the dust generated from travel on roads. However, along the path traveled, emissions, including particulate matter emissions are relatively low and any impacts are expected to be at a minor level.

Aluminum oxide particles, and hydrogen chloride, are expected to be released during interceptor missile launches. Aluminum oxide, aluminum chloride and ferric oxide particles are categorized as PM emissions; hydrogen chloride is a HAP. Because the emissions would be widely dispersed and mostly over ocean waters due to their release characteristics in the atmosphere, they would reach the ground or ocean surface at expected concentration levels that would not have adverse effects on humans or wildlife.

Post- Flight Test

Post-flight test emissions would occur from personnel travel to the booster drop zone, the extraction of the first stage booster by a helicopter or backhoe, and the shipment of the equipment by truck to Minnesota for refurbishment. The vehicle, backhoe, and helicopter activities are short-term, lasting less than a few hours, and producing nearly negligible emissions. Due to the prevailing wind directions from the east, which would transport emissions away from public areas most of the time, and proximity to the nearest receptors, any impacts are expected to be negligible.

The shipment of the equipment by truck to Minnesota would occur over 6,000 miles per test. It is anticipated that, at the conclusion of each test, three trucks would travel 2,000 miles per truck from Port of Los Angeles to Minnesota. Concentrations of criteria pollutants and HAPs would temporarily increase in the immediate vicinity of the activity. Emissions, including particulate matter emissions, are relatively low and any impacts are expected to be at a minor level.

Due to expected low concentrations impacting locations of exposure on an infrequent basis for short durations, Alternative 1 emissions are not expected to interfere with the attainment of AAQS or contribute to human health risks from HAP exposure in areas where public presence is expected.

The analysis conclusions for air quality under Alternative 1 are consistent with a minor determination, as described in Table 6-1, and therefore would result in a less than significant impact on air quality.

6.2.2 Alternative 2 (Preferred Alternative)

Alternative 2 (Preferred Alternative) would implement the use of land- or sea-based launch systems for interceptor launch with land-, airborne-, sea-, and space-based sensor integration. Under this alternative, a Navy Aegis cruiser or destroyer vessel in the area would pull into NBG to conduct a mission brief with the MDA team prior to and after the test. Emissions, in addition to those generated over land, released within 3 nautical miles from shore and 12 nautical miles from shore are estimated for the analyzing impacts on attaining AAQS and for all other air impact analysis under NEPA, respectively. All other vessel activities under Alternative 2 are performed by vessels already in locations beyond 12 nautical miles. Criteria pollutant and HAP emissions were estimated for activities occurring within 3,000 ft. above ground level/MSL. It was assumed that each year, one interceptor missile would launch from AAFB, and one would launch from a U.S. Navy ship underway in the Western Pacific BOA, which is the open ocean area beyond 12 nautical miles from shore. All other activities remain the same as Alternative 1. Table 6-7 presents a summary of Alternative 2 criteria pollutant emissions that would be released over land and within 3 nautical miles from shore for each activity. Table 6-8 presents a summary of Alternative 2 criteria pollutant emissions that would be released over land and within 12 nautical miles from shore for each activity. The estimated emissions for HAPs of concern within 12 nautical miles are the same as those presented for Alternative 1 since the contribution to HAP emissions from vessel operations within 12 nautical miles is insignificant.

Table 6-7: Alternative 2 Criteria Pollutant Emissions Generated on Land and Within 3 Nautical Miles from Shore

Emissions	Total Emissions, Ton/yr					
	NO_x	SO_x	CO	VOC	PM_{10}	$PM_{2.5}$
Aircraft	8.96	0.37	0.92	0.06	1.11	1.00
Vessel - Test Flight	0.09	0.00	0.01	0.00	0.00	0.00
Truck Transport, Flight Test	0.03	0.00	0.02	0.00	44.88	4.49
Truck Transport, Post-Flight Test, from NWF to Port of Guam and from Los Angeles to Minnesota	0.02	0.00	0.00	0.00	1.04	0.11
Test Assets and Range Safety Generators	1.00	3.14	12.10	3.70	0.05	0.05
Climate Control Generator	0.15	0.00	0.20	0.01	0.01	0.01
Missile Launch			0.32		0.58	0.58
Personnel Commute to the Site	1.70	0.03	34.00	2.07	3.40	0.85
Total	**11.95**	**3.54**	**47.57**	**5.84**	**51.07**	**7.09**

Table 6-8: Alternative 2 Criteria Pollutant Emissions Generated on Land and Within 12 Nautical Miles from Shore

Emissions	Total Emissions, Ton/yr					
	NO_x	SO_x	CO	VOC	PM_{10}	$PM_{2.5}$
Aircraft	8.96	0.37	0.92	0.06	1.11	1.00
Vessel - Test Flight	0.38	0.00	0.03	0.00	0.01	0.01
Truck Transport, Flight Test	0.03	0.00	0.02	0.00	44.88	4.49
Truck Transport, Post-Flight Test, from NWF to Port of Guam and from Los Angeles to Minnesota	0.02	0.00	0.00	0.00	1.04	0.11
Test Assets and Range Safety Generators	1.00	3.14	12.10	3.70	0.05	0.05
Climate Control Generator	0.15	0.00	0.20	0.01	0.01	0.01
Missile Launch			0.32		0.58	0.58
Personnel Commute to the Site	1.70	0.03	34.00	2.07	3.40	0.85
Total	**12.23**	**3.54**	**47.59**	**5.84**	**51.08**	**7.10**

Note: Numbers may not add up exactly due to rounding.

Alternative 2 emissions within 12 nautical miles are slightly higher than Alternative 1 due to the addition of vessel activity. These emissions are not expected to significantly increase concentrations of criteria pollutants or HAPs or have an impact on human health. All other impact discussions presented for Alternative 1 also apply to Alternative 2.

Due to the expected dispersion and transport of pollutant plumes from intermittent and low rates of emissions, under local meteorological conditions, and infrequent public exposure , Alternative 2 emissions are not expected to interfere with the attainment of AAQS or contribute to human health risks from HAP exposure in areas where public presence is expected.

The analysis conclusions for air quality under Alternative 2 (Preferred Alternative) are consistent with a minor determination, as described in Table 6-1, and therefore would result in less than significant impact on air quality.

6.3 Impact Analysis – Executive Order EO 12114

6.3.1 Alternative 1

For this alternative, activities beyond 12 nautical miles of the U.S. coastline occur in elevations greater than 3,000 feet above ground level. As such, these activities are not analyzed under EO 12114 for Alternative 1.

6.3.2 Alternative 2

Under this alternative, one interceptor missile would launch from a U.S. Navy ship underway in the Western Pacific BOA, which is the open ocean area beyond 12 nautical miles of the U.S. coastline. Table 6-9 presents a summary of Alternative 2 criteria pollutant emissions in distances beyond 12 nautical miles. Tables 6-9 through 6-12 present the estimated emissions of HAPs of concern, group based on their potential cancer, non-cancer chronic, and non-cancer acute health impacts, that would be emitted under Alternative 2 in distances beyond 12 nautical miles.

Table 6-9: Alternative 2 Criteria Pollutant Emissions Greater than 12 Nautical Miles from Shore

Emissions	Total Emissions, Ton/yr					
	NO_x	SO_x	CO	VOC	PM_{10}	$PM_{2.5}$
Vessel	0.46	0.00	0.24	0.02	0.01	0.01
Missile Launch			0.32		0.584	0.584
Total	**0.46**	**0.00**	**0.55**	**0.02**	**0.59**	**0.59**

Note: Numbers may not add up exactly due to rounding.

Table 6-10: Alternative 2 Estimated Carcinogenic HAP Emissions Greater than 12 Nautical Miles from Shore

Pollutant	Total, ton/year	Main Contributing Activity
Naphthalene	0.00050	Vessel
Propanal (Propionaldehyde)	0.00002	Vessel
Formaldehyde	0.00068	Vessel
Benzene	0.00008	Vessel
Acetaldehyde	0.00016	Vessel

Table 6-11: Alternative 2 Estimated Non-Cancer Chronic HAP Emissions Greater than 12 Nautical Miles from Shore

Pollutant	Total, ton/year	Main Contributing Activity
Toluene	0.00003	Vessel
Hexane	0.00004	Vessel
Xylenes	0.00002	Vessel
Benzene	0.00008	Vessel
Hydrochloric Acid	0.31500	Missile Launch
Formaldehyde	0.00068	Vessel
Acetaldehyde	0.00016	Vessel
Acrolein	0.00003	Vessel

Table 6-12: Alternative 2 Estimated Non-Cancer Acute HAP Emissions Greater than 12 Nautical Miles from Shore

Pollutant	Total, pound/hour	Main Contributing Activity
Propanal (Propionaldehyde)	0.005	Vessel
Hexane	0.01	Vessel
Xylenes	0.005	Vessel
Phenol	0.025	Vessel
Toluene	0.0075	Vessel
Hydrochloric Acid	630	Missile Launch
Acetaldehyde	0.04	Vessel
Formaldehyde	0.17	Vessel
Benzene	0.02	Vessel

Due to the expected dispersion and transport of pollutant plumes from intermittent and low rates of emissions, under local meteorological conditions, and infrequent public exposure, Alternative 2 emissions are not expected to interfere with the attainment of AAQS or contribute to human health risks from HAP exposure in areas where public presence is expected.

The analysis conclusions for air quality under Alternative 2 (Preferred Alternative) are consistent with a minor determination, as described in Table 6-1, and therefore would result in less than significant impact on air quality.

6.4 No Action Alternative

Under the No Action Alternative, no flight tests would occur from land- or sea-based launchers, and no tracking exercises to test and calibrate the land-based and airborne sensors would occur. AAFB would continue with normal activities. Short-term and long-term air quality conditions in the project area would remain unchanged. Due to no changes to activities and therefore no new pollutant emissions, there would be no impact on air quality.

7.0 References

Air Force Civil Engineer Center. (2023). *Air Emissions Guide for Air Force Mobile Sources*. Lackland, TX: Air Force Civil Engineer Center Compliance Technical Support Branch.

Hawaii Department of Health. (2022). *State of Hawaii Annual Summary 2021 Air Quality Data*. Pearl City, HI: State of Hawaii Department of Health.

Naval Ordnance Missile Test Station. (1992). *Environmental Assessment for Standard Missile*.

Naval Sea Systems Command. (2024). *Navy and MSC Engine Emissions Calculator*.

U.S. Environmental Protection Agency. (2022). *Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions*. U.S. Environmental Protection Agency, Office of Transportation and Air Quality, Transportation and Climate Division: Washington, DC.

U.S. Environmental Protection Agency. (2023a). *AP-42: Compilation of Air Emissions Factors from Stationary Sources*. Retrieved February 1, 2024, from https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors-stationary-sources.

U.S. Environmental Protection Agency. (2023b). *Guam Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants*. Retrieved from https://www3.epa.gov/airquality/greenbook/anayo_gu.html.

U.S. Environmental Protection Agency. (2023c). *National Ambient Air Quality Standards Table*. Retrieved August 31, 2023, from https://www.epa.gov/criteria-air-pollutants/naaqs-table.

U.S. Environmental Protection Agency. (2024). *National Ambient Air Quality Standards Table*. Retrieved April 2, 2024, from https://www.epa.gov/criteria-air-pollutants/naaqs-table.

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Attachment A. Record of Nonapplicability

Record of Non-Applicability for Clean Air Act Conformity

The PA falls under the RONA category and is documented with this RONA.

Introduction

The USEPA published Determining Conformity of General Federal Actions to State or Federal Implementation Plans; Final Rule, in the November 30, 1993, Federal Register (40 CFR Parts 6, 51, and 93). On April 5, 2010, the EPA finalized revisions to the General Conformity Rule (75 Federal Register 17253–17279).

Federal regulations state that "no department, agency, or instrumentality of the Federal Government shall engage in, support in any way or provide financial assistance for, license or permit, or approve any activity that does not conform to an applicable State Implementation Plan." It is the responsibility of the federal agency to determine whether a federal action conforms to the applicable State Implementation Plan before the action is taken (40 CFR Part 51.850[a]).

Federal actions may be exempt from conformity determinations if their emissions do not exceed designated *de minimis* levels for the criteria pollutants of nonattainment or maintenance in the areas of the federal action (40 CFR Part 51.853[b]).

Proposed Action

Action Proponent: Missile Defense Agency

Proposed Action Name: Guam Flight Test Environmental Assessment/Overseas Environmental

Date RONA Prepared: April 15, 2024

RONA Prepared by: ManTech International

Proposed Action and Emissions Summary:

Under Alternative 1 and Alternative 2 of the PA, at the conclusion of the flight test, the launcher and range safety equipment would be transported from AAFB NWF to the Port of Guam via truck to be shipped back to the mainland U.S. via commercial barges. Once the containers arrive at the Port of Los Angeles, they would be shipped by truck to Minnesota for refurbishment. The transport routes from NWF to Port of Guam and from Port of Los Angeles to Minnesota pass through nonattainment or maintenance areas for some pollutants. Table 1 presents the total emissions for the transport route, including from NWF to Port of Guam, and compares the emissions to the lowest applicable General Conformity Rule *de minimis* threshold for each pollutant. As shown, the total emissions are well below all applicable thresholds. As such, a conformity determination is not required for the PA.

Table 1: Alternatives 1 and 2 Total Criteria Pollutant Emissions for Post Launch Transport of Assets

Emissions	Total Emissions, ton/year					
	NO_x	SO_x	CO	VOC	PM_{10}	$PM_{2.5}$
Truck Transport, Post-Flight Test, from NWF to Port of Guam and from Port of Los Angeles to Minnesota	0.02	0.00	0.00	0.00	1.04	0.11
Lowest *de minimis* threshold	10	100	100	10	70	70
Exceeds threshold?	**No**	**No**	**No**	**No**	**No**	**No**

Proposed Action Exemptions

The PA is exempt from the General Conformity Rule requirements based on the determination that the emissions are well below the *de minimis* threshold for all applicable pollutants.

Emissions Evaluation Conclusion

The Missile Defense Agency concludes none of the *de minimis* thresholds for affected pollutants would be exceeded as a result of implementation of the PA. The emissions data supporting that conclusion are shown in Table 1. The calculations, methodology, data, and references are contained in the Air Quality Impact Study presented in this appendix. Therefore, the Missile Defense Agency concludes that further formal Conformity Determination procedures are not required, resulting in this RONA.

RONA Approval

Signature:____

Name / Rank:_____________________________________

Date:________________________________

Position:____

Attachment B. Detailed Calculations

Aircraft Emissions Calculations

C17 Operations **F117-PW100 Engine (4)**

Type of Operation		Number of Operations per year	Number of Minutes per Operation	Number of Hours per year	Number of Engines	Fuel Flowrate (lb/hr)	Emissions in lbs/1000 lbs fuel NOx	SOx	CO	VOC	HAPs	PM10	PM2.5	CO2e
Takeoff	Idle (Taxi)	22	21.20	7.8	4	978	3.76	1.07	22.7	0.37	0.291	10.67	9.6	3214.64
	Take off	22	12.40	4.5	4	13905	35.04	1.07	0.32	0.01	0.006	0.06	0.05	3214.64
	Climb Out (Intermediate)	22	10.20	3.7	4	10408	32.72	1.07	0.32	0.04	0.012	2.31	2.08	3214.64
Arrival	Approach				4	4645	15.49	1.07	0.51	0.05	0.019	5.53	4.98	3214.64
	Idle (Taxi)	22	32.10	11.8	4	978	3.76	1.07	22.7	0.37	0.291	10.67	9.6	3214.64

Reference: June 2023 Air Emissions Guide For Air Force Mobile Sources; Table 2-3, GHG Emission Factors for Aircraft Engines; Table 2-9. Aircraft Engine Emission Factors for Criteria Pollutants; Table 2-10, VOC and HAP Emission Factors for Select Engines

Equations:	**Pollutant (lb/year) = number of hours per year*number of engines*emissions (lb/1000 lb fuel)*(fuel flowrate (lb/hr)/1000)** **Total (tons/year) = Total (lb/year)/2000**

Number of operations is based on the following:

1) Transport of the range safety equipment from White Sands Missile Range, New Mexico, or other test ranges, to AAFB. For CPs and HAPs, two LTOs per event (departure location and Guam), two events per year. Total: 4

2) Transport of the interceptor systems from Redstone Arsenal, Alabama to AAFB. For CPs and HAPs, two LTOs per event (departure location and Guam), two events per year. Total: 4

3) Transport of the target missiles from Cape Canaveral, FL, to AAFB. For CPs and HAPs, three LTOs per event (departure location, refueling stop, and Guam), two events per year. Total: 6

4) Transport of SM-3 interceptor missile from Redstone Arsenal, Alabama to AAFB. For CPs and HAPs, two LTOs per event (departure location and Guam), two events per year. Total: 4

5) Flight activities in support of target launches. For CPs and HAPs, two LTO per event, two events per year. Total: 4

Minutes per operation are from ACAM run data.

C17 Operations **F117-PW100 Engine (4)**

Type of Operation		Pounds per Year							
		NOx	SOx	CO	VOC	HAPs	PM10	PM2.5	CO2e
Takeoff	Idle (Taxi)	114.34	32.54	690.29	11.25	8.85	324.47	291.93	97,754.89
	Take off	8,861.11	270.59	80.92	2.53	-	15.17	12.64	812,936.17
	Climb Out (Intermediate)	5,094.62	166.60	49.83	6.23	1.87	359.68	323.86	500,531.28
Arrival	Approach	3,387.46	233.99	111.53	10.93	4.16	1,209.34	1,089.06	702,998.69
	Idle (Taxi)	100.86	28.70	608.89	9.92	7.81	286.20	257.50	86,227.19
	Tons per year	**8.78**	**0.37**	**0.77**	**0.02**	**0.01**	**1.10**	**0.99**	

Ground Support Equipment Emissions - Based on ACAM run – See Appendix B

Emissions	Total Emissions, Ton/yr						
	NO_x	SO_x	CO	VOC	PM_{10}	$PM_{2.5}$	CO_2e (MT)
GSE	0.18	0.01	0.15	0.04	0.01	0.01	7

C17 Operations

Type of Operation		Total Pounds per Year											
		Acetaldehyde	Acrolein	Benzene	1,3 Butadiene	Ethylbenzene	Formaldehyde	Naphthalene	Phenol	Propanal	Styrene	Toluene	Xylenes
Takeoff	Idle (Taxi)	0.36	-	0.68	-	0.09	7.18	0.07	0.12	-	0.05	0.20	0.10
	Take off	0.11	0.06	0.04	0.04	0.00	0.31	0.01	0.02	0.02	0.01	0.02	0.01
	Climb Out (Intermediate)	-	-	0.10	-	-	1.48	-	-	-	-	0.17	0.09
Arrival	Approach	-	-	0.19	-	-	3.61	-	-	-	-	0.31	0.14
	Idle (Taxi)	0.32	-	0.60	-	0.08	6.33	0.06	0.10	-	0.04	0.18	0.09
		3.97E-04	**3.10E-05**	**8.11E-04**	**2.14E-05**	**8.29E-05**	**9.45E-03**	**7.52E-05**	**1.18E-04**	**9.19E-06**	**4.83E-05**	**4.41E-04**	**2.10E-04**

Type of Operation		Emissions in lbs/1000 lbs fuel											
		Acetaldehyde	Acrolein	Benzene	1,3 Butadiene	Ethylbenzene	Formaldehyde	Naphthalene	Phenol	Propanal	Styrene	Toluene	Xylenes
Takeoff	Idle (Taxi)	0.012		2.25E-02		2.82E-03	2.36E-01	2.39E-03	3.79E-03		1.55E-03	6.68E-03	3.27E-03
	Take off	4.27E-04	2.45E-04	1.68E-04	1.69E-04	1.74E-05	1.23E-03	5.41E-05	7.26E-05	7.27E-05	3.09E-05	6.42E-05	4.48E-05
	Climb Out (Intermediate)			6.25E-04			9.50E-03					1.12E-03	5.47E-04
Arrival	Approach			8.90E-04			1.65E-02					1.41E-03	6.21E-04
	Idle (Taxi)	0.012		2.25E-02		2.82E-03	2.36E-01	2.39E-03	3.79E-03		1.55E-03	6.68E-03	3.27E-03

MH-60S Seahawk Helicopter Operations **T700-GE-700 Engine (2)**

Type of Operation	Number of Operations	Number of Minutes per Operation	Number of Hours per year	Number of Engines	Fuel Flowrate (lb/hr)	Emissions in lbs/1000 lbs fuel							
						NOx	SOx	CO	VOC	HAPs	PM10	PM2.5	CO2e
Ground Idle	2	5	0.17	2	134	3.36	1.07	46.24	0.5	0.334	1.48	1.33	3214.64
Flight Idle	2	5	0.17	2	469	10.95	1.07	5.12	0.02	0.007	1.26	1.13	3214.64
Flight Max	2	5	0.17	2	626	11.87	1.07	3.51	0.01	0.003	2.22	2	3214.64
Overspeed	2	5	0.17	2	725	11.43	1.07	2.81	0.01	0.007	2.61	2.33	3214.64

Equations:

Pollutant (lb/year) = number of hours per year*number of engines*emissions (lb/1000 lb fuel)*(fuel flowrate (lb/hr)/1000)

Total (tons/year) = Total (lb/year)/2000

Reference: June 2023 Air Emissions Guide for Air Force Mobile Sources; Table 2-3, GHG Emission Factors for Aircraft Engines; Table 2-9. Aircraft Engine Emission Factors for Criteria Pollutants; Table 2-10, VOC, and HAP

An MH-60S Seahawk helicopter would hover over the booster approximately 80-100 ft. above ground level, and utilizing its cargo hook capacity of 6,000 lb., would extract the booster and airlift it back to AAFB. Total flight time would be approximately 20 minutes, including no more than 5 minutes of hovering over the booster. Flight time includes engine start, plane captain checks, taxi, flight from AAFB to the recovery area, hover, return flight from the recovery area to AAFB, taxi, and shutdown. No dust emissions are anticipated since the helicopter activity would occur over dense foliage and rotor downwash of the helicopter in a hover would be less than 35 miles per hour.

Number of minutes per operation was estimated based on the information in the DOPAA.

MH-60S Seahawk Helicopter Operations T700-GE-700 Engine (2)

Type of Operation	Total Pounds per Year							
	NOx	SOx	CO	VOC	HAPs	PM10	PM2.5	CO2e
Ground Idle	0.15	0.05	2.07	0.02	0.01	0.07	0.06	143.59
Flight Idle	1.71	0.17	0.80	0.00	0.00	0.20	0.18	502.56
Flight Max	2.48	0.22	0.73	0.00	0.00	0.46	0.42	670.79
Overspeed	2.76	0.26	0.68	0.00	0.00	0.63	0.56	776.87
	0.004	**0.00**	**2.14E-03**	**1.50E-05**	**9.17E-06**	**6.79E-04**	**6.08E-04**	

MH-60S Seahawk Helicopter Operations, T700-GE-700 Engine (2)

Type of Operation	Emissions in lbs/1000 lbs fuel											
	Acetaldehyde	Acrolein	Benzene	1,3 Butadiene	Ethylbenzene	Formaldehyde	Naphthalene	Phenol	Propanal	Styrene	Toluene	Xylenes
Ground Idle	1.81E-02	0.00723	4.87E-02		2.25E-03	2.19E-01	7.33E-03	6.24E-03		5.16E-03	1.28E-02	7.14E-03
Flight Idle	3.03E-04	9.68E-05	2.97E-04		2.57E-04	4.09E-03	1.56E-04				1.24E-03	5.69E-04
Flight Max	0.0002	0.000011	3.12E-04			2.09E-03	0.0000673					5.07E-04
Overspeed			0.0003		0.000199	0.00481	0.0000291				0.000292	0.00124

Type of Operation	Total Pounds per Year											
	Acetaldehyde	Acrolein	Benzene	1,3 Butadiene	Ethylbenzene	Formaldehyde	Naphthalene	Phenol	Propanal	Styrene	Toluene	Xylenes
Ground Idle	0.00	0.00	0.00	-	0.00	0.01	0.00	0.00	-	0.00	0.00	0.00
Flight Idle	0.00	0.00	0.00	-	0.00	0.00	0.00	-	-	-	0.00	0.00
Flight Max	0.00	0.00	0.00	-	-	0.01	0.00	-	-	-	-	0.00
Overspeed	-	-	0.00	-	0.00	0.01	0.00	-	-	-	0.00	0.00
	0.000	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

Equations:

HAP (lb/year) = number of hours per year*number of engines*emissions (lb/1000 lb fuel)*(fuel flowrate (lb/hr)/1000)

Total (tons/year) = Total (lb/year)/2000

Vessel Emissions Calculations

DDG-51 Emissions

Speed	12.0	Knots Assumed
Time to 12 NM	2.0	1 hour, each approach, 2 hours total for each event
Time to 3 NM	0.5	Total for each event
Time at distances >12 NM	8.0	

The only vessel activity near Guam would be when a Navy vessel is involved with the at-sea interceptor launch, once per year. In that situation, assume that an Arleigh Burke (DDG-51) class destroyer would pull into Naval Base Guam so the crew can conduct a mission brief with the MDA team prior to and after the test. No idling, maneuvering, or other operations within 12 NM are anticipated. Assume this activity would take 2 hours total, within 12 NM. All other vessel activities under Alternative 2 are performed by vessels already in locations beyond 12 NM. The activities are estimated to take 8 hours per test. Assume this activity would occur once per year.

Total Pounds per Year							
NOx	**SOx**	**CO**	**VOC**	**HAPs**	**PM10**	**PM2.5**	**CO2e**
1,666.00	3.00	539.00	37.00		22.00	22.00	390,798.00
Total tons per Year							
NOx	**SOx**	**CO**	**VOC**	**HAPs**	**PM10**	**PM2.5**	**CO2e (MT)**
0.83	0.00	0.27	0.02	-	0.01	0.01	177.26

Emissions are based on MS Access-based Navy and MSC Engine Emissions Calculator (EEC), Version January 2024

Total Pounds per Year -within 3 NM							
NOx	**SOx**	**CO**	**VOC**	**HAPs**	**PM10**	**PM2.5**	**CO2e**
187.50	0.25	15.25	1.25	-	2.75	2.75	42,570.25
Total tons per Year							
NOx	**SOx**	**CO**	**VOC**	**HAPs**	**PM10**	**PM2.5**	**CO2e (MT)**
0.09	0.00	0.01	0.00	-	0.001	0.001	19.31

DDG-51 Emissions

Total Pounds per Year -within 12 NM							
NOx	**SOx**	**CO**	**VOC**	**HAPs**	**PM10**	**PM2.5**	**CO2e**
750.00	1.00	61.00	5.00		11.00	11.00	170,281.00
Total tons per Year							
NOx	**SOx**	**CO**	**VOC**	**HAPs**	**PM10**	**PM2.5**	**CO2e (MT)**
0.38	0.00	0.03	0.00	-	0.01	0.01	77.24

Total Pounds per Year > 12 NM							
NOx	**SOx**	**CO**	**VOC**	**HAPs**	**PM10**	**PM2.5**	**CO2e**
916.00	2.00	478.00	32.00		11.00	11.00	220,516.00
Total tons per Year							
NOx	**SOx**	**CO**	**VOC**	**HAPs**	**PM10**	**PM2.5**	**CO2e (MT)**
0.46	0.00	0.24	0.02	-	0.01	0.01	100.02

Vessel HAP Speciations

Source: EPA Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions, April 2022 (https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P1014J1S.pdf)				
Pollutant	**Pollutant Code**	**Basis**	**Fraction**	**Source**
Formaldehyde*	50000	VOC	0.042696	64
Naphthalene*	91203	VOC	0.031304	64
Acetaldehyde*	75070	VOC	0.009783	64
2,2,4-Trimethylpentane	540841	VOC	0.00712	65
Benzene*	71432	VOC	0.004739	64
Hexane	110543	VOC	0.00279	65
Toluene*	108883	VOC	0.002035	64
Acrolein*	107028	VOC	0.001848	64
Propionaldehyde*	123386	VOC	0.001517	64
Xylenes (Mixed Isomers)*	1330207	VOC	0.001422	64
Phenanthrene*	85018	VOC	0.001356	64
1,3-Butadiene*	106990	VOC	0.001013	64
o-Xylene*	95476	VOC	0.000513	64
Ethyl Benzene*	100414	VOC	0.000439	64
Anthracene*	120127	VOC	0.000344	64
Fluorene*	86737	VOC	0.000164	64
Acenaphthylene*	208968	VOC	0.000118	64
Acenaphthene*	83329	VOC	0.0000509	64

Pollutant	Pollutant Code	Basis	Fraction	Source
Nickel	7440020	PM2.5	0.000687	29
Antimony*	7440360	PM2.5	0.000615	64
Cadmium*	7440439	PM2.5	0.000236	64
Benzo(g,h,i)Fluoranthene*	203123	PM2.5	0.000132	64
Lead	7439921	PM2.5	0.000125	29
Fluoranthene*	206440	PM2.5	0.0000897	64
Pyrene*	129000	PM2.5	0.0000337	64
Arsenic	7440382	PM2.5	0.0000259	29
Chrysene*	218019	PM2.5	0.0000163	64
Benz[a]Anthracene*	56553	PM2.5	0.00000882	64
Dibenzo[a,h]anthracene*	53703	PM2.5	0.00000865	64
Benzo[b]Fluoranthene	205992	PM2.5	0.00000835	29
Indeno[1,2,3-c,d]Pyrene	193395	PM2.5	0.00000835	29
Benzo[a]Pyrene	50328	PM2.5	0.00000418	29
Benzo[k]Fluoranthene	207089	PM2.5	0.00000418	29
Manganese	7439965	PM2.5	0.00000322	65
Polychlorinated Biphenyls	1336363	PM2.5	0.000000418	29
Selenium	7782492	PM2.5	4.38E-08	29
Mercury	7439976	PM2.5	4.18E-08	29
Chromium (VI)	18540299	PM2.5	7.24E-09	65

Vessel HAP Calculations

Pollutant	Pollutant Code	Basis	Fraction	Emissions, Ton/year, within 12 NM	Emissions, Ton/year, > 12 NM
Formaldehyde*	50000	VOC	0.042696	1.07E-04	6.83E-04
Naphthalene*	91203	VOC	0.031304	7.83E-05	5.01E-04
Acetaldehyde*	75070	VOC	0.009783	2.45E-05	1.57E-04
2,2,4-Trimethylpentane	540841	VOC	0.00712	1.78E-05	1.14E-04
Benzene*	71432	VOC	0.004739	1.18E-05	7.58E-05
Hexane	110543	VOC	0.00279	6.98E-06	4.46E-05
Toluene*	108883	VOC	0.002035	5.09E-06	3.26E-05
Acrolein*	107028	VOC	0.001848	4.62E-06	2.96E-05
Propionaldehyde*	123386	VOC	0.001517	3.79E-06	2.43E-05
Xylenes (Mixed Isomers)*	1330207	VOC	0.001422	3.56E-06	2.28E-05
Inorganic HAPs (including Metals)		PM2.5	0.002007	5.02E-06	3.21E-05

Equation: **HAP (ton/year) = VOC emissions (lb/year)*HAP speciation fraction/2000**

Vehicle Emissions Calculations

ALT	Activity		Transport							Emissions Factors, grams per mile (g/mile)						
	Activity	Frequency	Vehicle	Category	Fuel	Number of Vehicles	Number of Miles per year	Number of Trips	Total Miles	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO_2
1 and 2	Truck Transport -Pre Test Flight	Two events per year	Heavy-Duty Diesel Vehicles (HDDV) – Diesel-powered vehicles (10,001 lbs. to > 60,000 lbs. GVWR)	On-Road Truck	Diesel	15	300	2	9000	1.61	2.30	0.11	0.00	0.04	0.04	1217.63
1 and 2	Truck Transport - Post Test Flight, Retrieval and Transport of the First Stage Booster	Two events per year	Heavy-Duty Diesel Vehicles (HDDV) – Diesel-powered vehicles (10,001 lbs. to > 60,000 lbs. GVWR)	On-Road Truck	Diesel	2	30	2	120	1.61	2.30	0.11	0.00	0.04	0.04	1217.63
1 and 2	Truck Transport - Post Test Flight, Transport of Test Assets from NWS to Port of Guam	Two events per year	Heavy-Duty Diesel Vehicles (HDDV) – Diesel-powered vehicles (10,001 lbs. to > 60,000 lbs. GVWR)	On-Road Truck	Diesel	3	42	2	252	1.61	2.30	0.11	0.00	0.04	0.04	1217.63
1 and 2	Truck Transport - Fuel Delivery to Generators	Two events per year	Heavy-Duty Diesel Vehicles (HDDV) – Diesel-powered vehicles (10,001 lbs. to > 60,000 lbs. GVWR)	On-Road Truck	Diesel	1	990	2	1980	1.61	2.30	0.11	0.00	0.04	0.04	1217.63
Reference for emission factors: Air Emissions Guide for Air Force Mobile Sources, Air Force Civil Engineer Center, June 2023; Tables 5-20 and 5-25																

ALT	Activity		Emissions, lb/year							Emissions, ton/year						Emissions, MT/year
	Activity	Frequency	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO_2	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO_2
1 and 2	Truck Transport - Pre-Test Flight	Two events per year	31.90	45.71	2.18	0.08	0.87	0.81	24159.40	0.0160	0.0229	0.0011	0.00004	0.0004	0.0004	10.959
1 and 2	Truck Transport - Post Test Flight, Retrieval and Transport of the First Stage Booster	Two events per year	0.43	0.61	0.03	0.00	0.01	0.01	322.13	0.0002	0.0003	0.0000	0.00000	0.0000	0.0000	0.146
1 and 2	Truck Transport - Post Test Flight, Transport of Test Assets from NWS to Port of Guam	Two events per year	0.89	1.28	0.06	0.00	0.02	0.02	676.46	0.0004	0.0006	0.0000	0.00000	0.0000	0.0000	0.307
1 and 2	Truck Transport - Fuel Delivery to Generators	Two events per year	7.02	10.06	0.48	0.02	0.19	0.18	5315.07	0.0035	0.0050	0.0002	0.00001	0.0001	0.0001	2.411

Truck Transport -Pre-Test Flight

Total tons per Year							
NO_x	SO_x	CO	VOC	HAPs	PM_{10}	$PM_{2.5}$	CO_2e (MT)
0.023	0.00	0.02	0.00		0.000	0.000	10.96

Truck emissions from the following: (1) transportation of the safety assets to a location adjacent to AAFB NWF and test launcher, (2) transportation of the interceptor systems to a location adjacent to AAFB NWF and test launcher, (3) transportation and staging of target missiles. These activities occur under both alternatives. Assume 5 trucks per activity, 30 miles roundtrip per truck, 5 days per month for 2 months, twice per year (i.e., 4 months total for two events).

Truck Transport - Post Test Flight, Retrieval and Transport of the First Stage Booster

Total tons per Year							
NO_x	SO_x	CO	VOC	HAPs	PM_{10}	$PM_{2.5}$	CO_2e (MT)
0.000	0.00	0.00	0.00		0.000	0.000	0.15

Post-launch travel to the booster drop zone. The activity occurs twice per year. Duration is one day per event and 30 miles roundtrip per event (i.e., 60 miles RT per year). Includes post-launch retrieval and transportation of the first stage booster if it falls on existing developed area.

Truck Transport - Fuel Delivery to Generators

Total tons per Year							
NO_x	SO_x	CO	VOC	HAPs	PM_{10}	$PM_{2.5}$	CO_2e (MT)
0.005	0.00	0.00	0.00		0.000	0.000	2.41

For the generator fuel delivery, assume daily delivery of fuel for a period of 45 days, which is the duration of the first flight test. Assume the fuel vendor will travel approximately 17 km (11 miles) one way to AAFB, for a total of 22 miles per day . This activity would occur twice per year.

Truck Transport - Total (including Dust Emissions)

Total tons per Year							
NO_x	SO_x	CO	VOC	HAPs	PM_{10}	$PM_{2.5}$	CO_2e (MT)

0.028	0.000	0.020	0.001	0.000	44.882	4.489	13.515

Table 5-20. On-Road Vehicle Criteria Pollutant Emission Factors – 2025 (cont.)

State	Fuel Type	Vehicle Type		Emission Factors (g/mi) Criteria Pollutants and Ozone Precursors						
				CO	VOC	NO_X	SO_2	PM_{10}	$PM_{2.5}$	NH_3
Florida	Gasoline	LDGV	Light-Duty Vehicles (Passenger Cars)	3.798	0.217	0.097	0.002	0.003	0.003	0.024
	Gasoline	LDGT	Light-Duty Trucks (0-8,500 lbs)	4.231	0.234	0.176	0.003	0.004	0.004	0.026
	Gasoline	HDGV	Heavy-Duty Vehicles (8,501 + lbs)	14.430	0.995	0.827	0.006	0.023	0.021	0.052
	Diesel	LDDV	Light-Duty Vehicles (Passenger Cars)	3.752	0.053	0.078	0.001	0.003	0.002	0.008
	Diesel	LDDT	Light-Duty Trucks (0-8,500 lbs)	2.519	0.060	0.117	0.001	0.003	0.003	0.008
	Diesel	HDDV	Heavy-Duty Vehicles (8,501 + lbs)	1.630	0.103	2.324	0.004	0.044	0.041	0.032
	Gasoline	MC	Motorcycles	12.758	3.040	0.567	0.003	0.024	0.021	0.052
Georgia	Gasoline	LDGV	Light-Duty Vehicles (Passenger Cars)	3.207	0.198	0.101	0.002	0.004	0.003	0.024
	Gasoline	LDGT	Light-Duty Trucks (0-8,500 lbs)	3.623	0.210	0.181	0.003	0.005	0.005	0.026
	Gasoline	HDGV	Heavy-Duty Vehicles (8,501 + lbs)	13.590	0.881	0.836	0.006	0.024	0.021	0.051
	Diesel	LDDV	Light-Duty Vehicles (Passenger Cars)	3.288	0.064	0.079	0.001	0.003	0.002	0.008
	Diesel	LDDT	Light-Duty Trucks (0-8,500 lbs)	2.232	0.069	0.118	0.001	0.003	0.003	0.009
	Diesel	HDDV	Heavy-Duty Vehicles (8,501 + lbs)	1.543	0.106	2.343	0.004	0.042	0.039	0.032
	Gasoline	MC	Motorcycles	12.825	2.724	0.641	0.003	0.024	0.021	0.054
Hawaii	Gasoline	LDGV	Light-Duty Vehicles (Passenger Cars)	3.711	0.224	0.097	0.002	0.004	0.003	0.024
	Gasoline	LDGT	Light-Duty Trucks (0-8,500 lbs)	4.122	0.244	0.175	0.003	0.005	0.005	0.025
	Gasoline	HDGV	Heavy-Duty Vehicles (8,501 + lbs)	14.374	1.063	0.835	0.006	0.026	0.023	0.051
	Diesel	LDDV	Light-Duty Vehicles (Passenger Cars)	3.526	0.049	0.077	0.001	0.003	0.002	0.008
	Diesel	LDDT	Light-Duty Trucks (0-8,500 lbs)	2.370	0.056	0.115	0.001	0.003	0.003	0.008
	Diesel	HDDV	Heavy-Duty Vehicles (8,501 + lbs)	1.608	0.100	2.304	0.004	0.044	0.041	0.032
	Gasoline	MC	Motorcycles	13.399	2.944	0.603	0.003	0.025	0.022	0.052

Table 5-25. On-Road Vehicle Speciated GHG Emission Factors – 2025 (cont.)

State	Fuel Type	Vehicle Type		Emission Factors (g/mi) Greenhouse Gas Species			
				CH_4	N_2O	CO_2	CO_2e
District of Columbia	Gasoline	LDGV	Light-Duty Vehicles (Passenger Cars)	0.0129	0.0047	328.876	330.608
	Gasoline	LDGT	Light-Duty Trucks (0-8,500 lbs)	0.0154	0.0074	423.590	426.187
	Gasoline	HDGV	Heavy-Duty Vehicles (8,501 + lbs)	0.0848	0.0325	1004.288	1016.086
	Diesel	LDDV	Light-Duty Vehicles (Passenger Cars)	0.0400	0.0008	332.648	333.894
	Diesel	LDDT	Light-Duty Trucks (0-8,500 lbs)	0.0332	0.0013	383.274	384.476
	Diesel	HDDV	Heavy-Duty Vehicles (8,501 + lbs)	0.0379	0.0047	1231.486	1233.824
	Gasoline	MC	Motorcycles	0.1364	0.0038	381.633	386.171
Florida	Gasoline	LDGV	Light-Duty Vehicles (Passenger Cars)	0.0123	0.0046	318.106	319.795
	Gasoline	LDGT	Light-Duty Trucks (0-8,500 lbs)	0.0152	0.0071	412.011	414.501
	Gasoline	HDGV	Heavy-Duty Vehicles (8,501 + lbs)	0.0676	0.0295	945.995	956.472
	Diesel	LDDV	Light-Duty Vehicles (Passenger Cars)	0.0292	0.0007	323.574	324.517
	Diesel	LDDT	Light-Duty Trucks (0-8,500 lbs)	0.0214	0.0011	374.999	375.851
	Diesel	HDDV	Heavy-Duty Vehicles (8,501 + lbs)	0.0191	0.0035	1244.624	1246.144
	Gasoline	MC	Motorcycles	0.1127	0.0032	387.105	390.888
Georgia	Gasoline	LDGV	Light-Duty Vehicles (Passenger Cars)	0.0122	0.0046	305.282	306.946
	Gasoline	LDGT	Light-Duty Trucks (0-8,500 lbs)	0.0148	0.0068	396.478	398.880
	Gasoline	HDGV	Heavy-Duty Vehicles (8,501 + lbs)	0.0643	0.0281	914.945	924.909
	Diesel	LDDV	Light-Duty Vehicles (Passenger Cars)	0.0363	0.0007	309.405	310.514
	Diesel	LDDT	Light-Duty Trucks (0-8,500 lbs)	0.0280	0.0010	359.653	360.650
	Diesel	HDDV	Heavy-Duty Vehicles (8,501 + lbs)	0.0242	0.0032	1238.641	1240.209
	Gasoline	MC	Motorcycles	0.1085	0.0030	388.821	392.427
Hawaii	Gasoline	LDGV	Light-Duty Vehicles (Passenger Cars)	0.0151	0.0046	310.722	312.458
	Gasoline	LDGT	Light-Duty Trucks (0-8,500 lbs)	0.0185	0.0070	402.943	405.478
	Gasoline	HDGV	Heavy-Duty Vehicles (8,501 + lbs)	0.0850	0.0292	932.752	943.563
	Diesel	LDDV	Light-Duty Vehicles (Passenger Cars)	0.0266	0.0007	316.215	317.090
	Diesel	LDDT	Light-Duty Trucks (0-8,500 lbs)	0.0190	0.0010	366.886	367.669
	Diesel	HDDV	Heavy-Duty Vehicles (8,501 + lbs)	0.0171	0.0036	1216.132	1217.634
	Gasoline	MC	Motorcycles	0.1368	0.0032	386.706	391.071

ALT	Activity		Transport							Emissions Factors, grams per mile (g/mile)						
	Activity	Frequency	Vehicle	Category	Fuel	Number of Vehicles	Number of Miles per year	Number of Trips	Total Miles	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO_2
1 and 2	Truck Transport - Port of Los Angeles to Minnesota	One one-way trip per flight test per vehicle	Heavy-Duty Diesel Vehicles (HDDV) – Diesel-powered vehicles (10,001 lbs. to > 60,000 lbs. GVWR)	On-Road Truck	Diesel	3	2000	2	12000	0.26	1.17	0.08	0.01	0.10	0.05	1237.85

Reference for emission factors: Air Emissions Guide for Air Force Mobile Sources, Air Force Civil Engineer Center, June 2023

Truck Transport, Post-Flight Test, from NWF to Port of Guam and from Los Angeles to Minnesota

Total tons per Year							
NO_x	SO_x	CO	VOC	HAPs	PM_{10}	$PM_{2.5}$	CO_2e (MT)
0.016	0.13	0.00	0.00		1.037	0.107	15.16

The components will ship off the island via normal commercial carriers in 3 CONEX boxes. They will offload at Port of Los Angeles and shipped via ground transport (truck) to Minnesota. Assume three trucks and 2,000 miles per truck per trip, twice per year (i.e., 12,000 miles total per year). Emissions include PM_{10} and $PM_{2.5}$ from dust generated from travel on paved roads.

Table 5-42. California On-Road Vehicle Speciated GHG Emission Factors – 2025

State	Fuel Type	Vehicle Type		Emission Factors (g/mi) Greenhouse Gas Species			
				CH_4	N_2O	CO_2	CO_2e
California	Gasoline	LDGV	Light-Duty Vehicles (Passenger Cars)	0.0095	0.0046	299.153	300.766
	Gasoline	LDGT	Light-Duty Trucks (0-8,500 lbs)	0.0119	0.0071	390.872	393.292
	Gasoline	HDGV	Heavy-Duty Vehicles (8,501 + lbs)	0.0606	0.0292	904.163	914.379
	Diesel	LDDV	Light-Duty Vehicles (Passenger Cars)	0.0359	0.0007	303.226	304.324
	Diesel	LDDT	Light-Duty Trucks (0-8,500 lbs)	0.0287	0.0010	354.726	355.739
	Diesel	HDDV	Heavy-Duty Vehicles (8,501 + lbs)	0.0240	0.0033	1236.270	1237.848
	Gasoline	MC	Motorcycles	0.1082	0.0031	390.443	394.057

Table 5-38. EMFAC County-Specific On-Road Vehicle EFs – 2025 (cont.)

County	Fuel Type	Vehicle Type		Emission Factors (g/mi)						
				Criteria Pollutants and Ozone Precursors						
				NO_X	SOx	CO	ROG	PM_{10}	$PM_{2.5}$	NH_3
Lake	Gasoline	LDGV	Light-Duty Vehicles (Passenger Cars)	0.120	0.003	1.637	0.195	0.017	0.006	0.025
	Gasoline	LDGT	Light-Duty Trucks (0-8,500 lbs)	0.227	0.004	2.312	0.294	0.019	0.007	0.027
	Gasoline	HDGV	Heavy-Duty Vehicles (8,501 + lbs)	0.343	0.005	2.548	0.378	0.029	0.011	0.052
	Diesel	LDDV	Light-Duty Vehicles (Passenger Cars)	0.518	0.002	0.553	0.051	0.048	0.036	0.008
	Diesel	LDDT	Light-Duty Trucks (0-8,500 lbs)	0.197	0.003	0.285	0.031	0.033	0.020	0.009
	Diesel	HDDV	Heavy-Duty Vehicles (8,501 + lbs)	2.706	0.006	0.744	0.229	0.134	0.080	0.033
	Gasoline	MC	Motorcycles	0.819	0.002	21.388	6.761	0.018	0.008	0.053
Lassen	Gasoline	LDGV	Light-Duty Vehicles (Passenger Cars)	0.082	0.003	1.273	0.144	0.017	0.006	0.025
	Gasoline	LDGT	Light-Duty Trucks (0-8,500 lbs)	0.176	0.004	1.980	0.233	0.019	0.007	0.027
	Gasoline	HDGV	Heavy-Duty Vehicles (8,501 + lbs)	0.310	0.005	2.464	0.334	0.030	0.011	0.052
	Diesel	LDDV	Light-Duty Vehicles (Passenger Cars)	0.234	0.002	0.471	0.033	0.030	0.019	0.008
	Diesel	LDDT	Light-Duty Trucks (0-8,500 lbs)	0.090	0.003	0.273	0.029	0.028	0.016	0.009
	Diesel	HDDV	Heavy-Duty Vehicles (8,501 + lbs)	2.499	0.006	0.706	0.219	0.132	0.077	0.033
	Gasoline	MC	Motorcycles	0.750	0.002	20.281	5.909	0.018	0.008	0.053
Los Angeles	Gasoline	LDGV	Light-Duty Vehicles (Passenger Cars)	0.065	0.003	1.060	0.117	0.017	0.006	0.025
	Gasoline	LDGT	Light-Duty Trucks (0-8,500 lbs)	0.120	0.003	1.427	0.144	0.019	0.007	0.027
	Gasoline	HDGV	Heavy-Duty Vehicles (8,501 + lbs)	0.196	0.005	1.638	0.189	0.028	0.010	0.052
	Diesel	LDDV	Light-Duty Vehicles (Passenger Cars)	0.195	0.002	0.404	0.037	0.038	0.027	0.008
	Diesel	LDDT	Light-Duty Trucks (0-8,500 lbs)	0.052	0.003	0.182	0.020	0.024	0.012	0.009
	Diesel	HDDV	Heavy-Duty Vehicles (8,501 + lbs)	1.173	0.005	0.260	0.079	0.099	0.046	0.033
	Gasoline	MC	Motorcycles	0.546	0.002	14.182	4.223	0.017	0.008	0.053

Vehicle Dust Emissions Calculations

Truck Transport - Dust Emissions, Unpaved Road

ALTs 1 and 2

For vehicles traveling on unpaved surfaces at industrial sites, emissions are estimated from the following equation:

$$E = k\ (s/12)^a (W/3)^b \qquad (1a)$$

E = size-specific emission factor (lb/VMT)
s = surface material silt content (%)
W = mean vehicle weight (tons)
M = surface material moisture content (%)
S = mean vehicle speed (mph)
C = emission factor for 1980's vehicle fleet exhaust, brake wear and tire wear.

Reference: AP-42 (13.2.2), November 2006, https://www.epa.gov/sites/production/files/2020-10/documents/13.2.2_unpaved_roads.pdf

Pollutant	PM_{10}	$PM_{2.5}$	
VMT	11,100	11,100	
k	1.5	0.15	Table 13.2.2-2
s	25.2	25.2	Table 13.2.2-3
a	0.9	0.9	Table 13.2.2-2
b	0.45	0.45	Table 13.2.2-2
S	25	25	
W-empty, tons	17.5	17.5	Average weight of semi-truck trailer (35,000 pounds)
W-full, tons	40	40	Assumed weight of semi-truck trailer with cargo-maximum allowed: 80,000 pounds
e	0	0	
Emissions (lbs/year)	89,762.3	8,976.2	
Emissions (tons/yr)	44.88	4.49	

Assumed no control efficiency (water spray or other controls).

Vehicle Miles Traveled (VMT)	VMT per event	Number of Events	Total, Miles	Assumptions
Truck Transport -Pre-Launch	4500	2	9000	Assume 5 trucks per activity, 3 activities, 30 miles roundtrip per truck, 5 days per month for 2 months, twice per year (i.e., 4 months total for two events).
Truck Transport - Post Launch	60	2	120	Duration is one day per event and 30 miles roundtrip per event (i.e., 60 miles RT per year).
Truck Transport - Fuel Delivery to Generators	990	2	1980	22 miles per day RT, 45 days per event
Total			**11100**	

Truck Dust Emissions - NWF to Port of G
Unpaved Road

ALTs 1 and 2

Reference: AP-42 (13.2.2), November 2006, https://www.epa.gov/sites/production/files/2020-10/documents/13.2.2_unpaved_roads.pdf

Pollutant	PM_{10}	$PM_{2.5}$	
VMT	252	252	
k	1.5	0.15	Table 13.2.2-2
s	25.2	25.2	Table 13.2.2-3
a	0.9	0.9	Table 13.2.2-2
b	0.45	0.45	Table 13.2.2-2
S	25	25	
W-empty, tons	17.5	17.5	Average weight of semi-truck trailer (35,000 pounds) Assumed weight of semi-truck trailer with cargo – maximum allowed: 80,000 pounds
W-full, tons	40	40	
e	0	0	
Emissions (lbs/year)	2,037.8	203.8	
Emissions (tons/yr)	1.019	0.102	

Assumed no control efficiency (water spray or other controls).

Truck Transport - Truck Transport - LA to MN, Dust, Paved Road

Ea = (VMT)[(k)(sL)0.91(W)1.02](Ci)(1 - e)

13.2.1.3 Predictive Emission Factor Equations[10,29]

The quantity of particulate emissions from resuspension of loose materi due to vehicle travel on a dry paved road may be estimated using the followi expression:

$$E = k\ (sL)^{0.91} \times (W)^{1.02}$$

where: E = particulate emission factor (having units matching the units
k = particle size multiplier for particle size range and units of int
sL = road surface silt loading (grams per square meter) (g/m^2), an
W = average weight (tons) of the vehicles traveling the road.

Pollutant	PM_{10}	$PM_{2.5}$
VMT	12,000	12,000
k	0.0022	0.00054
sL	0.03	0.03
W-full, tons	40	40
W-empty, tons	17.5	17.5
e		
Emissions (lbs/year)	33.4	8.2
Emissions (tons/yr)	0.02	0.004
Assumed weight of semi-truck trailer with cargo – maximum allowed: 80,000 pounds Average weight of semi-truck trailer (35,000 pounds)		

Reference: EPA AP-42 13.2.1 Paved Roads

VMT: vehicle miles traveled - see below

Vehicle Miles Traveled (VMT)	VMT per event	Number of Events	total	Assumptions
Truck Transport - LA to MN	6000	2	12000	Three trucks and 2,000 miles per truck per trip, twice per year (i.e., 12,000 miles total per year).

Personnel Commute to the Site, Dust Emissions

$Ea = (VMT)[(k)(sL)^{0.91}(W)^{1.02}](Ci)(1 - e)$

Pollutant	PM_{10}	$PM_{2.5}$	
VMT	2,352,000	2,352,000	
k	0.0022	0.00054	Default value, AP-42 Table 13.2.1-1
sL	0.6	0.6	AP-42 Table 13.2.1-2 - default for Average Daily Traffic (ADT) <500
W-full, tons	2	2	Average weight of passenger cars
W-empty, tons	2	2	Average weight of passenger cars
e			Assumed no control efficiency (water spray or other controls).
Emissions (lbs/year)	6,592.2	1,618.1	
Emissions (tons/yr)	3.30	0.81	

Reference: EPA AP-42 13.2.1 Paved Roads

VMT: vehicle miles traveled - see below

Reference: EPA AP-42 13.2.1 Paved Roads

VMT: vehicle miles traveled - see below

Vehicle Miles Traveled (VMT)	VMT per event	Number of Events	total	Assumptions
Personnel Commute	1176000	2	2352000	350 personnel, commuting 40 miles RT to the site, seven days per week for 12 weeks (84 days) per event.

Table 13.2.1-1. PARTICLE SIZE MULTIPLIERS FOR PAVED ROAD EQUATION

Size range[a]	Particle Size Multiplier k[b]		
	g/VKT	g/VMT	lb/VMT
PM-2.5[c]	0.15	0.25	0.00054
PM-10	0.62	1.00	0.0022
PM-15	0.77	1.23	0.0027
PM-30[d]	3.23	5.24	0.011

[a] Refers to airborne particulate matter (PM-x) with an aerodynamic diameter equal to or less than x micrometers.

[b] Units shown are grams per vehicle kilometer traveled (g/VKT), grams per vehicle mile traveled (g/VMT), and pounds per vehicle mile traveled (lb/VMT). The multiplier k includes unit conversions to produce emission factors in the units shown for the indicated size range from the mixed units required in Equation 1.

[c] The k-factors for $PM_{2.5}$ were based on the average $PM_{2.5}$:PM_{10} ratio of test runs in Reference 30.

[d] PM-30 is sometimes termed "suspendable particulate" (SP) and is often used as a surrogate for TSP.

Table 13.2.1-2. Ubiquitous Silt Loading Default Values with Hot Spot Contributions from Anti-Skid Abrasives (g/m^2)

ADT Category	< 500	500-5,000	5,000-10,000	> 10,000
Ubiquitous Baseline g/m^2	0.6	0.2	0.06	0.03 0.015 limited access
Ubiquitous Winter Baseline Multiplier during months with frozen precipitation	X4	X3	X2	X1
Initial peak additive contribution from application of antiskid abrasive (g/m^2)	2	2	2	2
Days to return to baseline conditions (assume linear decay)	7	3	1	0.5

Vehicle HAP Emission Calculations

Table 5-41. On-Road Vehicle Speciated VOC Weight Fractions

		Selected highest value from Table 5-41, %
VOC	**HAP**	
Acetaldehyde	X	1.64%
Acrolein	X	0.40%
Benzene	X	5.89%
1,3-Butadiene	X	1.44%
Ethylbenzene	X	2.56%
Formaldehyde	X	3.37%
Hexane	X	2.40%
Methyl-tert-Butyl Ether	X	0.05%
Methylethylbenzene	X	2.39%
Naphthalene	X	0.07%
Propionaldehyde	X	0.11%
Styrene	X	2.04%
Toluene	X	12.52%
2,2,4-Trimethylpentane	X	4.04%
Xylenes (Mixed Isomers)	X	10.11%

Reference: AIR EMISSIONS GUIDE FOR AIR FORCE MOBILE SOURCES METHODS FOR ESTIMATING EMISSIONS OF AIR POLLUTANTS FOR MOBILE SOURCES AT UNITED STATES AIR FORCE INSTALLATIONS, June 2021

HDGV (>8,500 lb GVWR)

Truck Transport HAP calculations - tons/year

Pollutant	Basis	Fraction	Emissions, Ton/year
Acetaldehyde	VOC	1.64%	2.21E-05
Acrolein	VOC	0.40%	5.38E-06
Benzene	VOC	5.89%	7.93E-05
1,3-Butadiene	VOC	1.44%	1.94E-05
Ethylbenzene	VOC	2.56%	3.45E-05
Formaldehyde	VOC	3.37%	4.54E-05
Hexane	VOC	2.40%	3.23E-05
Methyl-tert-Butyl Ether	VOC	0.05%	6.73E-07
Methylethylbenzene	VOC	2.39%	3.22E-05
Naphthalene	VOC	0.07%	9.42E-07
Propionaldehyde	VOC	0.11%	1.48E-06
Styrene	VOC	2.04%	2.75E-05
Toluene	VOC	12.52%	1.69E-04
2,2,4-Trimethylpentane	VOC	4.04%	5.44E-05
Xylenes (Mixed Isomers)	VOC	10.11%	1.36E-04

Equation: HAP (ton/year) = Total VOC emissions ton/year)*

HAP speciation fraction

Reference: AIR EMISSIONS GUIDE FOR AIR FORCE MOBILE SOURCES METHODS FOR ESTIMATING EMISSIONS OF AIR POLLUTANTS FOR MOBILE SOURCES AT UNITED STATES AIR FORCE INSTALLATIONS, June 2021

Truck Transport to Minnesota, HAP calculations - tons/year

Pollutant	Basis	Fraction	Emissions, Ton/year
Acetaldehyde	VOC	1.64%	1.76E-05
Acrolein	VOC	0.40%	4.30E-06
Benzene	VOC	5.89%	6.33E-05
1,3-Butadiene	VOC	1.44%	1.55E-05
Ethylbenzene	VOC	2.56%	2.75E-05
Formaldehyde	VOC	3.37%	3.62E-05
Hexane	VOC	2.40%	2.58E-05
Methyl-tert-Butyl Ether	VOC	0.05%	5.38E-07
Methylethylbenzene	VOC	2.39%	2.57E-05
Naphthalene	VOC	0.07%	7.53E-07
Propionaldehyde	VOC	0.11%	1.18E-06
Styrene	VOC	2.04%	2.19E-05
Toluene	VOC	12.52%	1.35E-04
2,2,4-Trimethylpentane	VOC	4.04%	4.35E-05
Xylenes (Mixed Isomers)	VOC	10.11%	1.09E-04

Equation: HAP (ton/year) = Total VOC emissions ton/year)*

HAP speciation fraction

Reference: AIR EMISSIONS GUIDE FOR AIR FORCE MOBILE SOURCES METHODS FOR ESTIMATING EMISSIONS OF AIR POLLUTANTS FOR MOBILE SOURCES AT UNITED STATES AIR FORCE INSTALLATIONS, June 2021

Personnel Commute
HAP Calculations

Tons per year - within 12 NM

Pollutant	Basis	Fraction	Emissions, Ton/year
Acetaldehyde	VOC	1.64%	0.034
Acrolein	VOC	0.40%	0.008
Benzene	VOC	5.89%	0.122
1,3-Butadiene	VOC	1.44%	0.030
Ethylbenzene	VOC	2.56%	0.053
Formaldehyde	VOC	3.37%	0.070
Hexane	VOC	2.40%	0.050
Methyl-tert-Butyl Ether	VOC	0.05%	0.001
Methylethylbenzene	VOC	2.39%	0.049
Naphthalene	VOC	0.07%	0.001
Propionaldehyde	VOC	0.11%	0.002
Styrene	VOC	2.04%	0.042
Toluene	VOC	12.52%	0.259
2,2,4-Trimethylpentane	VOC	4.04%	0.084
Xylenes (Mixed Isomers)	VOC	10.11%	0.209

Equation: HAP (ton/year) = Total VOC emissions ton/year)*

HAP speciation fraction

Reference: AIR EMISSIONS GUIDE FOR AIR FORCE MOBILE SOURCES METHODS FOR ESTIMATING EMISSIONS OF AIR POLLUTANTS FOR MOBILE SOURCES AT UNITED STATES AIR FORCE INSTALLATIONS, June 2021

Generators Emissions Calculations

Generators - Test Asset and Range Safety										
			Total tons per Year							
Operation	**Gen #**	**Purpose**	**NOx**	**SOx**	**CO**	**VOC**	**HAPs**	**PM10**	**PM2.5**	**CO2e (MT)**
Test Asset	11	Prime	0.200	0.74	2.10	0.90		0.01	0.01	372.85
Test Asset	12	Replacement for Unit 11								
Range Safety	13	Prime	0.200	0.60	2.50	0.70	0.23	0.01	0.01	310.87
Range Safety	14	Prime	0.200	0.60	2.50	0.70	0.23	0.01	0.01	310.87
Range Safety	15	Prime	0.200	0.60	2.50	0.70	0.23	0.01	0.01	310.87
Range Safety	16	Prime	0.200	0.60	2.50	0.70	0.23	0.01	0.01	310.87
Range Safety	18	Emergency	0	0	0	0	0	0	0	0.91
Total			**1.00**	**3.14**	**12.10**	**3.70**	**0.92**	**0.05**	**0.05**	**1617.24**

Reference: July 2023 Synthetic Minor, Noncovered Source Permit Application for Defense of Guam Initial Deployment and Flight Test, submitted by MDA to the Guam Environmental Protection Agency.

Unit 18 is an insignificant source of emissions.

			Total tons per Year							
Operation	Gen #	Purpose	**Acetaldehyde**	**Acrolein**	**Benzene**	**1,3-Butadiene**	**Formaldehyde**	**Naphthalene**	**Toluene**	**Xylenes**
Test Asset	11	Prime	2.00E-03	0.00E+00	2.00E-03	0.00E+00	3.00E-03		1.00E-03	1.00E-03
Test Asset	12	Replacement for Unit 11								
Range Safety	13	Prime	7.00E-04	2.00E-04	2.00E-03	1.00E-04	2.50E-03	2.00E-04	9.00E-04	6.00E-04
Range Safety	14	Prime	7.00E-04	2.00E-04	2.00E-03	1.00E-04	2.50E-03	2.00E-04	9.00E-04	6.00E-04
Range Safety	15	Prime	7.00E-04	2.00E-04	2.00E-03	1.00E-04	2.50E-03	2.00E-04	9.00E-04	6.00E-04
Range Safety	16	Prime	7.00E-04	2.00E-04	2.00E-03	1.00E-04	2.50E-03	2.00E-04	9.00E-04	6.00E-04
Range Safety	18	Emergency	0	0	0	0	0	0	0	0
Total			**0.005**	**0.001**	**0.010**	**0.000**	**0.013**	**0.001**	**0.005**	**0.003**

Exhibit 2 – Summary of Portable Diesel Generator Information by Location

Location	ID – 2 Years			Test Asset	FEM-02 Range Safety		Far-Field Tower
Manufacturer	Caterpillar	TBD	Cummins	Cummins	Caterpillar	Caterpillar	Kubota
Model	Tier IV XQ570	**RENTAL** Tier IV - **TBD**	Tier III, C150 D6D, Spec. B	Tier IV C200D2RE	Tier IV XQ125 C4.4	Tier III D40-2LC	Tier IV GL7000-USA
Capacity	455 kW / 568 kVA	150 kW / 187 kVA	150 kW / 187 kVA	180 kW / 225 kVA	100 kW / 125 kVA	40 kW	7 kW / 6.5 kVA
Total units required	8 (7+1)	1	1	2 (1+1)	4	1	1
CONOPS	• 6 (18hr/day) • 1 (24hr/day) • 1 Replacement	• Prime (24/7 for 6 months)	• 1 Backup	• 1 (16hr/day for 6 months) • 1 Replacement	• 4 (24 hr/day for 6 months)	• 1 Hot Backup – 20 hr total operation	• 1 (24 hr/day for 3 months)
Total Hours Per Year	48,180	4,464	100	2,976	17,856	20	2,232
GEN ID#	Gen #1-8	Gen #9	Gen #10	Gen #11-12	Gen #13-16	Gen #18	Gen #19
GEN S#	**TBD**	**TBD**	C210898200 **or** C210898202	D230225851 D230225852	CATXQ125LCK501189 CATXQ125ACK501188 CATXQ125VCK501190 CATXQ125ACK501191	CAT00C44CCN301112	665957

Climate Control Gensets

Engine Specifications - Assumed

Tier	3	
Horsepower	100	
Fuel Consumption (gal/hr)	5.11	**Fuel Flow Rate = horsepower (hp) x BSFC / HHV x Load Factor. Assume Load Factor = 100%**
Number of Engines	2	Per the DOPAA, V3, the C-17 would be climate controlled using two diesel-fueled air conditioning units.
Annual Fuel Consumption	2452.55	gal/year
KW to HP	0.7457	kw/hr
g to lbs	453.592	grams/lb
Days per flight test	5	Five days per launch x two launches per year, continuous operation
Flight tests per year	2	
Hours per day	24	

Pollutants	Emission Factor (g/bhp-hr)	Total Hourly Emissions (lbs) per engine	Total Daily Emissions (lbs) per engine	Total Annual Emissions (lbs) All engines	Total Annual Emissions (tons) All engines
NOx	2.8500	0.6283	15.08	302	0.15
CO	3.7000	0.8157	19.58	392	0.20
HC	0.1500	0.0331	0.79	16	0.01
PM	0.2200	0.0485	1.16	23	0.01
SOx	-	0.0011	0.03	1	0.00

Equations:

Pollutant hourly emissions (lb/hour): **Emission Factor (g/bhp-hr)*engine horsepower (hp)/453.592(g/lb)**

Reference for % NOx and HC in NOx+NMHVC: Bay Area AQMD Policy, June 28, 2004, CARB Emission Factors for CI Diesel Engines – Percent HC in Relation to NMHC + NOx (https://www.baaqmd.gov/~/media/Files/Engineering/policy_and_procedures/Engines/EmissionFactorsforDieselEngines.ashx)

Sulfur content

0.0015%	by mass	Ultra Low Sulfur
5.11	Fuel Consumption (gal/hr)	
7.10	Fuel density, lb/gal	
0.0011	lb/hr of SOx	Per engine

Climate Control Gensets

Calculation table used to calculate the fuel flow rate

Fuel	BSFC (Btu/hp-hr)	HHV (Btu/gal)	Value	Units
Diesel	7,000	137,000	0.0511	gal/hp-hr

Tier 1-3 Emission Standards

The 1998 nonroad engine regulations were structured as a 3-tiered progression. Each tier involved a phase-in (by horsepower rating) over several years. Tier 1 standards were phased-in from 1996 to 2000. The more stringent Tier 2 standards took effect from 2001 to 2006, and yet more stringent Tier 3 standards phased-in from 2006 to 2008 (Tier 3 standards applied only for engines from 37-560 kW).

Tier 1-3 emissions standards are listed in Table 1. Nonroad regulations use the metric system of units, with regulatory limits expressed in grams of pollutant per kWh.

Table 1
EPA Tier 1-3 nonroad diesel engine emission standards, g/kWh (g/bhp·hr)

Engine Power	Tier	Year	CO	HC	NMHC+NOx	NOx	PM
kW < 8 (hp < 11)	Tier 1	2000	8.0 (6.0)	-	10.5 (7.8)	-	1.0 (0.75)
	Tier 2	2005	8.0 (6.0)	-	7.5 (5.6)	-	0.8 (0.6)
8 ≤ kW < 19 (11 ≤ hp < 25)	Tier 1	2000	6.6 (4.9)	-	9.5 (7.1)	-	0.8 (0.6)
	Tier 2	2005	6.6 (4.9)	-	7.5 (5.6)	-	0.8 (0.6)
19≤ kW < 37 (25 ≤ hp < 50)	Tier 1	1999	5.5 (4.1)	-	9.5 (7.1)	-	0.8 (0.6)
	Tier 2	2004	5.5 (4.1)	-	7.5 (5.6)	-	0.6 (0.45)
37 ≤ kW < 75 (50 ≤ hp < 100)	Tier 1	1998	-	-	-	9.2 (6.9)	-
	Tier 2	2004	5.0 (3.7)	-	7.5 (5.6)	-	0.4 (0.3)
	Tier 3	2008	5.0 (3.7)	-	4.7 (3.5)	-	-†
75 ≤ kW < 130 (100 ≤ hp < 175)	Tier 1	1997	-	-	-	9.2 (6.9)	-
	Tier 2	2003	5.0 (3.7)	-	6.6 (4.9)	-	0.3 (0.22)
	Tier 3	2007	5.0 (3.7)	-	4.0 (3.0)	-	-†

Climate Control Gensets – HAP Emissions		
Pollutant	Emission Factor lb/1000 gal	Emissions, tons/year
Acetaldehyde	7.83E-01	9.60E-04
Acrolein	3.39E-02	4.16E-05
Benzene	1.86E-01	2.28E-04
1,3-Butadiene	2.17E-01	2.66E-04
Ethylbenzene	1.09E-02	1.34E-05
Formaldehyde	1.73	2.12E-03
Hexane	2.69E-02	3.30E-05
Methyl-tert-Butyl Ether		0.00E+00
Methylethylbenzene		0.00E+00
Naphthalene	1.97E-02	2.42E-05
Propylene	4.67E-01	5.73E-04
Styrene		0.00E+00
Toluene	1.05E-01	1.29E-04
2,2,4-Trimethylpentane		0.00E+00
Xylenes (Mixed Isomers)	4.24E-02	5.20E-05

Reference for HAP Emission Factors: San Diego APCD/Ventura County APCD Calculation Method E15 for Uncontrolled Diesel-Fired Engines <600hp (See screenshot)

Equation: HAP (ton/year) = (HAP emission factor (lb/1000 gal)* (fuel flowrate (gal)/1000))/2000

Missile Launch Calculations

Missile Launch Emissions

Emissions Factors in tons/launch							
NO_x	SO_x	CO	VOC	HAPs	PM_{10}	$PM_{2.5}$	CO_2e
		0.105		0.105	0.19479	0.19479	0.0116

Reference: MDA provided emissions data from EA for Standard Missile (Naval Ordnance Missile Test Station, 1992). Emissions are multiplied by a factor of three (3), since the reference indicates that the exhaust volume of SM-3 is three time larger than SM-1.

HCL is the only HAP shown.

Assume PM_{10} = Ferric Oxide emissions

Number of Launches per year 2

Adjustment for SM-3 versus SM-1 3

Total tons per Year							
NO_x	SO_x	CO	VOC	HAPs	PM_{10}	$PM_{2.5}$	CO_2e (MT)
		0.63		0.63	1.17	1.17	0.06

Equation: HAP (tons/year) = HAP (tons/launch)*number of Launches per year*Adjustment for SM-3 versus SM-1

Table 4.2.1.1.1-4 lists the emission constituents for each SM-1 launch as analyzed in the *Environmental Assessment for Standard Missile* (Naval Ordnance Missile Test Station, 1992). The hydroxyl-terminated polybutadiene/ammonium perchlorate (HTPB/AP)-based composite solid propellants for the booster contains a mixture of primarily ammonium perchlorate, aluminum, and cyclotetramethylenetetranitramine (HMX). The solid fuel propellant of the sustainer portion of the dual-thrust rocket motor and the sustainer rocket motor consists of ammonium perchlorate and aluminum.

Table 4.2.1.1.1-4. Estimated Emissions from Standard Missile-1 Propellants: Ammonium Perchlorate, Aluminum, and HMX

Reaction Product	Name	Tons per Launch
H_2O	Water	0.039
N_2	Molecular Nitrogen	0.042
CO	Carbon Monoxide	0.105
CO_2	Carbon Dioxide	0.0116
NO	Nitric Oxide	0.000006
NH_3	Ammonia	2.2×10^{-7}
H	Hydrogen	0.00011
HCl	Hydrogen Chloride	0.105
$AlCl_3$	Aluminum Chloride	0.00019
Al_2O_3	Aluminum Oxide	0.187 (liquid)
Fe_2O_3	Ferric Oxide	0.0076 (solid)
$FeCl_3$	Ferric Chloride	No emission factor listed

Source: Calculations based on Naval Ordnance Missile Test Station, 1992, Appendix A "Theoretical Specific Impulse and Exhaust Constituents."

The 1992 EA also found that the polyisoprene rubber used to insulate the SM-1 MK104 Dual Thrust Rocket Motor case contains approximately 46 percent chrysotile asbestos, the most commonly used form of asbestos. Any asbestos released during the launch process would be transformed into a non-asbestos condensate. If this did not occur due to a launch failure, exhausted concentrations of asbestos would be above ambient concentrations, which are likely to be near zero (Naval Ordnance Missile Test Station, 1992). SOPs concerning the handling of asbestos would be followed.

The analysis of the SM-1 in 1992 determined that the launch of the SM-1 would not significantly impact the ambient air quality. The exhaust volume from the SM-3 would be the larger than the SM-1. The propulsion system of the SM-1 was assumed to have 1,033 pounds of propellant in the booster and sustainer. The propulsion systems of the missiles for the Proposed Action have

Attachment C. Air Conformity Applicability Model results

1. General Information

- Action Location

Base: ANDERSEN AFB
State: Guam
County(s): Guam
Regulatory Area(s): NOT IN A REGULATORY AREA

- Action Title: Guam Test Flight - EA/OEA

- Project Number/s (if applicable):

- Projected Action Start Date: 1 / 2025

- Action Purpose and Need:

The purpose of the Proposed Action is to deploy, test, and conduct flight tests or tracking exercises from a location on Guam or at sea from a U.S. Navy ship to validate the interoperability of multiple sensors and interceptor systems from the Services that could become a part of the "system of systems" (or the backbone) of a missile defense system developed to protect Guam.

- Action Description:

The Proposed Action is to deploy, test, and conduct up to two flight tests or tracking exercises per year over a ten-year period from a location on Guam and/or from a U.S. Navy ship underway in the broad ocean area (BOA) of the western Pacific Ocean. A flight test includes the launch and interception of a target by an interceptor, whereas a tracking exercise involves using sensors to track a target with no interceptor. The interceptor for flight tests would launch from Northwest Field (NWF), Andersen Air Force Base (AAFB) on Guam or from a U.S. Navy ship underway in the western Pacific Ocean. Tracking exercises could include both land- and sea-based sensors.

• Alternative 1 – Flight tests or tracking exercises utilizing land-based launch systems for interceptor launch with land-, airborne-, sea-, and space-based sensor integration.

• Alternative 2 (Preferred Alternative) – Flight tests or tracking exercises utilizing land- or sea-based launch systems for interceptor launch with land-, airborne-, sea-, and space-based sensor integration.

- Point of Contact

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Title: Contractor
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Phone Number: 949.892.9515

- Activity List:

Activity Type		Activity Title
2.	Aircraft	C-17 activities
3.	Personnel	Personnel Commute to the site

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. Aircraft

2.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

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

- Activity Title: C-17 activities

- Activity Description:

1) transport of the range safety equipment from White Sands Missile Range, New Mexico, or other test ranges, to AAFB; (2) transport of the interceptor systems from Redstone Arsenal, Alabama to AAFB; (3) transport of the target missiles from Cape Canaveral, FL, to AAFB; (4) transport of SM-3 interceptor missile from Redstone Arsenal, Alabama to Guam; and (5) flight activities in support of target launches.

- Activity Start Date
Start Month: 1
Start Year: 2025

- Activity End Date
Indefinite: No
End Month: 12
End Year: 2025

- Activity Emissions:

Pollutant	Total Emissions (TONs)	Pollutant	Total Emissions (TONs)
VOC	0.045612	PM 2.5	0.475298
SO_x	0.202191	Pb	0.000000
NO_x	4.950624	NH_3	0.000000
CO	0.471318	CO_2e	598.5
PM 10	0.561276		

- Activity Emissions [Flight Operations (includes Trim Test & APU) part]:

Pollutant	Total Emissions (TONs)	Pollutant	Total Emissions (TONs)
VOC	0.010539	PM 2.5	0.463412
SO_x	0.195596	Pb	0.000000
NO_x	4.774647	NH_3	0.000000
CO	0.325112	CO_2e	591.3
PM 10	0.549001		

- Activity Emissions [Aerospace Ground Equipment (AGE) part]:

Pollutant	Total Emissions (TONs)	Pollutant	Total Emissions (TONs)
VOC	0.035074	PM 2.5	0.011886
SO_x	0.006595	Pb	0.000000
NO_x	0.175977	NH_3	0.000000
CO	0.146206	CO_2e	7.3
PM 10	0.012275		

2.2 Aircraft & Engines

2.2.1 Aircraft & Engines Assumptions

- Aircraft & Engine

Aircraft Designation: C-17A
Engine Model: F117-PW-100
Primary Function: Transport - Bomber
Aircraft has After burn: No
Number of Engines: 4

- Aircraft & Engine Surrogate

Is Aircraft & Engine a Surrogate? No
Original Aircraft Name:
Original Engine Name:

2.2.2 Aircraft & Engines Emission Factor(s)

- Aircraft & Engine Emissions Factors (lb/1000lb fuel)

	Fuel Flow	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	CO_2e
Idle	978.00	0.37	1.07	3.76	22.70	10.67	8.75	3234
Approach	4645.00	0.05	1.07	15.49	0.51	5.53	5.10	3234
Intermediate	10408.00	0.04	1.07	32.72	0.32	2.31	1.42	3234
Military	13905.00	0.01	1.07	35.04	0.32	0.06	0.05	3234
After Burn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3234

2.3 Flight Operations

2.3.1 Flight Operations Assumptions

- Flight Operations

Number of Aircraft: 1
Number of Annual LTOs (Landing and Take-off) cycles for all Aircraft: 12
Number of Annual TGOs (Touch-and-Go) cycles for all Aircraft: 0
Number of Annual Trim Test(s) per Aircraft: 12

- Default Settings Used: Yes

- Flight Operations TIMs (Time In Mode)

Taxi/Idle Out [Idle] (mins): 9.2 (default)
Takeoff [Military] (mins): 0.4 (default)
Takeoff [After Burn] (mins): 0 (default)
Climb Out [Intermediate] (mins): 1.2 (default)
Approach [Approach] (mins): 5.1 (default)
Taxi/Idle In [Idle] (mins): 6.7 (default)

Per the Air Emissions Guide for Air Force Mobile Sources, the defaults values for military aircraft equipped with after burner for takeoff is 50% military power and 50% afterburner. (Exception made for F-35 where KARNES 3.2 flight profile was used)

- Trim Test

Idle (mins): 12 (default)
Approach (mins): 27 (default)
Intermediate (mins): 9 (default)
Military (mins): 12 (default)
AfterBurn (mins): 0 (default)

2.3.2 Flight Operations Formula(s)

- Aircraft Emissions per Mode for LTOs per Year

AEM_{POL} = (TIM / 60) * (FC / 1000) * EF * NE * LTO / 2000

AEM_{POL}: Aircraft Emissions per Pollutant & Mode (TONs)
TIM: Time in Mode (min)
60: Conversion Factor minutes to hours
FC: Fuel Flow Rate (lb/hr)
1000: Conversion Factor pounds to 1000pounds
EF: Emission Factor (lb/1000lb fuel)
NE: Number of Engines
LTO: Number of Landing and Take-off Cycles (for all aircraft)
2000: Conversion Factor pounds to TONs

- Aircraft Emissions for LTOs per Year

AE_{LTO} = AEM_{IDLE_IN} + AEM_{IDLE_OUT} + $AEM_{APPROACH}$ + $AEM_{CLIMBOUT}$ + $AEM_{TAKEOFF}$

AE_{LTO}: Aircraft Emissions (TONs)
AEM_{IDLE_IN}: Aircraft Emissions for Idle-In Mode (TONs)
AEM_{IDLE_OUT}: Aircraft Emissions for Idle-Out Mode (TONs)
$AEM_{APPROACH}$: Aircraft Emissions for Approach Mode (TONs)
$AEM_{CLIMBOUT}$: Aircraft Emissions for Climb-Out Mode (TONs)
$AEM_{TAKEOFF}$: Aircraft Emissions for Take-Off Mode (TONs)

- Aircraft Emissions per Mode for TGOs per Year

AEM_{POL} = (TIM / 60) * (FC / 1000) * EF * NE * TGO / 2000

AEM_{POL}: Aircraft Emissions per Pollutant & Mode (TONs)
TIM: Time in Mode (min)
60: Conversion Factor minutes to hours
FC: Fuel Flow Rate (lb/hr)
1000: Conversion Factor pounds to 1000pounds
EF: Emission Factor (lb/1000lb fuel)
NE: Number of Engines
TGO: Number of Touch-and-Go Cycles (for all aircraft)
2000: Conversion Factor pounds to TONs

- Aircraft Emissions for TGOs per Year

AE_{TGO} = $AEM_{APPROACH}$ + $AEM_{CLIMBOUT}$ + $AEM_{TAKEOFF}$

AE_{TGO}: Aircraft Emissions (TONs)
$AEM_{APPROACH}$: Aircraft Emissions for Approach Mode (TONs)
$AEM_{CLIMBOUT}$: Aircraft Emissions for Climb-Out Mode (TONs)
$AEM_{TAKEOFF}$: Aircraft Emissions for Take-Off Mode (TONs)

- Aircraft Emissions per Mode for Trim per Year

$AEPS_{POL}$ = (TD / 60) * (FC / 1000) * EF * NE * NA * NTT / 2000

$AEPS_{POL}$: Aircraft Emissions per Pollutant & Power Setting (TONs)
TD: Test Duration (min)
60: Conversion Factor minutes to hours
FC: Fuel Flow Rate (lb/hr)
1000: Conversion Factor pounds to 1000pounds
EF: Emission Factor (lb/1000lb fuel)

NE: Number of Engines
NA: Number of Aircraft
NTT: Number of Trim Test
2000: Conversion Factor pounds to TONs

- Aircraft Emissions for Trim per Year

$AE_{TRIM} = AEPS_{IDLE} + AEPS_{APPROACH} + AEPS_{INTERMEDIATE} + AEPS_{MILITARY} + AEPS_{AFTERBURN}$

AE_{TRIM}: Aircraft Emissions (TONs)
$AEPS_{IDLE}$: Aircraft Emissions for Idle Power Setting (TONs)
$AEPS_{APPROACH}$: Aircraft Emissions for Approach Power Setting (TONs)
$AEPS_{INTERMEDIATE}$: Aircraft Emissions for Intermediate Power Setting (TONs)
$AEPS_{MILITARY}$: Aircraft Emissions for Military Power Setting (TONs)
$AEPS_{AFTERBURN}$: Aircraft Emissions for After Burner Power Setting (TONs)

2.4 Auxiliary Power Unit (APU)

2.4.1 Auxiliary Power Unit (APU) Assumptions

- Default Settings Used: Yes

- Auxiliary Power Unit (APU) (default)

Number of APU per Aircraft	Operation Hours for Each LTO	Exempt Source?	Designation	Manufacturer
1	0.5	No	331 250G	

2.4.2 Auxiliary Power Unit (APU) Emission Factor(s)

- Auxiliary Power Unit (APU) Emission Factor (lb/hr)

Designation	Fuel Flow	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	CO_2e
331 250G	272.6	0.493	0.289	1.216	3.759	0.131	0.037	910.8

2.4.3 Auxiliary Power Unit (APU) Formula(s)

- Auxiliary Power Unit (APU) Emissions per Year

$APU_{POL} = APU * OH * LTO * EF_{POL} / 2000$

APU_{POL}: Auxiliary Power Unit (APU) Emissions per Pollutant (TONs)
APU: Number of Auxiliary Power Units
OH: Operation Hours for Each LTO (hour)
LTO: Number of LTOs
EF_{POL}: Emission Factor for Pollutant (lb/hr)
2000: Conversion Factor pounds to tons

2.5 Aerospace Ground Equipment (AGE)

2.5.1 Aerospace Ground Equipment (AGE) Assumptions

- Default Settings Used: Yes

- AGE Usage

Number of Annual LTO (Landing and Take-off) cycles for AGE: 12

- Aerospace Ground Equipment (AGE) (default)

Total Number of AGE	Operation Hours for Each LTO	Exempt Source?	AGE Type	Designation
1	0.66	No	Air Compressor	MC-1A - 18.4hp
1	1.5	No	Air Conditioner	MA-3D - 120hp
1	1.5	No	Bomb Lift	MJ-1B
1	2	No	Generator Set	A/M32A-86D
1	1.5	No	Heater	BT400-46
1	1.5	No	Light Cart	NF-2
1	0.5	No	Pumping Unit	AF/M27M-1
1	2	No	Start Cart	A/M32A-95

2.5.2 Aerospace Ground Equipment (AGE) Emission Factor(s)

- Aerospace Ground Equipment (AGE) Emission Factor (lb/hr)

Designation	Fuel Flow	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	CO_2e
MC-1A - 18.4hp	1.1	0.267	0.008	0.419	0.267	0.071	0.068	24.8
MA-3D - 120hp	7.1	0.053	0.050	4.167	0.317	0.109	0.105	161.7
MJ-1B	0.0	3.040	0.219	4.780	3.040	0.800	0.776	141.2
A/M32A-86D	6.5	0.294	0.046	6.102	0.457	0.091	0.089	147.0
BT400-46	0.4	0.100	0.003	0.158	0.181	0.109	0.105	8.9
NF-2	0.0	0.010	0.043	0.110	0.080	0.010	0.010	22.1
AF/M27M-1	1.8	0.276	0.004	0.177	12.262	0.109	0.100	34.8
A/M32A-95	0.0	0.070	0.264	1.470	5.860	0.110	0.107	190.4

2.5.3 Aerospace Ground Equipment (AGE) Formula(s)

- Aerospace Ground Equipment (AGE) Emissions per Year

$AGE_{POL} = AGE * OH * LTO * EF_{POL} / 2000$

AGE_{POL}: Aerospace Ground Equipment (AGE) Emissions per Pollutant (TONs)
AGE: Total Number of Aerospace Ground Equipment
OH: Operation Hours for Each LTO (hour)
LTO: Number of LTOs
EF_{POL}: Emission Factor for Pollutant (lb/hr)
2000: Conversion Factor pounds to tons

3. Personnel

3.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

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

- Activity Title: Personnel Commute to the site

- Activity Description:

Emissions due to 350 personnel commuting to the site.

Test duration could last up to 8 hours, and pre-launch activities would occur up to 12 weeks prior to the flight test. Up to 350 personnel could be needed for the flight test. Modeled seven days per week for a duration of 6 months per year (two events per year).

- Activity Start Date
Start Month: 1
Start Year: 2025

- Activity End Date
Indefinite: No
End Month: 7
End Year: 2025

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	2.074572
SO_x	0.029496
NO_x	1.704230
CO	33.996107
PM 10	0.091766

Pollutant	Total Emissions (TONs)
PM 2.5	0.045883
Pb	0.000000
NH_3	0.311350
CO_2e	1641.3

3.2 Personnel Assumptions

- Number of Personnel
Active Duty Personnel: 0
Civilian Personnel: 0
Support Contractor Personnel: 350
Air National Guard (ANG) Personnel: 0
Reserve Personnel: 0

- Default Settings Used: No

- Average Personnel Round Trip Commute (mile): 40

- Personnel Work Schedule
Active Duty Personnel: 5 Days Per Week
Civilian Personnel: 6 Days Per Week
Support Contractor Personnel: 7 Days Per Week
Air National Guard (ANG) Personnel: 4 Days Per Week
Reserve Personnel: 4 Days Per Month

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 Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
LDGV	00.6330	00.0090	00.5200	10.3730	00.0280	00.0140		00.0950	00500.800
LDGT	00.6330	00.0090	00.5200	10.3730	00.0280	00.0140		00.0950	00500.800
HDGV	00.6330	00.0090	00.5200	10.3730	00.0280	00.0140		00.0950	00500.800
LDDV	00.6330	00.0090	00.5200	10.3730	00.0280	00.0140		00.0950	00500.800
LDDT	00.6330	00.0090	00.5200	10.3730	00.0280	00.0140		00.0950	00500.800
HDDV	00.6330	00.0090	00.5200	10.3730	00.0280	00.0140		00.0950	00500.800
MC	00.6330	00.0090	00.5200	10.3730	00.0280	00.0140		00.0950	00500.800

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