



DEPARTMENT OF THE ARMY
U.S. ARMY SPACE AND MISSILE DEFENSE COMMAND/
ARMY FORCES STRATEGIC COMMAND
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ATTENTION OF

October 26, 2017

SUBJECT: Final Environmental Assessment/Overseas Environmental Assessment for Flight Experiment 1 (FE-1)

TO WHOM IT MAY CONCERN:

Please provide space in your library or offices for public access to the enclosed *Final Environmental Assessment/Overseas Environmental Assessment for Flight Experiment 1 (FE-1)*. The Final Environmental Assessment/Overseas Environmental Assessment (FEA/OEA) and Final Finding of No Significant Impacts (FONSI) are also available on the internet at https://tbe.com/Flight_Experiment_1_Documents_for_Public_Review and at the following locations:

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2. Office Lobby of the Republic of the Marshall Islands Environmental Protection Authority, Ebeye, Marshall Islands
3. Grace Sherwood Library, Kwajalein, Marshall Islands
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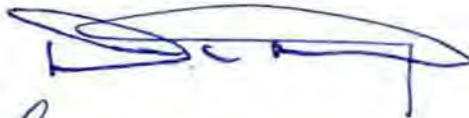
Public and agency comments on the Draft Environmental Assessment/Overseas Environmental Assessment and Draft FONSI were accepted from May 19 through June 19, 2017. Comments received were incorporated into the Final EA/OEA. An Environmental Impact Statement is not required. Thus, the Final EA/OEA is being distributed to various individuals and agencies.

SUBJECT: Final Environmental Assessment/Overseas Environmental Assessment for Flight Experiment 1 (FE-1)

Questions regarding the document or requests for additional copies should be addressed to:

Strategic Systems Program
ATTN: Mr. Fred Chamberlain
1250 10th Street, SE
Washington Navy Yard, DC 20374-5127

Sincerely,

A handwritten signature in blue ink, appearing to read 'W. Hill', with a long horizontal flourish extending to the right.

 Weldon Hill
Deputy Chief of Staff, Engineer

Enclosure

FINAL
ENVIRONMENTAL ASSESSMENT/OVERSEAS ENVIRONMENTAL ASSESSMENT
For
Flight Experiment 1 (FE-1)



Responsible Agencies



Cooperating Agency



Participating Agency

August 2017

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Abstract

Designation: Environmental Assessment (EA)/Overseas Environmental Assessment (OEA)

Title of Proposed Action: Flight Experiment 1 (FE-1)

Project Location: Pacific Missile Range Facility, Hawai'i, and US Army Kwajalein Atoll, Republic of the Marshall Islands

Lead Agency for the EA/OEA: Department of the Navy, US Navy Strategic Systems Programs

Cooperating Agency: Department of Energy

Participating Agency: US Army Space and Missile Defense Command/Army Forces Strategic Command

Affected Region: Barking Sands, Kauai, Hawai'i, Broad Ocean Areas in the Pacific Ocean, and US Army Kwajalein Atoll, Republic of the Marshall Islands

Action Proponent: US Navy Strategic Systems Programs

Point of Contact: Mr. Fred Chamberlain
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Date: July 2017

The Proposed Action, Flight Experiment 1 (FE-1), is sponsored by the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, which has designated the United States Department of the Navy (US Navy) Strategic Systems Programs (SSP) as the lead agency and action proponent of the Proposed Action. The US Navy, along with the Department of Energy (DOE) as cooperating agency and the US Army Space and Missile Defense Command/Army Forces Strategic Command (USASMDC/ARSTRAT) as participating agency, has prepared this Environmental Assessment (EA)/Overseas Environmental Assessment (OEA) in accordance with the National Environmental Policy Act (NEPA), as implemented by the Council on Environmental Quality Regulations and Navy regulations for implementing NEPA.

The purpose of the Proposed Action is to collect data on a developmental payload by testing range performance and to demonstrate technologies for prospective strike capabilities. Specifically, the FE-1 experiment would develop, integrate, and flight test the developmental payload concept to demonstrate the maturity of key technologies. These technologies include precision navigation, guidance and control, and enabling capabilities.

The need for the Proposed Action is to provide flight test data and information required by the DoD to provide a basis for ground testing, modeling, and simulation of developmental payload performance applicable to a range of possible FE-1 concepts being studied as a way to inform potential future strike capability determinations.

The Proposed Action would be one experimental flight test within a year after signing the Finding of No Significant Impact, if approved. This EA/OEA assesses all potential environmental impacts associated with the Proposed Action, any viable alternatives, and the No-Action Alternative, including the analysis of the following resource areas: air quality, air space, biological resources, cultural resources, hazardous materials and wastes, noise, public health and safety, and water resources.

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EXECUTIVE SUMMARY

Proposed Action

The Proposed Action, Flight Experiment 1 (FE-1), is sponsored by the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, which has designated the United States (US) Department of the Navy (US Navy) Strategic Systems Programs (SSP) as the lead agency and action proponent of the Proposed Action. The US Navy SSP proposes to conduct a developmental flight test as described in this Environmental Assessment (EA)/Overseas Environmental Assessment (OEA). The US Navy, along with the Department of Energy (DOE) as cooperating agency and the US Army Space and Missile Defense Command/Army Forces Strategic Command (USASMDC/ARSTRAT) as participating agency, has prepared this Environmental Assessment (EA)/Overseas Environmental Assessment (OEA) in accordance with the National Environmental Policy Act (NEPA), as implemented by the Council on Environmental Quality (CEQ) Regulations and Navy regulations for implementing NEPA. The Proposed Action would be one experimental flight test within a year after signing a Finding of No Significant Impact (FONSI), if approved.

Purpose of and Need for the Proposed Action

The purpose of the Proposed Action is to collect data on a developmental payload by testing range performance and to demonstrate technologies for prospective strike capabilities. Specifically, the FE-1 experiment would develop, integrate, and flight test the developmental payload concept to demonstrate the maturity of key technologies. These technologies include precision navigation, guidance and control, and enabling capabilities.

The need for the Proposed Action is to provide flight test data and information required by the DoD to provide a basis for ground testing, modeling, and simulation of developmental payload performance applicable to a range of possible FE-1 concepts being studied as a way to inform potential future strike capability determinations.

Alternatives Considered

Alternatives were generated and evaluated using screening criteria of existing launch facilities and impact areas, to include their ability to support the flight test distances, infrastructure, equipment, instrumentation for data collection, and their availability to the Navy in the planned flight test timeframe. Only the Proposed Action meets the purpose and need, however, the US Navy is also considering the No Action Alternative, as required by the CEQ regulations.

Summary of Environmental Resources Evaluated in the EA/OEA

CEQ regulations, NEPA, and Navy instructions for implementing NEPA, specify that an EA/OEA should address those resource areas potentially subject to impacts. In addition, the level of analysis should be commensurate with the anticipated level of environmental impact.

The following resource areas have been analyzed in this EA/OEA:

Pacific Missile Range Facility:

Air quality, water resources, biological resources, air space, noise, public health and safety, hazardous materials and waste

Over-Ocean Flight Corridor:

Air quality, biological resources

US Army Kwajalein Atoll and Ronald Reagan Ballistic Missile Defense Test Site:

Cultural resources, biological resources, noise, public health and safety, hazardous materials and waste

Because potential impacts were considered to be negligible or nonexistent, the following resources were not evaluated in this EA/OEA:

Pacific Missile Range Facility:

Geological resources, cultural resources, land use, infrastructure, transportation, socioeconomics, environmental justice, visual resources, and marine sediments

Over-Ocean Flight Corridor:

Water resources, geological resources, cultural resources, land use, air space, noise, infrastructure, transportation, public health and safety, hazardous materials and wastes, socioeconomics, environmental justice, visual resources, and marine sediments

US Army Kwajalein Atoll and Ronald Reagan Ballistic Missile Defense Test Site:

Air quality, greenhouse gases, and climate change; water resources, geological resources, land use, air space, infrastructure, transportation, socioeconomics, environmental justice, visual resources, and marine sediments

Summary of Potential Environmental Consequences of the Action Alternatives and Major Mitigating Actions**Pacific Missile Range Facility:**

Air Quality, Greenhouse Gases, and Climate Change – No impacts to air quality or air resources would occur with implementation of the No Action Alternative. The Strategic Target System (STARS) booster has been previously launched at SNL/KTF, and it is anticipated that the launch of the FE-1 flight test at the same site would have a similar air quality impact as described for the No Action Alternative. Because the STARS is relatively small and the launch is a short-term, discrete event, the time between launches of the Proposed Action and other launches scheduled from SNL/KTF would allow the dispersion of greenhouse gases and ozone depleting substances. Therefore, implementation of the FE-1 flight test would not result in significant impacts to air quality.

Water Resources – No significant impacts to water resources would occur with implementation of the No Action Alternative. Based on previous analysis and sampling, the Proposed Action activities do not adversely affect water resources. Therefore, implementation of the Proposed Action would not result in significant impacts to water resources.

Biological Resources – No significant impacts to biological resources would occur with implementation of the No Action Alternative. The area for the analysis of effects to biological resources associated with the Proposed Action includes SNL/KTF for the greatest launch effects. Surrounding terrestrial and

marine areas of PMRF may also be affected by hazardous chemicals, increased sound pressure levels, and increased human and vessel activity. No long term adverse impacts on vegetation are expected. No threatened or endangered plants have been observed on PMRF and critical habitat for the ohai and lau'ehu would not be affected by the action. Wildlife species such as birds may be impacted by elevated sound pressure levels from launch as well as hazardous chemicals, increased human activity, and direct contact from debris. The launch site at KTF is in an area that has routine human activity, equipment operation, and launch activity. Pre-launch activities at KTF include final vehicle and experiment assembly, preflight checks, and demonstration of system performance. None of these activities will take place at night and lights will not be turned on at night for any FE-1 activities during the period of concern for Newell's shearwaters. If program activities are required to occur at night (outside the Newell's shearwater period of concern), the US Navy will coordinate these activities through PMRF to comply with the Dark Skies policy. Marine wildlife species, which include marine mammals and sea turtles, have the potential to be impacted by elevated sound pressure levels, hazardous chemicals, direct contact from debris, and disturbance from increase human or equipment operation. The offshore waters of PMRF is an area that has routine human activity, equipment operation, and launch activity. The probability for a launch mishap is very low. However, an early flight termination or mishap would cause missile debris to impact along the flight corridor, potentially in offshore waters. If humpback whales, monk seals, or sea turtles were observed in the offshore launch safety zone, the launch would be delayed. Some fish near the surface could be injured or killed by larger pieces of debris. It is unlikely that the smaller pieces of sinking debris would have sufficient velocity to harm individual marine mammals or fish.

Air Space – No significant impacts to airspace would occur with implementation of the No Action Alternative. The advanced planning and coordination with the Federal Aviation Administration regarding: scheduling of special use airspace, and coordination of the proposed FE-1 flight test relative to en route airways and jet routes, would result in minimal impacts on airspace and implementation of the Proposed Action would not result in significant impacts to airspace.

Noise – No significant impacts due to the noise environment would occur with implementation of the No Action Alternative. The STARS booster has been previously launched at SNL/KTF, and noise levels would be the same as previous launches. The Proposed Action would produce similar noise levels to previous STARS launches at SNL/KTF. Therefore, implementation of the FE-1 flight test would not result in significant impacts to the noise environment.

Public Health and Safety – No significant impacts would occur with implementation of the No Action Alternative. The FE-1 flight test would include the launch of a STARS booster with the payload from SNL/KTF. The STARS booster has been previously launched at SNL/KTF. The testing of the developmental payload at the same site would have a similar potential health and safety impact as described for the No Action Alternative. The proposed solid propellants would be similar to past launches and would follow the same health and safety procedures developed under existing plans. The probability for a launch mishap is very low. However, an early flight termination or mishap would cause missile debris to impact at PMRF or along the flight corridor. In most cases, an errant missile would be moving at such a high-speed that resulting missile debris would strike the water further downrange. Therefore, implementation of the Proposed Action would not result in significant impacts to public health and safety.

Hazardous Materials and Waste – No significant impacts would occur with implementation of the No Action Alternative. The STARS booster has been previously launched at SNL/KTF, and hazardous

materials and wastes would be the same for these launches. The launch of the Proposed Action would be anticipated to use similar hazardous materials and produce similar hazardous waste. This launch is included in the overall number of missile launches proposed in previous environmental documentation. Hazardous material usage and waste generation would continue to be managed by PMRF under appropriate State and Federal requirements. Therefore, implementation of the Proposed Action would not result in significant impacts with hazardous materials and wastes.

Major Mitigating Actions are not required for any of the noted resources at PMRF. Minor mitigation activities are incorporated into the Proposed Action such that there are no significant impacts to any resource from the planned activities.

Over-Ocean Flight Corridor:

Air Quality, Greenhouse Gases, and Climate Change – No significant impacts would occur to air quality, the greenhouse gases, or climate change from the FE-1 flight test in the Over-Ocean Flight Corridor. The active flight time over the region of influence would be measured in minutes, the emissions would be from a single flight, the majority of emissions would be removed from the atmosphere through dry deposition and precipitation or diffusion and wind dispersion. The STARS booster would be relatively small compared to emissions released on a global scale. Due to the large air volume over which these emissions are spread, and the rapid dispersion of the emissions by stratospheric winds, a single launch of a STARS booster would not be expected to have a significant impact on the upper atmosphere. Ozone-depleting gas emissions from the single flight test would represent a minute increase and even incremental effects on the global atmosphere are not likely. Because of the solid propellant used, the launch would release only a small quantity of carbon dioxide. This limited amount of emissions would not likely contribute to global warming or climate change to any discernible extent.

Biological Resources – No significant impacts to biological resources would occur with implementation of the No Action Alternative. Potential impacts of the Action in the broad ocean area of the over-ocean flight corridor include the effects of elevated sound pressure levels, direct contact from missile debris, exposure to hazardous chemicals, and increased human and vessel activity. Seabirds, marine mammals, sea turtles, and fish may be affected by elevated sound pressure levels. Any disturbances from elevated sound pressure levels are likely to be temporary, behavioral modifications with no lasting effects. The chances of a marine mammal or sea turtle being directly contacted by falling vehicle components are so low as to be discountable. Any hazardous materials released into the waters of the broad ocean area would be rapidly diluted by seawater and larger and heavier components would sink to the ocean floor fairly quickly where organisms are not likely to be in contact with hazardous materials. No significant impacts from these stressors are expected for seabirds, marine mammals, sea turtles, or fish in the over-ocean flight corridor.

Major Mitigating Actions are not required for any of the noted resources within the Over-Ocean Flight Corridor. As this is a single flight test, impacts are very limited and temporary such that there are no significant impacts to either noted resource from the planned activities.

US Army Kwajalein Atoll and Ronald Reagan Ballistic Missile Defense Test Site:

Illeginni Islet

Cultural Resources – No significant impacts would occur to cultural resources on Illeginni Islet. The developmental payload would impact on the west side of Illeginni Islet. Existing surface cover and site disturbance from construction of a helipad, roads, and facilities, and operations including previous

missile flight tests with land impacts encompass almost the entirety of Illeginni Islet. A land impact would not occur in proximity to known or potential cultural resources on Illeginni Islet. Personnel involved in the FE-1 flight test operational activities would be briefed on and would follow UES requirements in handling or avoiding any cultural resources uncovered during operational or monitoring activities.

Biological Resources – No significant impacts to biological resources would occur with implementation of the No Action Alternative. Potential impacts of the Action at and near Illeginni Islet include the effects of elevated sound pressure levels, direct contact from payload impact, exposure to hazardous chemicals, and increased human and vessel activity. The payload impact area at Illeginni is previously disturbed habitat and vegetation; therefore, terrestrial vegetation would not be adversely impacted. Nesting and roosting seabirds have the potential to be affected by elevated sound pressure levels, direct contact, and human disturbance. Mitigation measures would be employed to deter birds from nesting or roosting in the impact area and while birds may be temporarily startled by sounds, any behavioral or physiological response is likely to be brief. Mitigation measures would be employed to decrease the chances of there being effects on sea turtles from direct contact from payload impact, exposure to hazardous chemicals, and disturbance from human activity and equipment operation. The US Fish and Wildlife Service was provided a biological assessment for these activities and their Letter of Concurrence has been included as an appendix in the Final EA/OEA. Sea turtles in the water and fish may be exposed to elevated sound pressure levels high enough to elicit a behavioral response. Any responses are likely to be temporary, with organisms quickly returning to normal behaviors; therefore, no significant impacts are expected for sea turtles in the water, marine mammals, or most fish species near Illeginni Islet. Direct contact from payload impact as well as disturbance from human activity and equipment operation may adversely affect coral colonies, individual mollusks, and humphead wrasses. The National Marine Fisheries Service was provided a biological assessment for these activities and the findings of their Final Biological Opinion are included as an appendix in the Final EA/OEA.

Noise – No significant impacts would occur from noise generated during the pre-test and post-test activities or during the impact of the payload at Illeginni Islet. There is no resident population at or near Illeginni Islet, and during the flight test, RTS would verify that no non-mission vessels would be in the area. Ship-board personnel on mission vessels may be required to wear hearing protection in compliance with the Army's Hearing Conservation Program. Sonic boom noise at impact would be audible only once and would last a fraction of a second.

Public Health and Safety – No significant impacts to public safety would occur from the FE-1 flight test during an Illeginni Islet impact. A flight termination system would perform a failsafe operation to ensure debris would fall short of any protected or inhabited area if performance were not within safety criteria. There are no resident populations at or near Illeginni Islet. A NOTMAR and NOTAM would be issued to clear commercial, private, and non-mission military vessel and aircraft traffic from caution areas and the Government of the RMI also would be informed in advance. Radar and visual sweeps of hazard areas would be regularly scheduled and conducted prior to launch to clear any non-mission ships and aircraft.

Hazardous Materials and Wastes – No significant impacts would occur to hazardous materials and waste from the FE-1 flight test with an impact at Illeginni Islet. Hazardous materials used in the developmental payload would be limited to batteries, small electro-explosive devices, and a tungsten alloy. No solid or liquid propellants, DU, Be, or radioactive materials would be carried on the developmental payload. Following impact, all visible debris would be recovered, and all equipment and materials would be

recovered from Illeginni Islet. Any hazardous waste resulting from FE-1 flight test activities on Illeginni Islet would be disposed of in accordance with the UES.

Major Mitigating Actions are not required for any of the noted resources at Illeginni Islet. As this is a single flight test, impacts are very limited and temporary such that there are no significant impacts to either noted resource from the planned activities.

Offshore Waters - Southwest and Northeast

Cultural Resources – No cultural resources have been identified in either Offshore Waters location. No impacts to cultural resources would occur from the FE-1 flight test.

Biological Resources – No significant impacts to biological resources would occur with implementation of the No Action Alternative. Potential impacts of the Action at and near Illeginni Islet include the effects of elevated sound pressure levels, direct contact from payload impact, exposure to hazardous chemicals, and increased human and vessel activity. Foraging and resting seabirds have the potential to be affected by elevated sound pressure levels, direct contact, and human disturbance. Mitigation measures will be employed to deter birds from roosting on sensor rafts and while birds may be temporarily startled by sounds, any behavioral or physiological response is likely to be brief and no significant impacts are expected. Sea turtles in the water, marine mammals, and fish may be exposed to elevated sound pressure levels high enough to elicit a behavioral response. Any responses are likely to be temporary, with organisms quickly returning to normal behaviors. Sea turtles, marine mammals, fish, and larval fish, coral, and mollusks have a small chance of being adversely affected by direct contact from payload impact. While these organisms also may be affected by vessel strike, exposure to hazardous chemicals, and disturbance from human activity; no significant impacts are expected for sea turtles, marine mammals, or fish in the offshore impact areas.

Noise – No significant impacts would occur from noise generated during the pre-test and post-test activities or during the impact of the payload in either Offshore Waters location. There is no resident population at or near either of these sites, and during the flight test, RTS would verify that no non-mission vessels would be in the area. Ship-board personnel on mission vessels may be required to wear hearing protection in compliance with the Army's Hearing Conservation Program. Sonic boom noise at impact would be audible only once and would last no more than a fraction of a second.

Public Health and Safety – No significant impacts to public safety would occur from the FE-1 flight test during an Offshore Waters impact. A flight termination system would perform a failsafe operation to ensure debris would fall short of any protected or inhabited area if performance were not within safety criteria. There are no resident populations at or near either Offshore Waters location. A NOTMAR and NOTAM would be issued to clear commercial, private, and non-mission military vessel and aircraft traffic from caution areas and the Government of the RMI also would be informed in advance. Radar and visual sweeps of hazard areas would be regularly scheduled and conducted prior to launch to clear any non-mission ships and aircraft.

Hazardous Materials and Wastes – No significant impacts would occur to hazardous materials and waste from the FE-1 flight test with an impact at either Offshore Waters location. Hazardous materials used in the developmental payload would be limited to batteries, small electro-explosive devices, and a tungsten alloy. No solid or liquid propellants, DU, Be, or radioactive materials would be carried on the developmental payload. Following impact, any floating debris would be recovered, and all equipment and rafts would be recovered. Any hazardous waste resulting from FE-1 flight test activities in the Offshore Waters would be disposed of in accordance with the UES.

Major Mitigating Actions are not required for any of the noted resources within the Offshore Waters – Southwest and Northeast. As this is a single flight test, impacts are very limited and temporary such that there are no significant impacts to either noted resource from the planned activities.

Table ES-1 provides a tabular summary of the potential impacts to the resources associated with each of the alternative actions analyzed.

Public Involvement

The Navy circulated the Draft EA/OEA for public review for 30-days from 19 May 2017 to 19 June 2017. Substantive comments received from US and Republic of the Marshall Island agencies on the Draft EA/OEA and their responses are provided in the Final EA/OEA. No comments were received from the public.

Table ES-1 Summary of the Potential Impacts to the Resources Associated with each of the Alternative Actions Analyzed

Location	Resource Area	No Action Alternative	Proposed Action Alternative
PMRF	Air Quality	No Change	Minor, short-term impact
	Water Resources	No Change	Minor, short-term impact
	Biological Resources	No Change	No significant impact
	Airspace	No Change	No impact
	Noise	No Change	Minor, short-term impact
	Public Health and Safety	No Change	Minor, short-term impact
	Hazardous Materials and Wastes	No Change	Minor, short term impact
Over-Ocean Flight Corridor	Air Quality	No Change	No significant impact
	Biological Resources	No Change	No significant impact
USAKA, RMI Illeginni Islet	Cultural Resources	No Change	No significant impact
	Biological Resources	No Change	No significant impact
	Noise	No Change	No significant impact
	Public Health and Safety	No Change	No significant impact
	Hazardous Materials and Wastes	No Change	No significant impact
USAKA, RMI Offshore Waters – Southwest and Northeast	Cultural Resources	No Change	No impact
	Biological Resources	No Change	No significant impact
	Noise	No Change	No significant impact
	Public Health and Safety	No Change	No significant impact
	Hazardous Materials and Wastes	No Change	No significant impact

Environmental Assessment/Overseas Environmental Assessment
for
FE-1 Flight Test

TABLE OF CONTENTS

Abbreviations and Acronyms.....	v
1 PURPOSE OF AND NEED FOR THE PROPOSED ACTION	1-1
1.1 Introduction	1-1
1.2 Locations	1-1
1.2.1 Pacific Missile Range Facility (PMRF), Barking Sands, Kauai, Hawai'i.....	1-1
1.2.2 Sandia National Laboratory/Kauai Test Facility (SNL/KTF)	1-1
1.2.3 US Army Kwajalein Atoll (USAKA) and Reagan Test Site (RTS), Republic of the Marshall Islands (RMI)	1-2
1.3 Purpose of and Need for the Proposed Action	1-2
1.4 Scope of Environmental Analysis	1-3
1.5 Relevant Laws and Regulations.....	1-6
1.6 Public and Agency Participation and Intergovernmental Coordination	1-7
2 PROPOSED ACTION AND ALTERNATIVES	2-1
2.1 Proposed Action.....	2-1
2.2 Screening Factors	2-2
2.3 Alternatives Carried Forward for Analysis	2-3
2.4 No Action Alternative.....	2-3
2.5 Flight Experiment 1 (FE-1) (Preferred Alternative)	2-3
2.5.1 Pre-Flight Activities.....	2-3
2.5.2 Rocket Motor Transportation.....	2-3
2.5.3 Launch Site Preparations and Operations	2-3
2.5.4 Flight Test	2-4
2.5.5 Post-Launch Operations	2-12
2.6 Alternatives Considered but not Carried Forward for Detailed Analysis.....	2-15
2.6.1 Johnston Atoll	2-15
2.6.2 Pacific Spaceport Complex Alaska	2-15
2.6.3 Farallon De Medinilla.....	2-16
3 AFFECTED ENVIRONMENT	3-1
3.1 PMRF/Kauai Test Facility.....	3-1
3.1.1 Air Quality	3-1
3.1.2 Water Resources.....	3-7
3.1.3 Biological Resources at SNL/KTF.....	3-11
3.1.4 Airspace	3-23

3.1.5	Noise	3-29
3.1.6	Public Health and Safety	3-37
3.1.7	Hazardous Materials and Wastes	3-42
3.2	Over-Ocean Flight Corridor	3-45
3.2.1	Air Quality, Greenhouse Gases and Climate Change	3-47
3.2.2	Biological Resources in the Over-Ocean Flight Corridor	3-50
3.3	US Army Kwajalein Atoll (USAKA), Republic of the Marshall Islands	3-62
3.3.1	Cultural Resources	3-63
3.3.2	Biological Resources at Kwajalein Atoll	3-64
3.3.3	Noise	3-77
3.3.4	Public Health and Safety	3-78
3.3.5	Hazardous Materials and Wastes	3-78
4	ENVIRONMENTAL CONSEQUENCES	4-1
4.1	Kauai Test Facility, Pacific Missile Range Facility	4-1
4.1.1	Air Quality	4-1
4.1.2	Water Resources at Kauai Test Facility, Pacific Missile Range Facility	4-3
4.1.3	Biological Resources at SNL/KTF	4-4
4.1.4	Airspace at SNL/KTF	4-7
4.1.5	Noise at SNL/KTF	4-8
4.1.6	Public Health and Safety at SNL/KTF	4-8
4.1.7	Hazardous Materials and Wastes at SNL/KTF	4-9
4.2	Over-Ocean Flight Corridor	4-11
4.2.1	Air Quality, Global Atmosphere, and Climate Change in the Over-Ocean Flight Corridor	4-11
4.2.2	Biological Resources in the Over-Ocean Flight Corridor	4-12
4.3	USAKA, Kwajalein Atoll, Republic of the Marshall Islands	4-22
4.3.1	Cultural Resources at Illeginni Islet	4-22
4.3.2	Biological Resources at Kwajalein Atoll	4-23
4.3.3	Noise within the Kwajalein Atoll	4-45
4.3.4	Public Health and Safety within Kwajalein Atoll	4-47
4.3.5	Hazardous Materials and Wastes within Kwajalein Atoll	4-48
4.4	Summary of Potential Impacts to Resources and Impact Avoidance and Impact Avoidance and Minimization	4-49

5	CUMULATIVE IMPACTS	5-1
5.1	Definition of Cumulative Impacts.....	5-1
5.2	Scope of Cumulative Impacts Analysis.....	5-2
5.3	Past, Present, and Reasonably Foreseeable Actions	5-2
5.3.1	Past Actions	5-2
5.3.2	Past Actions Not Carried Forward for Analysis.....	5-3
5.3.3	Present and Reasonably Foreseeable Actions	5-4
5.4	Cumulative Impact Analysis	5-4
5.4.1	PMRF.....	5-5
5.4.2	Over-Ocean Flight Corridor.....	5-5
5.4.3	USAKA, RMI.....	5-6
6	OTHER CONSIDERATIONS REQUIRED BY NEPA	6-1
6.1	Consistency with Other Federal, State, and Local Laws, Plans, Policies, and Regulations	6-1
6.2	Coastal Zone Management	6-1
6.3	Relationship between Short-Term Use of the Environment and Long-Term Productivity	6-1
7	REFERENCES	7-1
8	LIST OF PREPARERS	8-1
9	DISTRIBUTION LIST.....	9-1
10	PERSONS CONTACTED LIST	10-1

List of Figures

Figure 1-1	FE-1 Activity Location Map	1-2
Figure 2-1	Typical Strategic Target System Vehicle	2-1
Figure 2-2	Notional Impact Areas in the Vicinity of Kwajalein Atoll	2-5
Figure 2-3	Notional Locations of Precision Scoring Augmentation Rafts	2-6
Figure 3-1	Exclusive Economic Zones and Extent of Essential Fish Habitat in the Western Pacific Region	3-18
Figure 3-2	Airspace Use Surrounding Pacific Missile Range Facility	3-25
Figure 3-3	Airways and Special Use Airspace.....	3-26
Figure 3-4	A-Weighted Sound Levels from Typical Sources.....	3-30
Figure 3-5	Representative Stage 1 Spent Motor Drop Zone and Hawaiian Monk Seal Critical Habitat	3-53
Figure 3-6	Illeginni Islet Littoral Forest, Potential Sea Turtle Nesting/Haulout Areas, and Notional Payload Impact Zone	3-69
Figure 4-1	Representative Maximum Direct Contact Affect Areas for a Shoreline Payload Impact at Illeginni Islet, Kwajalein Atoll	4-32

List of Tables

Table ES-1	Summary of the Potential Impacts to the Resources Associated with each of the Alternative Actions Analyzed	ES-5
Table 1-1	Summary of the Potential Impacts to the Resources Associated with each of the Alternative Actions Analyzed	1-4
Table 2-1	Launch Vehicle Characteristics	2-2
Table 2-2	Payload System Characteristics	2-2
Table 3-1	General Conformity De minimis Levels.....	3-4
Table 3-2	Special-status Species Known to Occur or Potentially Occurring at or near SNL/KTF and Critical Habitat Present at PMRF	3-12
Table 3-3	Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC) for Hawaiian Archipelago Management Unit Species ¹	3-19
Table 3-4	Special Use Airspace in the PMRF/Main Base Airspace Use Region of Influence (ROI)	3-27
Table 3-5	Subjective Responses to Changes in A-Weighted Decibels	3-30
Table 3-6	Noise Levels Monitored for STARS Launches at PMRF/Main Base.....	3-37
Table 3-7	Total Emissions from a STARS Booster	3-49
Table 3-8	Special-Status Species Known to Occur or Potentially Occurring in the BOA of the Over-Ocean Flight Corridor.....	3-50
Table 3-9	Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC) for All Western Pacific Archipelagic Management Unit Species (including the Pacific Remote Islands Area) ¹	3-57
Table 3-10	Special-Status Species Requiring Consultation Known to Occur or Potentially Occurring in ROI at Illeginni and the Offshore Waters of Kwajalein Atoll.....	3-65
Table 3-11	Consultation and Coordination Fish Species Frequency of Occurrence at 2010 Biological Inventory Sites at Illeginni Islet and Throughout Kwajalein Atoll.....	3-71
Table 3-12	Concentrations of Beryllium and Uranium in Soil at Illeginni Islet	3-80
Table 4-1	Estimated Emissions from a STARS Missile Launch ¹ at SNL/KTF	4-2
Table 4-2	Estimated Sonic Boom Peak Sound Pressure Levels in Water for FE-1 Trajectory.....	4-14
Table 4-3	Estimated Stage Impact Contact Areas and Peak Sound Pressure Levels for FE-1 Vehicle Components.....	4-15
Table 4-4	Marine Mammal Species Groups for Assessing the Effects of Elevated Sound Pressure Levels	4-15
Table 4-5	Acoustic Thresholds for PTS, TTS, and Behavioral Disruption from Single Exposure to Impulsive In-Water Sounds in Marine Mammals (Peak SPL Thresholds in dB re 1 μ Pa).....	4-17
Table 4-6	Potential Impacts Associated with the No Action Alternative and the Proposed Action.....	4-49
Table 4-7	Impact Avoidance and Minimization Measures	4-59
Table 5-1	NEPA Analyses Performed for Actions Considered in Cumulative Action Evaluation	5-4
Table 6-1	Principal Federal and State Laws Applicable to the Proposed Action	6-2

Appendices

Appendix A Agency Correspondence A-1

Appendix B Biological Resources at Kwajalein AtollB-1

Appendix C Comments and Responses on Draft EA/OEA.....C-1

Appendix D Tungsten Alloy Bench Study and Model Results Report..... D-1

Appendix E Formal Consultation Under the Environmental Standards for United States Army
Kwajalein Atoll Activities in the Republic of the Marshall Islands Biological OpinionE-1

Abbreviations and Acronyms

Acronym	Definition	Acronym	Definition
μPa	micropascal	EO	Executive Order
AAQS	Ambient Air Quality Standards	ESA	Endangered Species Act
ACHP	Advisory Council on Historic Preservation	ESQD	explosive safety quantity distance
AFB	Air Force Base	FAA	Federal Aviation Administration
AICUZ	Air Installation Compatible Use Zone	fm	Fathom
ALTRV	Altitude Reservation	FONSI	Finding of No Significant Impact
APZ	Accident Potential Zone	ft	Foot/Feet
ATCAA	Air Traffic Control Assigned Airspace	FTS	Flight Termination System
BA	Biological Assessment	GHG	greenhouse gas
Be	Beryllium	GRMI	Government of the Republic of the Marshall Islands
BMP	best management practices	HAP	hazardous air pollutant
CAA	Clean Air Act	HAPC	habitat areas of particular concern
CEQ	Council on Environmental Quality	hr	hour(s)
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act	HRC	Hawai'i Range Complex
CFR	Code of Federal Regulations	Hz	hertz
CNEL	community noise equivalent level	IFR	Instrument Flight Rules
CO	carbon monoxide	IRP	Installation Restoration Program
CO ₂	carbon dioxide	KEEP	Kwajalein Environmental Emergency Plan
CWA	Clean Water Act	kg	kilogram(s)
CZMA	Coastal Zone Management Act	km	kilometer(s)
dB	decibel	km ²	square kilometer(s)
dBA	A-weighted sound level	KTF	Kauai Test Facility
dB(C)	C-weighted sound level	lbs	pounds
DEP	Document of Environmental Protection	LCU	Landing Craft Utility
DNL	day-night average sound level	LLNL	Lawrence Livermore National Laboratory
DoD	United States Department of Defense	m	meter(s)
DOE	Department of Energy	m ²	square meter
DOT	Department of Transportation	m ³	cubic meter
DPS	Distinct Population Segment	mi ²	square miles
DU	Depleted Uranium	MMIII	Minuteman III
EA	Environmental Assessment	mg	milligram(s)
EFH	Essential Fish Habitat	MMPA	Marine Mammal Protection Act
EIS	Environmental Impact Statement	MSA	Magnuson-Stevens Fishery Conservation and Management Act
		MSAT	Mobile Source Air Toxics

Acronym	Definition	Acronym	Definition
MSL	mean sea level	RMI	Republic of the Marshall Islands
MUS	Management Unit Species	RMIEPA	RMI Environmental Protection Authority
NAAQS	National Ambient Air Quality Standards	ROI	Region of Influence
NAGPRA	Native American Graves Protection and Repatriation Act	RTS	Ronald Reagan Ballistic Missile Defense Test Site
NHPA	National Historic Preservation Act	RV	Re-entry Vehicle
Ni	Nickel	SEL	sound exposure level
nm	nautical mile(s)	SHPO	State Historic Preservation Officer
nm ²	square nautical mile(s)	SIP	State Implementation Plan
NMFS	National Marine Fisheries Service	SO ₂	sulfur dioxide
NO ₂	nitrogen dioxide	SPL	sound pressure level
NOA	Notice of Availability	SSP	Strategic Systems Programs
NOAA	National Oceanic and Atmospheric Administration	STARS	Strategic Target System
NOI	Notice of Intent	TTS	temporary threshold shift
NPDES	National Pollutant Discharge Elimination System	U	Uranium
NRHP	National Register of Historic Places	US	United States
OEA	Overseas Environmental Assessment	USACE	US Army Corps of Engineers
OEIS	Overseas Environmental Impact Statement	USAF	US Air Force
OPNAV	Office of the Chief of Naval Operations	U.S.C.	United States Code
OPNAVINST	Office of the Chief of Naval Operations Instruction	USAPHC	US Army Public Health Command
Pb	Lead	US Navy	United States Department of the Navy
PCB	polychlorinated biphenyl	USEPA	US Environmental Protection Agency
PM ₁₀	particulate matter less than or equal to 10 microns in diameter	USFWS	US Fish and Wildlife Service
PM _{2.5}	particulate matter less than or equal to 2.5 microns in diameter	USGS	US Geological Survey
PMRF	Pacific Missile Range Facility		
ppm	parts per million		
PSD	Prevention of Significant Deterioration		
RCRA	Resource, Conservation, and Recovery Act		
RDT&E	Research, Development, Test, and Evaluation		

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1 Purpose of and Need for the Proposed Action

1.1 Introduction

The Proposed Action, Flight Experiment 1 (FE-1), is sponsored by the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, which has designated the Department of the Navy (US Navy) Strategic Systems Programs (SSP) as the lead agency and action proponent of the Proposed Action. The US Navy SSP proposes to conduct a developmental flight test as described in this Environmental Assessment (EA)/Overseas Environmental Assessment (OEA). The Proposed Action entails one experimental flight test to take place within a year of the signed Finding of No Significant Impact (FONSI), if approved. The Navy, along with the Department of Energy (DOE) as a Cooperating Agency, and with the US Army Space and Missile Defense Command/Army Forces Strategic Command (USASMDC/ARSTRAT) as a participating agency, has prepared this EA/OEA in accordance with the National Environmental Policy Act (NEPA), as implemented by the Council on Environmental Quality (CEQ) Regulations and Navy regulations for implementing NEPA.

1.2 Locations

The locations analyzed in this EA/OEA are the Pacific Missile Range Facility (PMRF), Barking Sands, Kauai, Hawai'i, and the US Army Kwajalein Atoll (USAKA) and the Ronald Reagan Ballistic Missile Defense Test Site (RTS), Republic of the Marshall Islands (RMI). These locations are shown in Figure 1-1. Various other government facilities would participate in support operations related to the Proposed Action. Those additional facilities maintain NEPA documentation and/or regulatory permitting for their ongoing activities. As such, analysis of these support operations is not included in this EA/OEA.

1.2.1 Pacific Missile Range Facility (PMRF), Barking Sands, Kauai, Hawai'i

PMRF is located in Hawai'i on and off the western shores of the island of Kauai and includes broad ocean areas to the north, south, and west. The relative isolation of PMRF, a year-round tropical climate, and an open ocean area relatively free of human presence are significant factors in PMRF's excellent record of safely conducting testing and training activities. PMRF's mission includes providing training for Navy and other Department of Defense (DoD) personnel using existing equipment and technologies to meet real world requirements to maintain and achieve required states of readiness. PMRF's mission also includes providing support to Research, Development, Test, and Evaluation (RDT&E) programs being developed by the DoD and the Missile Defense Agency.

PMRF is the world's largest instrumented, multi-environment, military test range capable of supporting subsurface, surface, air, and space operations. PMRF consists of over 2,850 square kilometers (km²) [1,100 square miles (mi²)] of instrumented underwater ranges, over 117,000 km² (42,000 mi²) of controlled airspace (CNIC, 2016), and a Temporary Operating Area covering 7.2 million km² (2.1-million square nautical miles[nm²]) of ocean area (US Navy, 2008). PMRF support to the FE-1 flight test would include base support, range safety, flight test support and test instrumentation.

1.2.2 Sandia National Laboratory/Kauai Test Facility (SNL/KTF)

The DOE, National Nuclear Security Administration's (NNSA's) Sandia National Laboratories (SNL) operates the Kauai Test Facility (KTF) on the western coast of Kauai in the Hawaiian Islands for the US DOE. The SNL/KTF, which is a tenant of the PMRF, fulfills multiple purposes in support

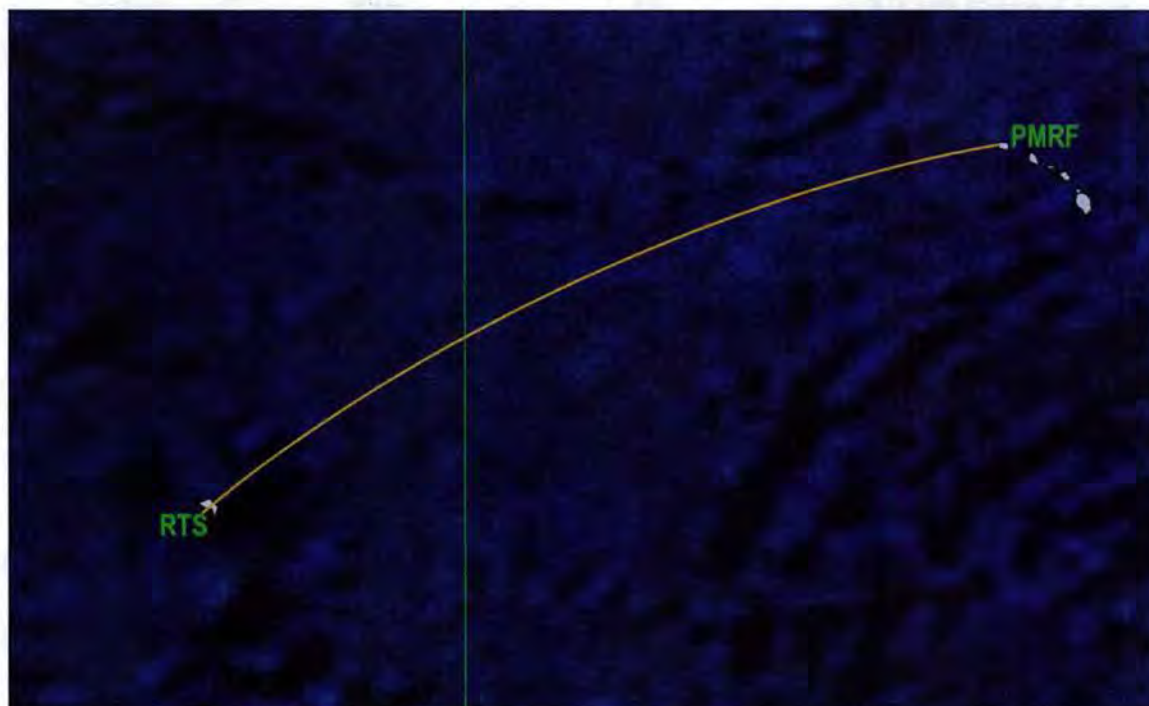


Figure 1-1 FE-1 Activity Location Map

of DOE research and development activities including launching of rockets carrying experimental non-nuclear payloads. SNL/KTF has been an active rocket launching facility since 1962. Most of these launches are targeted to various areas of the South Pacific, including the US Army Kwajalein Atoll (USAKA) in the RMI.

1.2.3 US Army Kwajalein Atoll (USAKA) and Reagan Test Site (RTS), Republic of the Marshall Islands (RMI)

The US Army's RTS resides on the US Army Garrison Kwajalein Atoll (USAG-KA), RMI. RTS is a premiere asset within the Department of Defense Major Range and Test Facility Base (MRTFB). The value of RTS to the MRTFB is based upon its strategic geographical location, unique instrumentation, and unsurpassed capability to support ballistic missile testing and space operations. For more than 40 years, RTS has been successfully supporting the research, development, test and evaluation effort of America's missile defense and space programs.

RTS hosts a suite of unique instrumentation, located on eight islands throughout the Kwajalein Atoll. This instrumentation includes a comprehensive suite of precision metric and signature radars, optical sensors, telemetry receiving stations, and impact scoring assets. RTS would provide both mobile and fixed ground and flight safety instrumentation.

Eleven islands in the RMI, referred to as USAKA, are used by USAG-KA under the terms of the Military Use and Operating Rights Agreement of the Compact of Free Association between the US and the RMI. USAG-KA provides complete base support facilities, including logistics, air, and marine services as well as community services for visiting mobile sensors and Range users.

1.3 Purpose of and Need for the Proposed Action

The purpose of the Proposed Action is to collect data on a developmental payload by testing range performance and to demonstrate technologies for prospective strike capabilities. Specifically, the FE-1

experiment would develop, integrate, and flight test the developmental payload concept to demonstrate the maturity of key technologies. These technologies include precision navigation, guidance and control, and enabling capabilities.

The need for the Proposed Action is to provide flight test data and information required by the DoD to provide a basis for ground testing, modeling, and simulation of developmental payload performance applicable to a range of possible FE-1 concepts being studied as a way to inform potential future strike capability determinations.

1.4 Scope of Environmental Analysis

This EA/OEA includes an analysis of potential environmental impacts associated with the Proposed Action and the No Action Alternative. The Navy has considered alternate launch and impact locations, and only the launch from SNL/KTF with impact near RTS meets the test requirements for vehicle performance and data collection. This EA/OEA analyzes potential impacts to the launch area (PMRF/KTF), the over-ocean flight corridor, and the three impact scenarios at RMI (Illeginni Islet and two ocean impact zones). The Navy's preferred impact scenario is Illeginni Islet because it best meets the requirements of the Purpose and Need for the Proposed Action.

The environmental resource areas analyzed in this EA/OEA include: air quality, water resources, geological resources, cultural resources, biological resources, land use, airspace, noise, infrastructure, public health and safety, hazardous materials and waste, socioeconomics, environmental justice, aesthetics/visual resources, and marine sediments. The study area for each resource analyzed may differ due to how the Proposed Action interacts with or impacts the resource. For instance, the study area for geological resources may only include the construction footprint of a building whereas the noise study area would expand out to include areas that may be impacted by airborne noise. Table 1-1 provides a tabular summary of the potential impacts to the resources associated with each of the alternative actions analyzed.

Key Documents

Key documents are sources of information incorporated by reference into this EA/OEA. These documents are considered to be key because they address similar actions, analyses, or impacts that may apply to this Proposed Action. CEQ guidance encourages incorporating documents by reference. Documents incorporated by reference in part or in whole include:

- *Environmental Assessment Missile Impacts, Illeginni Island at the Kwajalein Missile Range, Kwajalein Atoll Trust Territory of the Pacific Islands*, 1977. This assessment addresses the probable environmental effects of missile impacts on Illeginni Islands District, Trust Territory of the Pacific Islands.
- *Strategic Target System Environmental Assessment*, 1990. This EA/OEA documents the results of an analysis of the potential for and magnitude of impacts from pre-launch and launch activities of the STARS from PMRF.

Table 1-1 Summary of the Potential Impacts to the Resources Associated with each of the Alternative Actions Analyzed

<i>Location</i>	<i>Resource Area</i>	<i>No Action Alternative</i>	<i>Proposed Action Alternative</i>
PMRF	Air Quality	No Change	Minor, short-term impact
	Water Resources	No Change	Minor, short-term impact
	Biological Resources	No Change	No significant impact
	Airspace	No Change	No impact
	Noise	No Change	Minor, short-term impact
	Public Health and Safety	No Change	Minor, short-term impact
	Hazardous Materials and Wastes	No Change	Minor, short term impact
Over-Ocean Flight Corridor	Air Quality	No Change	No significant impact
	Biological Resources	No Change	No significant impact
USAKA, RMI Illeginni Islet	Cultural Resources	No Change	No significant impact
	Biological Resources	No Change	No significant impact
	Noise	No Change	No significant impact
	Public Health and Safety	No Change	No significant impact
	Hazardous Materials and Wastes	No Change	No significant impact
USAKA, RMI Offshore Waters – Southwest and Northeast	Cultural Resources	No Change	No impact
	Biological Resources	No Change	No significant impact
	Noise	No Change	No significant impact
	Public Health and Safety	No Change	No significant impact
	Hazardous Materials and Wastes	No Change	No significant impact

- *Strategic Target System Environmental Impact Statement*, 1992. This Environmental Impact Statement documents the results of an analysis of the potential for and magnitude of impacts from launch activities of the STARS from the KTF at the PMRF on the island of Kauai, Hawai'i.
- *Kauai Test Facility Environmental Assessment*, 1992. This EA documents the results of an analysis of the potential for and magnitude of impacts from pre-launch and launch activities from SNL/KTF.
- *US Army Kwajalein Atoll (USAKA) Supplemental Environmental Impact Statement*, 1993. This Final Supplemental EIS evaluates the environmental impacts of two proposed actions at USAKA. The first proposed action is the types and levels of test activities, including test facilities and support services at USAKA. The second proposed action is the adoption of new environmental standards and procedures for U.S government activities at USAKA.
- *Kodiak Launch Complex Environmental Assessment*, 1996. The purpose of this EA was to examine the potential for environmental impacts resulting from proposed Kodiak Launch Complex construction and operation. The proposed launch complex would support commercial rocket launches to place small satellites into orbit.

- *North Pacific Target Launch Environmental Assessment*, 2001. This EA analyzed the impacts of using the STARS launch vehicle for strategic target launch services from Kodiak Launch Complex, Kodiak Island, Alaska. The STARS target would also continue to be launched from KTF at the PMRF, Kauai, Hawai'i to the broad ocean area near the USAKA in the Marshall Islands. The proposed action was to increase the launch capability of the STARS by adding a new STARS flight trajectory from KTF and providing a launch capability from Kodiak Launch Complex. The proposed action would provide ballistic missile targets to test North American sensors, and for possible use in testing various sensors and ground-based interceptors at USAKA and various sensors and ship-based interceptors at PMRF.
- *Environmental Assessment for Minuteman III Modification*, 2004. This EA documents the potential environmental impacts of (1) Minuteman III (MMIII) missile flight tests using modified reentry system hardware/software, in addition to the continuation of Force Development Evaluation flight tests; (2) deployment of new and modified reentry system hardware/software; and (3) deployment activities for new command and control console equipment. The locations covered in this EA include: FE Warren Air Force Base (AFB), Wyoming; Hill AFB, Utah; Malmstrom AFB, Montana; Minot AFB, North Dakota; Vandenberg AFB, California; and USAKA, Republic of the Marshall Islands.
- *Hawaii Range Complex Environmental Impact Statement/Overseas Environmental Impact Statement*, 2008. The Navy has identified the need to support and conduct current, emerging, and future training and research, development, test, and evaluation (RDT&E) activities in the Hawai'i Range Complex (HRC). The alternatives—the No Action Alternative, Alternative 1, Alternative 2, and Alternative 3—are analyzed in this Final EIS/OEIS. All alternatives include an analysis of potential environmental impacts associated with the use of mid-frequency active (MFA) and high-frequency active (HFA) sonar. The No Action Alternative stands as no change from current levels of HRC usage and includes HRC training, support, and RDT&E activities, Major Exercises, and maintenance of the technical and logistical facilities that support these activities and exercises.
- *Advanced Hypersonic Weapon Program Environmental Assessment*, 2011. This EA analyzes the impacts of launching a flight test vehicle from PMRF, Kauai, Hawai'i, using an existing STARS with three stages. The payload on the STARS vehicle would fly to a land or ocean impact at the USAKA/RTS (on or near Illeginni Islet) in the Republic of the Marshall Islands.
- *Hawaii-Southern California Training and Testing Activities Final Environmental Impact Statement/Overseas Environmental Impact Statement*, 2013. The Navy identified its need to support and conduct current, emerging, and future training and testing activities in the Hawaii-Southern California Study Area, which is made up of air and sea space off Southern California, around the Hawaiian Islands, and the air and sea space connecting them.
- *Advanced Hypersonic Weapon Flight Test 2 Hypersonic Technology Test Environmental Assessment*, 2014. This EA documents the demonstration flight test of a flight test vehicle launched from the Kodiak Launch Complex, using an existing three-stage STARS. Following booster separation, the test vehicle would fly to an impact site in the vicinity of Illeginni Islet at the USAKA in the Republic of the Marshall Islands.

1.5 Relevant Laws and Regulations

The Navy has prepared this EA/OEA based upon federal and state laws, statutes, regulations, and policies that are pertinent to the implementation of the proposed action, including the following:

- NEPA (42 United States Code (U.S.C.) sections 4321-4370h), which requires an environmental analysis for major federal actions that have the potential to significantly impact the quality of the human environment
- CEQ Regulations for Implementing the Procedural Provisions of NEPA (40 CFR parts 1500-1508)
- Navy regulations for implementing NEPA (32 CFR part 775), which provides Navy policy for implementing CEQ regulations and NEPA
- Clean Air Act (CAA) (42 U.S.C. section 7401 et seq.)
- Clean Water Act (CWA) (33 U.S.C. section 1251 et seq.)
- Coastal Zone Management Act (CZMA) (16 U.S.C. section 1451 et seq.)
- National Historic Preservation Act (NHPA) (54 U.S.C. section 306108 et seq.)
- Endangered Species Act (ESA) (16 U.S.C. section 1531 et seq.)
- Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (16 U.S.C. section 1801 et seq.)
- Marine Mammal Protection Act (MMPA) (16 U.S.C. section 1361 et seq.)
- Migratory Bird Treaty Act (MBTA) (16 U.S.C. sections 703-712)
- Bald and Golden Eagle Protection Act (16 U.S.C. section 668-668d)
- EO 11988, Floodplain Management
- EO 12088, Federal Compliance with Pollution Control Standards
- EO 12114, Environmental Effects Abroad of Major Federal Actions
- EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations
- EO 13045, Protection of Children from Environmental Health Risks and Safety Risks
- EO 13089, Coral Reef Protection
- EO 13423, Strengthening Federal Environmental, Energy, and Transportation Management
- EO 13175, Consultation and Coordination with Indian Tribal Governments
- EO 13693, Planning for Federal Sustainability in the Next Decade
- Compact of Free Association Between the United States and the Republic of the Marshall Islands, which became effective on October 21, 1986, under Presidential Proclamation No. 5564 on November 3, 1986; and was amended pursuant to Public Law 108-188 – December 17, 2003; 17 STAT 2723
- Compact of Free Association Military Use and Operating Rights Agreement between the United States of America and the Marshall Islands, March 23, 2004

- USAKA Environmental Standards (UES) 14th Edition, September 2016

A description of the Proposed Action's consistency with these laws, policies and regulations, as well as the names of regulatory agencies responsible for their implementation, is presented in Chapter 6.0 (Table 6-1).

1.6 Public and Agency Participation and Intergovernmental Coordination

The DOE NNSA SNL accepted the Navy SSP invitation to participate as a cooperating agency (40 CFR Part 1501.6) in the preparation of this EA/OEA (refer to Appendix A for relevant correspondence).

Regulations from the CEQ (40 CFR part 1506.6) direct agencies to involve the public in preparing and implementing their NEPA procedures. The Navy circulated the Draft EA/OEA for public review from May 19, 2017 to June 19, 2017. Substantive comments received from US and RMI agencies on the Draft EA/OEA and their responses are provided in the Final EA/OEA (See Appendix C). No comments were received from the public.

The Navy has coordinated or consulted with the US Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), and the other UES Appropriate Agencies regarding the Proposed Action. A project specific Notice of Proposed Activity (NPA) and Document of Environmental Protection were prepared and submitted to the UES Appropriate Agencies and to the RMI public for a 30-day review and comment period.

The UES Appropriate Agencies include:

- RMI Environmental Protection Authority (RMIEPA)
- US Environmental Protection Agency (USEPA)
- USFWS
- NMFS
- US Army Corps of Engineers(USACE)

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2 Proposed Action and Alternatives

2.1 Proposed Action

The US Navy SSP FE-1 program would consist of a flight test designed to prove various aspects of the system's capabilities. The FE-1 launch vehicle consists of a three-stage Strategic Target System (STARS) booster system (Figure 2-1). This test would be designed to collect data to provide a basis for ground testing, modeling, and simulation of payload performance.

The Proposed Action entails ground preparations for the flight test at the DOE/NNSA's SNL/KTF located on PMRF, Barking Sands, Kauai, Hawai'i, KTF; the flight test to RTS; and post launch operations. Characteristics of the launch vehicle and the payload are presented in Table 2-1 and Table 2-2, respectively. The Proposed Action flight test would occur within a year after signing of the FONSI, if approved.

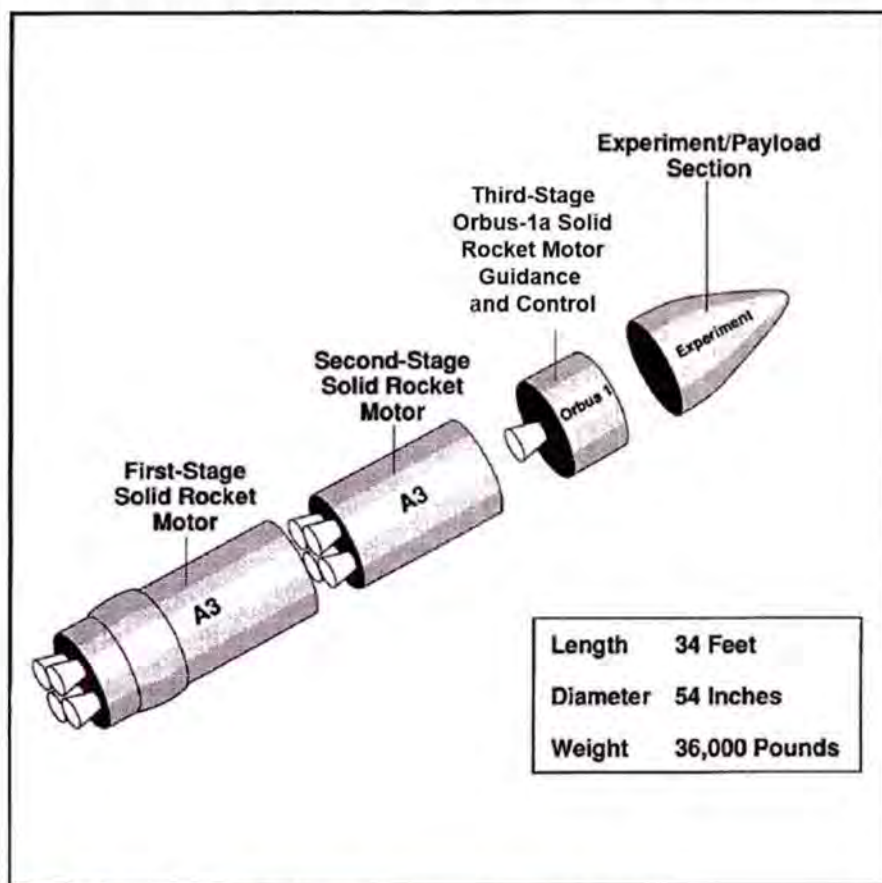


Figure 2-1 Typical Strategic Target System Vehicle

Table 2-1 Launch Vehicle Characteristics

Major components	Rocket motors, propellant, magnesium thorium (booster interstage) ¹ , nitrogen gas, halon, asbestos (contained in second stage), battery electrolytes (lithium-ion, silver zinc)
Communications	Various 5- to 20-watt radio frequency transmitters; one maximum 400-watt radio frequency transponder
Power	Up to nine lithium ion polymer and silver zinc batteries, each weighing between 1.36 and 22.68 kilograms (kg; 3 and 40 pounds [lbs])
Propulsion/Propellant	Solid Rocket propellant
Other	Small Class C (1.4) electro-explosive devices, ~1.36 kg (3 lbs) of pressurized nitrogen gas

Table 2-2 Payload System Characteristics

Structure	Aluminum, steel, titanium, magnesium and other alloys, copper, fiber glass, chromate coated hardware, tungsten, plastic, teflon, quartz, Room Temperature Vulcanizing silicone
Communications	Two less-than-20-watt radio frequency transmitters
Power	Up to four lithium ion polymer batteries, each weighing between 1.36 and 22.68 kg (3 and 50 lbs)
Propulsion/Propellant	None
Other	Class C (1.4) electro-explosive devices for safety and payload subsystems operations

2.2 Screening Factors

NEPA's implementing regulations provide guidance on the consideration of alternatives to a federally Proposed Action and require rigorous exploration and objective evaluation of reasonable alternatives. Only those alternatives determined to be reasonable and meet the purpose and need require detailed analysis.

The alternatives for the FE-1 flight test were derived through the following screening criteria/evaluation factors:

1. Launch facility and impact location must have the specialized infrastructure (e.g., equipment, instrumentation for data collection) and personnel capable of conducting an FE-1 flight test;
2. Launch facility and impact location must provide the required range distance to conduct the test; and
3. Launch facility and impact location must be available for conducting the test.

¹ The skin of the STARS first/second interstage structure was manufactured from a magnesium-thorium alloy (HK31A-H24). This is a surplus Polaris A3R asset that has been adapted to STARS and it contains less than 3% (<80 micro curies [μCi]) thorium. The interstage alloys are commercially available products containing magnesium-thorium alloy and are exempted from controls by the Nuclear Regulatory Commission (10 CFR 40.13) and the Radiological Procedures Protection Manual (RPPM) (Chapter 6, Attachment 6-2) since there is no physical, chemical or metallurgical processing performed on the items.

2.3 Alternatives Carried Forward for Analysis

Based on the reasonable alternative screening factors and meeting the purpose and need for the Proposed Action, no alternatives to the Proposed Action were identified that meet the program needs, and therefore no other alternatives were analyzed within this EA/OEA.

2.4 No Action Alternative

US Navy SSP has been directed by DoD to perform the FE-1 flight test. The flight test must meet certain mission and project objectives to provide the data desired by DoD. In accordance with Chief of Naval Operations Instruction (OPNAVINST) 5090.1D, *Environmental Readiness Program*, the no action alternative is an alternative that must be analyzed.

The no action alternative can either be stop all activities or continue the *status quo* without implementing the Proposed Action. In the FE-1 EA/OEA the no action is the continuation of the *status quo* as described in Chapter 3.0, *Affected Environment*. Environmental information on the alternative target areas is included in detail in the EA/OEA.

Under the No Action Alternative, the Proposed Action would not occur. Under the No Action Alternative, the Navy would not pursue the FE-1 program. The No Action Alternative would not meet the purpose and need for the Proposed Action; however, as required by NEPA and OPNAVINST 5090.1D, the No Action Alternative is carried forward for analysis in this EA/OEA and provides a baseline for measuring the environmental consequences of the action alternatives.

2.5 Flight Experiment 1 (FE-1) (Preferred Alternative)

2.5.1 Pre-Flight Activities

Various other government facilities would participate in pre-flight support operations related to the Proposed Action. Those additional locations maintain NEPA documentation and/or regulatory permitting for their ongoing activities. As such, analysis of these support operations is not included in this EA/OEA.

2.5.2 Rocket Motor Transportation

All transportation, handling, and storage of the rocket motors and other ordnance would occur in accordance with DoD, Navy, and US Department of Transportation (DOT) policies and regulations to safeguard the materials from fire or other mishap. All shipments would be inspected to prevent the introduction of alien species of plants and animals into the environment at Hawai'i and the RMI.

The Navy SSP would arrange for the US Air Force (USAF) to transport the rocket motors to PMRF airfield on Barking Sands, Kauai, Hawai'i. The Navy would transport the hazardous material and test items from PMRF airfield to SNL/KTF once the aircraft has landed in Hawai'i.

2.5.3 Launch Site Preparations and Operations

Prior to launch, routine activities would take place at the SNL/KTF to prepare for flight testing. These activities are described below. While working within the guidance and limitations of PMRF and SNL/KTF oversight, project personnel would execute ground equipment checkout, flight vehicle-to-booster assembly and checkout, and other preparations for flight testing. These activities would be directed by the Navy SSP representatives who would coordinate activities with PMRF, SNL/KTF and other range organizations. All activities would use existing facilities and infrastructure systems. Other launch supporting activities would include the following:

- Final motor and experiment assembly and integration
- Placement of missile on existing pad
- Mechanical and electrical checkouts (equipment tested, controls of electronic components-systems exercised before launch activities)
- Demonstration of system performance prior to launch
- Preflight checkouts, recommendations, consultation
- Advisory role throughout launch operations

As regular SNL routine operations for any launch at KTF, Sandia personnel would also conduct various range responsibilities to ensure appropriate launch preparation, including explosive safety, support to PMRF range safety and inter-range coordination.

These proposed activities would enable the FE-1 flight test to occur.

2.5.4 Flight Test

Flight testing activities would include the launch from the SNL/KTF and the impact of the payload at the Ronald Reagan Ballistic Missile Defense Test Site (RTS). Proposed activities at each location are described below. For the flight test, the booster would lift off from the SNL/KTF. The Navy developmental payload would impact at USAKA with three possible impact zone scenarios (Figure 2-2). Two of these scenarios would involve deep ocean impact while the third zone would involve a land impact. The first possible impact zone would be in the deep water region southwest of Illeginni Islet. This zone would have an approximate area of 488 meters [m] by 744 m (1,600 feet [ft] by 800 ft) (Figure 2-2). The second possible impact location would be a land impact on Illeginni Islet. This zone is approximately a 290 m by 137 m (950 ft by 450 ft) area on the northwest end of the Islet, as limited by available land mass. The third possible impact zone would be within the Kwajalein Missile Impact Scoring System (KMISS) area southeast of Gagan Islet and would have an approximate area of 2,400 m by 366 m (2,400 ft by 1,200 ft). The mission planning process would avoid to the maximum extent possible all potential risks to environmentally significant areas. All actual impact zones would be sized based on Range Safety requirements and chosen as part of the mission analysis process. Range Safety issues would also be part of selecting the impact scenario.

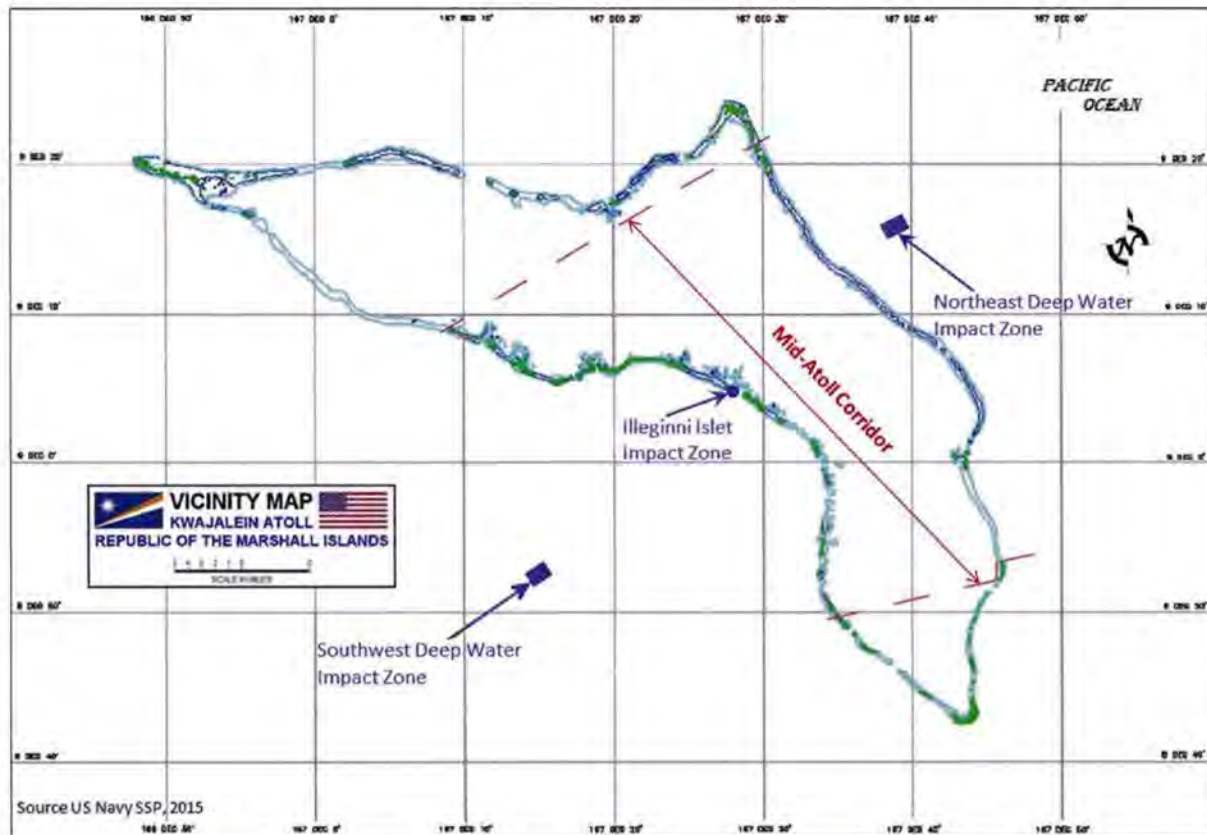


Figure 2-2 Notional Impact Areas in the Vicinity of Kwajalein Atoll

Efforts have been proposed to develop the instrumentation suite needed for the two deep water impact zone locations, while considering other past efforts. The leading proposal would be to develop a data collection instrumentation raft or barge. Previous environmental consideration of such a platform would be factored into the development, such as maritime safety (e.g., running lights and station-keeping), international policy (e.g., no intentional ocean dumping should the instrumentation raft be inadvertently struck during the conduct of the mission), and visual deterrents to birds loafing or resting on the raft (e.g., scarecrows, Mylar flags, helium-filled balloons, and strobe lights). It is anticipated that the instrumentation suite would be installed on the raft at the dock prior to being deployed to the test support location. After transit, it is expected that the raft would remain on station for up to two weeks while waiting for the test to occur. Once the test has been completed, the raft would be returned to port and the data would be delivered for analysis.

During ocean travel to and from impact and test support areas, ship personnel would monitor for marine mammals and sea turtles to avoid potential ship strikes and would report any observations to the USAG-KA Environmental Engineer. Vessel operators would also adjust their speed or raft deployment based on expected animal densities, and on lighting and turbidity conditions. Any marine mammal or sea turtle sightings during overflights or ship travel would be reported to the USAG-KA Environmental Engineer, the RTS Range Directorate, and the Flight Test Operations Director for consideration in approving the launch. Vessel operations, particularly in the BOA, would only occur when weather and sea conditions are acceptable for safe travel. Vessel operations would not involve any intentional ocean discharges of fuel, toxic wastes, or plastics and other solid wastes that could potentially harm marine life.

The main instrumentation raft would be supplemented with up to six self-stationing rafts (Figure 2-3) with associated radar, acoustic and optical sensors. The self-stationing rafts generally use twin battery-powered trolling motors for differential thrust navigation and station-keeping to ensure proper positioning for the flight impacts. Power to the trolling motors is provided by marine gel-cell batteries. None of the rafts would require an anchoring system. These rafts would also be outfitted and checked out at port prior to being emplaced for the test. This emplacement would also occur from the same seacraft that tows the main instrumentation raft to the test support location.

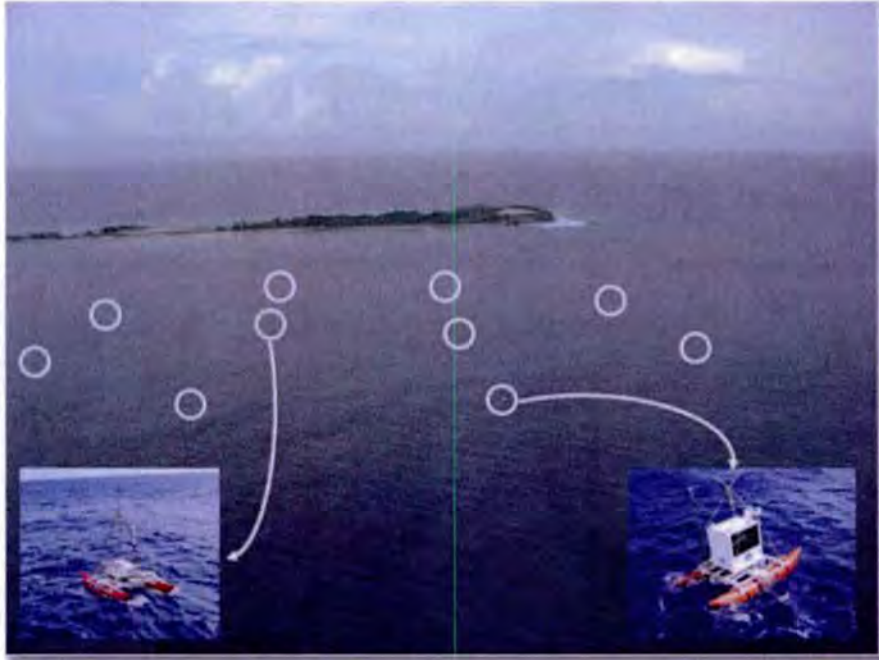


Figure 2-3 Notional Locations of Precision Scoring Augmentation Rafts

For the deep water impact zone to the northeast of Kwajalein Atoll, the use of the existing KMISS would be factored into the final data collection architecture.

Impacts in the deep water impact zones are a viable alternative to the land impact of the payload; however, the complementary suite of instrumentation necessary to collect the performance data does not provide the data resolution that can be obtained with a land impact.

For a nominal mission, it is anticipated that up to four weeks of increased activities would be required for either of the deep water impact zones. Included among these activities are:

- Set up mobile terminal area scoring using an ocean-going tug to tow and set up a station-keeping barge
- Deploy landing craft mechanized, landing craft utility (LCU), and Lawrence Livermore National Laboratory (LLNL) Independent Diagnostic Scoring System-type rafts (as many as a dozen)
- Deploy telemetry assets
- Recover all deployed assets from the specific deep water impact zone, and
- Perform marine and dive operations as needed to recover debris.

For the Proposed Action at Illeginni Islet, activities would include several vessel round-trips (likely with the Great Bridge) and helicopter trips. Additionally, raft-borne sensors would be deployed and recovered on both the ocean and lagoon sides. There would also be increased human activity on Illeginni that would

involve up to 24 persons over a three-month period. Heavy equipment placement and use would occur at times.

Pre-flight monitoring by qualified personnel would be conducted on Illeginni Islet for sea turtles or sea turtle nests. On-site personnel would report any observations of sea turtles or sea turtle nests on Illeginni to appropriate test and USAG-KA personnel to provide to NMFS and USFWS. During travel to and from impact zones, including Illeginni Islet, and during raft deployment, ship personnel would monitor for marine mammals and sea turtles to avoid potential vessel strikes. Vessel operators would adjust speed or raft deployment based on expected animal locations, densities, and or lighting and turbidity conditions.

For at least 8 weeks preceding the FE-1 flight test launch, Illeginni Islet would be surveyed by qualified persons for sea turtles, sea turtle nesting activity, and sea turtle nests. If possible, these persons would also inspect the area within days of the launch. Pre-test persons at Illeginni Islet and in vessels traveling to and from Illeginni Islet would look for and report any observations of sea turtles, evidence of sea turtle haul out or nesting, or of sea turtle nests at or near Illeginni Islet.

2.5.4.1 Sandia National Laboratories, Kauai Test Facility, Pacific Missile Range Facility, Barking Sands, Kauai, Hawai'i

The SNL/KTF is located on and is a tenant activity of the PMRF. SNL/KTF is operated independently by Sandia personnel, but relies on base operations and logistic support from PMRF. For the purposes of this document, references to PMRF include all current range assets and tenants on Kauai and at remote locations regardless of ownership. PMRF is the standard reference for the land-based installations on Kauai, the underwater ranges, and their assets unless referring to a specific site or facility complex. PMRF on Kauai includes the main base complex (PMRF/Main Base), the DOE/NNSA's SNL/KTF, as a tenant within the base complex, Makaha Ridge, Kokee, Kamokala Magazines, and the Navy activities at Port Allen. In addition, there are range assets on Niihau, Oahu, and Maui.

Launches of the STARS boosters were initially analyzed in the *Strategic Target System Environmental Impact Statement* (STARS EIS) and most recently in the *Hawaii Range Complex Environmental Impact Statement/Overseas Environmental Impact Statement* (US Navy, 2008). The FE-1 flight test would be scheduled within a year after signing of the FONSI, if approved. A modified 3,048-m (10,000-ft) ground hazard area adjacent to PMRF would be used.

2.5.4.2 US Army Garrison Kwajalein Atoll, Reagan Test Site, Republic of the Marshall Islands

USAG-KA and RTS support of the FE-1 flight test would include base support, range safety, flight test support and test instrumentation. The US Navy SSP would ensure that all relevant personnel associated with the Proposed Action are fully briefed on the best management practices (BMP) and the requirement to adhere to them for the duration of the Proposed Action. All activities would comply with the UES (USAG-KA, 2017). A project-specific Document of Environmental Protection (DEP) would be prepared to present requirements and limitations.

For an Offshore Waters impact, self-stationing sensor rafts would be placed around the targeted site to record and measure payload impacts. Shipboard and other radars and sensors would also gather information on the FE-1 flight test during terminal flight and impact, including a large instrumented raft that would be placed outside of the selected deep water impact zone. Following the flight test, all rafts would be collected or returned to dock for data collection and analysis.

On Illeginni Islet, the impact area would be searched for black-naped tern nests and chicks prior to any pre-flight equipment mobilization. Any discovered nests would be covered with an A-frame structure per USFWS guidance. The area would be monitored to ensure no black-naped tern nests are disturbed when

heavy equipment would position diagnostic equipment. Additionally, radars could be placed on Illeginni Islet to gather information on the payload. Up to four radar units which are less than 0.4 m³ (14 ft³) would be placed within the impact area and may be destroyed by payload impact. These radars are powered by automobile batteries or shore/generator power. Following impact, all visible debris would be recovered.

To prevent birds from nesting on the support equipment after initial setup, the equipment would be appropriately covered with tarps or other materials and “scare” techniques (e.g., scarecrows, mylar ribbons, and/or flags) would be used on or near the equipment.

Flight Test Scenarios

Following motor ignition and liftoff from the launch location, the first-stage motor would burn out downrange and separate from the second stage. Farther into flight, the second-stage would also burn out and separate, with the shroud assembly also being jettisoned prior to third stage ignition. Farther into flight, the third-stage would also burn out and separate from the payload. Splashdown of all three spent motor stages and the shroud assembly would occur at different points in the open ocean between 70 and 1,500 nautical miles (nm) (130 and 2,778 kilometers [km]) from the launch pad. Figure 2-4 depicts the rocket motor drop zones for the launches from KTF toward USAKA. The payload would impact in the vicinity of Illeginni Islet.

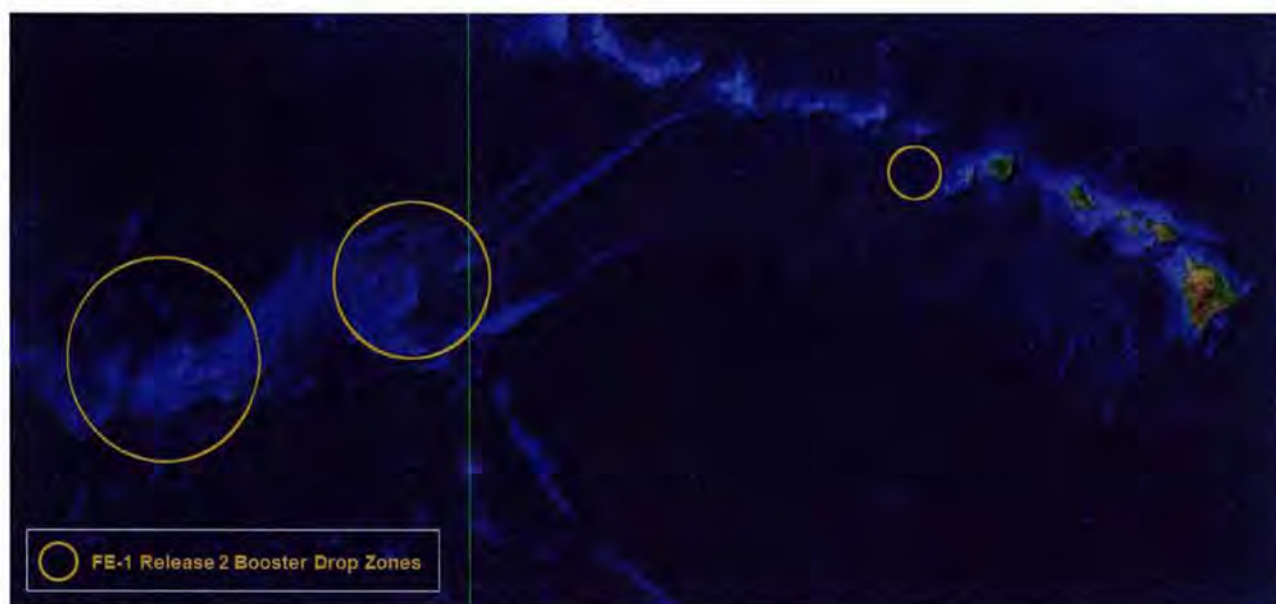


Figure 2-4 Representative Drop Zones for Spent Motors and Nose Fairing Assembly

The booster would fly in a southwesterly direction from PMRF in the Hawaiian Islands. Jettison of the fairing and separation of the payload would occur inside the atmosphere, and the payload's flight path would avoid flying over the Northwestern Hawaiian Islands. The payload would fly toward pre-designated target sites at Illeginni Islet or in the Offshore Waters.

If the launch vehicle were to deviate from its course or should other problems occur during flight that might jeopardize public safety, the onboard flight termination system (FTS) would be activated. This action would initiate a predetermined safe mode for the vehicle, causing it to fall towards the ocean and terminate flight. No inhabited land areas would be subject to unacceptable risks of falling debris. Computer-monitored destruct lines, based on no-impact lines, are pre-programmed for the flight safety software to avoid any debris falling on inhabited areas, as per Space System Software Safety Engineering protocols and US range operation standards and practices. In accordance with US range operation

standards, the risk of casualty (probability for serious injury or death) from falling debris for an individual of the general public cannot exceed 1 in 1,000,000 during a single flight test or mission (Range Commanders Council [RCC], 2007).

In addition to the commanded FTS operation, an FTS on the payload would include a failsafe operation to further ensure the safety of the Marshall Islands. This failsafe requires positive action to be taken by range safety personnel to allow the payload to continue flight to the vicinity of Illeginni Islet. Data would be transmitted to range safety personnel to allow a complete evaluation of the "health" of the FTS and the performance of the payload against the safety criteria.

The FTS also would contain logic to detect a premature separation of the booster stages and initiate a thrust termination action on all of the prematurely separated stages. Thrust would be terminated by initiation of an explosive charge to vent the motor chamber, releasing pressure and significantly reducing propellant combustion. This action would stop the booster's forward thrust, causing the launch vehicle to fall along a descending trajectory into the ocean.

The FTS would be designed to prevent any debris from falling into any protected area.

Sensor Coverage

The flight path would essentially be the same as that analyzed in the *Final Environmental Impact Statement for the Strategic Target System* (US Army Strategic Defense Command (USASDC), 1992). A series of sensors would overlap coverage of the flight from launch at KTF until impact at USAKA, as shown in Figure 2-5. The sensors would include:

- Ground based optics, telemetry and radars at PMRF
- Sea based sensors include the Mobile At-Sea System (MATSS), the Kwajalein Mobile Range Safety System (KMRSS) onboard the US Motor Vessel *Worthy*, and the Raytheon Portable Instrumented Range Augmentation Telemetry Equipment System (PIRATES)
- C-26 Safety Relay aircraft may be used as additional range safety support "off-axis" to ensure public safety. However, additional options would be considered. If the C-26 becomes the planned range safety support asset, takeoff and landing operations may be required at the PMRF airfield. These activities could occur in the day or night. Operations would be in compliance with the PMRF "Dark Skies" program, if required, or the C-26 would be based from another airfield in Hawai'i.
- Additional airborne and waterborne sensors on military or commercial aircraft are not planned as part of the FE-1 flight test. Other agencies might collect data on FE-1 for their own purposes, but these extra sensors are speculative and outside the scope of this EA/OEA.

All of these sensors are existing programs and would be scheduled for use based on availability.

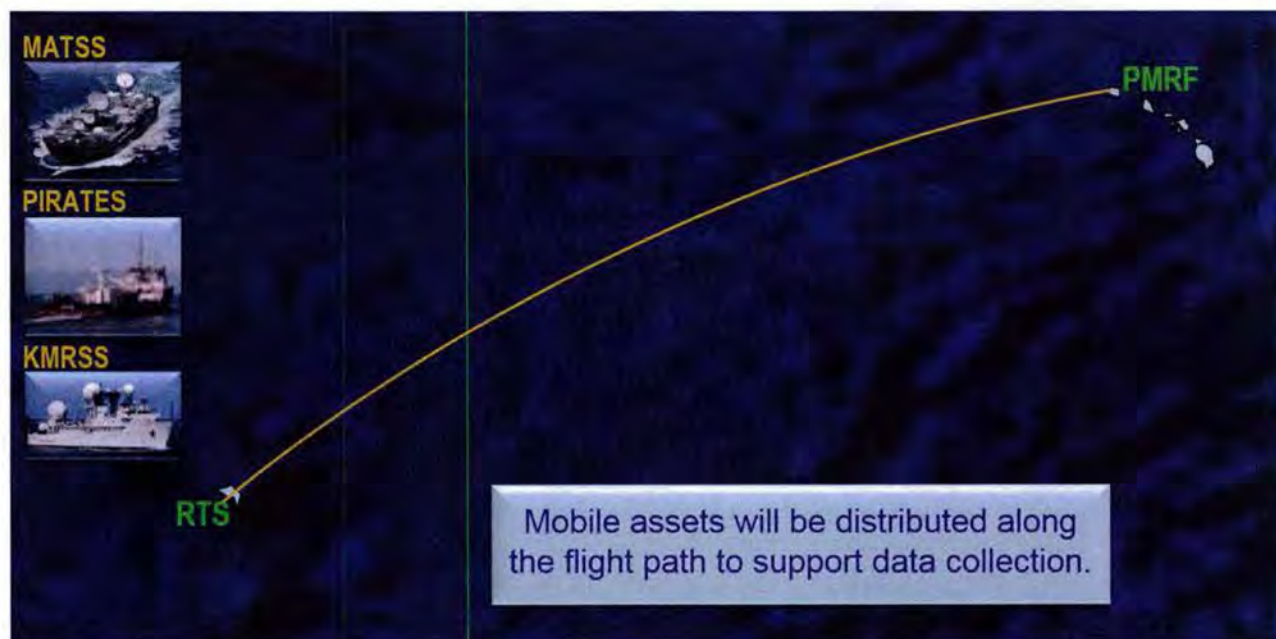


Figure 2-5 Notional FE-1 Flight Path Sensor Coverage

2.5.4.3 Terminal Phase Preparations and Operations

Following launch, the payload would separate from the booster over the Pacific Ocean, and fly at high-speeds in the upper atmosphere towards RTS. If payload onboard computers determine that there is insufficient energy to reach the target area, the payload could be directed to descend in a controlled termination of the test flight into the over-ocean flight corridor broad ocean area (BOA).

The RTS is a tenant activity of the USAG-KA. RTS is operated independently, but relies on base operations and logistic support from USAG-KA.

At USAKA, impact sites are located in deep ocean areas east and west of the Kwajalein Atoll and in the vicinity of Illeginni Islet, within the Mid-Atoll Corridor. Upon reaching the terminal end of the flight, the payload would either impact on the northwestern end of Illeginni Islet (Figure 2-6) or in the deep offshore waters northeast of Kwajalein Atoll or southwest of Illeginni Islet (Figure 2-2) at USAKA. Targeted areas for the payload would be selected to minimize impacts to reefs and identified wildlife habitats. A reef or shallow water impact is not part of the Proposed Action, would be unintentional, and is unlikely.

For the Illeginni Islet vicinity scenario, the proposed impact point for the Navy SSP payload would be in the non-forested area to avoid affecting the bird habitat. A crater would form as a result of this impact and leave debris that would need to be recovered². Post-test debris recovery and cleanup operations on Illeginni Islet would cause some short-term disturbance to small areas of migratory bird habitat and possibly to coral reef habitat. However, because this is one flight test, the overall effects are considered to be minimal. Debris would be recovered and the crater filled for a land impact. Visible debris would be removed following any unintentional shallow water impact.

For the deep water impact zone scenarios, the proposed impact would occur in the deep ocean waters surrounding the Kwajalein Atoll. No residual debris is expected following impact; however, a recovery team

² The payload debris would include tungsten for ballast, etc., in accordance with Table 2-2; exact quantities of tungsten are unknown at this time and are not expected before the EA/OEA is completed. In order to provide an appropriate conservative assessment, a quantity of up to 1,000 pounds of tungsten alloy is used for the environmental impact analysis.

would be sent to inspect the impact location as soon as range safety clears the area. The deep water areas surrounding the Kwajalein Atoll are too deep to allow safe recovery of any hardware that might survive the impact with the water and still have sufficient mass to sink. Visible debris still on the surface of the water would be recovered and removed.



Figure 2-6 Potential Land Impact Area on Illeginni Islet

Vehicle impacts from other tests have occurred within the Kwajalein Atoll lagoon, on and in the vicinity of Illeginni Islet, and in the deep water impact zones near RTS, USAKA. These and other actions within the geographical scope of this EA/OEA have undergone environmental analysis and review, which is provided in Section 1.3, Related Environmental Documentation and the analyses all resulted in FONSIs.

To ensure the safe conduct of flight testing, a Mid-Atoll Corridor Impact Area has been established across the mid-section of the Atoll (Figure 2-2). When a test is to occur in this area, a number of strict precautions are taken to protect personnel. Such precautions may consist of evacuating nonessential personnel and sheltering all other personnel remaining within the Mid-Atoll Corridor. Notices to Airmen (NOTAMs) and Notices to Mariners (NOTMARs) are published and circulated in accordance with established procedures to provide warning to persons, including native Marshallese citizens, concerning any potential hazard areas that should be avoided. For public notification within USAKA before any flight test occurs, standard practice is to distribute an announcement from Kwajalein Island regarding the upcoming mission that is then provided to the public in Marshallese and English on the Roller and in radio announcements. Additionally, notices of upcoming missions are provided by the US Embassy to the Government of the RMI (GRMI) for

the GRMI to distribute. A fact sheet describing the project and the environmental controls would be prepared in English and Marshallese and would be provided at locations on Ebeye and Kwajalein Island. Radar and visual sweeps of the hazard area are accomplished immediately prior to test flights to ensure the clearance of non-critical personnel.

In addition to land-based and sensor vessel support, up to 16 rafts with onboard optical and/or acoustical sensors (Figure 2-3) may be placed in the Kwajalein Atoll lagoon near Illeginni Island. Within a day of the flight test, one or two of the range LCU vessels would be used to deploy the rafts. The rafts would be equipped with battery-powered electric motors for propulsion to maintain position in the water. Sensors on the rafts would collect data during the payload's descent until impact.

During travel to and from impact zones, including Illeginni Islet, and during raft deployment, ship personnel would monitor for marine mammals and sea turtles to avoid potential vessel strikes. Vessel operators would adjust speed or raft deployment based on expected animal locations, densities, and or lighting and turbidity conditions.

Radars would also be placed on Illeginni Islet to gather information on the payload. Up to two radars that fit within a 24-inch by 15-inch by 6-inch cube would be placed within the impact area. These radars are powered by automobile batteries or shore/generator power.

2.5.5 Post-Launch Operations

At the launch location on SNL/KTF, the launch pad area would be checked for safe access after vehicle liftoff. Post-launch activities would include inspection of the launch pad facilities and equipment for damage, as well as general cleanup and performance of maintenance and repairs necessary to accommodate launches for other programs. The expended rocket motors and other vehicle hardware would not be recovered from the ocean following flight.

Within either deep water impact zone, the self-stationing rafts and the large instrumentation raft would be recovered and the data collected for analysis.

Prior to recovery and cleanup actions at the Illeginni Islet impact zone, payload recovery personnel would first survey the impact site for any residual explosive materials. Post-test recovery operations at Illeginni Islet would require the manual cleanup and removal of any debris, including hazardous materials. Site recovery and clean-up would be performed for land or shallow water impact in a manner to minimize further harm to biological resources. Post-survey monitoring would also be conducted to observe any impacts to adult black-naped terns of their nests. Results of the monitoring would be reported to the USAG-KA Environmental Engineer to provide to the USFWS.

When feasible, within 1 day after the land impact test at Illeginni Islet, USAK-KA environmental staff would survey the islet and the near-shore waters for any injured wildlife, damaged coral, or damage to sensitive habitats. For recovery and rehabilitation of any injured migratory birds or sea turtles found at Illeginni, USFWS and NMFS would be notified to advise on best care practices and qualified biologists would be allowed to assist in recovering and rehabilitating any injured sea turtles found. During inspections of the islet and near-shore waters, USAG-KA environmental staff would assess any sea turtle mortality. Any impacts to biological resources would be reported to the Appropriate Agencies, with USFWS and NMFS offered the opportunity to inspect the impact area to provide guidance on mitigations.

Following completion, personnel would recover all visible payload debris. Should an island impact occur, the impact area would be washed down to stabilize the disturbed soil. Following removal of all experiment items and any remaining debris from the target site, the impact crater would be backfilled and, if necessary, repairs made to surrounding structures. Any accidental spills from support equipment

operations would be contained and cleaned up. All waste materials would be returned to Kwajalein Island for proper disposal in the US. Following cleanup and repairs to the Illeginni site, soil samples would be collected at various locations around the impact area and tested for tungsten alloy.

Debris from the payload impact on land or in the Atoll lagoon would be recovered. Post-test recovery operations at Illeginni Island require the manual cleanup and removal of any debris, including hazardous materials, followed by filling in larger craters using a backhoe or grader. USAG-KA and RTS personnel are usually involved in these operations. Payload recovery/cleanup operations and removal of surface floating debris in the lagoon and ocean reef flats, within 150 to 300 m (500 to 1,000 ft) of the shoreline, would be conducted similarly to land operations when tide conditions and water depth permit. A backhoe would be used to excavate the crater. Excavated material would be screened for debris and the crater would be back-filled with coral ejected around the rim of the crater. Should the payload impact in the deeper waters of the Atoll lagoon, a dive team from USAG-KA or RTS would be brought in to conduct underwater searches. Also under consideration for underwater debris recovery would be the use of remotely operated vehicles (ROVs). If warranted due to other factors, such as significant currents or mass of the debris to be recovered, the recovery team would consider the use of an ROV instead of divers.

If an inadvertent impact occurs on the reef, reef flat, or in shallow waters less than 3 m (10 ft) deep, an inspection by project personnel would occur within 24 hours. Representatives from the NMFS and USFWS would also be invited to inspect the site as soon as practical after the test. The inspectors would assess any damage to coral and other natural and biological resources and, in coordination with SSP, USAG-KA and RTS representatives, decide on any response measures that may be required.

Recovery operations on the reef flat would be conducted similarly to land operations when tide conditions and water depth permit. Should the payload inadvertently impact in the deeper waters of the Atoll lagoon (up to approximately 55 m [180 ft]), a dive team from USAG-KA or RTS would be brought in to conduct underwater searches. Using a ship for recovery operations, the debris field would be located and certified divers in scuba gear would attempt to recover the debris manually.

In general, payload recovery operations would not be attempted in deeper waters on the ocean side of the Atoll. Searches for debris would be attempted out to depths of up to 55 m [180 ft]). An underwater operation similar to a lagoon recovery would be used if debris were located in this area.

Additionally, the US Navy and USASMDC have performed a bench study to measure the dissolution and potential for migration of the tungsten alloy in Illeginni Islet soils to inform future biological resources analyses of any potential effects (Appendix D).

Following cleanup and repairs to the Illeginni site, soil and groundwater sample would be collected at various locations around the impact area and tested for tungsten alloy.

In accordance with the Final Biological Opinion (Appendix F) provided by NMFS on June 29, 2017, the following reasonable and prudent measure would necessary and appropriate to minimize impacts of the Proposed Action and monitor levels of incidental take. The measures described below are non-discretionary and must be undertaken in order for the Incidental Take Statement to apply. (NMFS, 2017b)

1. The US Navy SSP shall reduce impacts on UES-protected corals, top shell snails, clams and their habitats through the employment of BMP and conservation measures.
2. The US Navy SSP shall record and report all action-related take of UES-consultation species.

The US Navy SSP must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. To meet reasonable and prudent measure 1 above, the US Navy SSP shall ensure that their personnel comply fully with the BMP and conservation measures identified in the Biological Assessment (US Navy and USASMDC, 2017) and below.
 - a. The US Navy SSP shall ensure that all relevant personnel associated with this project are fully briefed on the BMP and the requirement to adhere to them for the duration of this project.
 - b. In the event the payload impact that affects the reef at Illeginni, the US Navy SSP shall require its personnel to secure or remove from the water any substrate or coral rubble from the ejecta impact zone that may become mobilized by wave action as soon as possible.
 - i. Ejecta greater than 6 inches in any dimension shall be removed from the water or positioned such that it would not become mobilized by expected wave action, including replacement in the payload crater
 - ii. If possible, coral fragments greater than 6 inches in any dimension shall be positioned on the reef such that they would not become mobilized by expected wave action, and in a manner that would enhance its survival; away from fine sediments with the majority of the living tissue (polyps) facing up.
 - iii. UES consultation coral fragments that cannot be secure in-place should be relocated to suitable habitat where it is not likely to become mobilized.
 - c. In the event of the payload impact affects the reef at Illeginni, the US Navy SSP shall require its personnel to reduce impacts on top shell snails.
 - i. Rescue and reposition any living top shell snails that are buried or trapped by rubble.
 - ii. Relocate to suitable habitat, any living top shell snails that are in the path of any heavy equipment that must be used in the marine environment.
 - d. In the event the payload land impact affects the reef at Illeginni, the US Navy SSP shall require its personnel to reduce impact on clams.
 - i. Rescue and reposition any living clams that are buried or trapped by rubble.
 - ii. Relocate to suitable habitat, any living clams that are in the path of any heavy equipment that must be used in the marine environment.
2. To meet reasonable and prudent measure 2 above:
 - a. The US Navy SSP shall assign appropriately qualified personnel to record all suspected incidences of take of any UES-consultation species.
 - b. The US Navy SSP shall utilize digital photography/videography to record any UES-consultation species found injured or killed in or near the ocean target areas and/or at Illeginni. As practicable: 1) Photograph all damaged corals and/or other UES-consultation species that may be observed injured or dead; 2) Include a scaling device (such as a ruler) in photographs to aid in the determination of size; and 3) Record the location of the photograph.

- c. In the event the payload impact that affects the reef at Illeginni, the US Navy SSP shall require its personnel to survey the ejecta field for impacted corals, top shell snails, and clams. The personnel shall also be mindful for any other UES-consultation species that may have been affected.
- d. Within 60 days of completing post-test clean-up and restoration, provide photographs/videos and records to the USAG-KA environmental office. USAG-KA and NMFS biologists will review the photographs and records to identify the organisms to the lowest taxonomic level accurately possible to assess impacts on consultation species.
- e. Within 6 months of completion of the action, USAG-KA will provide a report to NMFS. The report shall identify: 1) The flight test and date; 2) The target area; 3) The results of the pre- and post-flight surveys; 4) The identity and quantity of affected resources (include photographs and videos as applicable); and 5) The disposition of any relocation efforts.

Reinitiation of formal consultation would be required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law, and if:

1. The amount or extent of anticipated incidental take is exceeded;
2. New information reveals that the action may affect UES-protected marine species or critical habitat in a manner or to an extent not considered in the NMFS Final Biological Opinion;
3. The action is subsequently modified in a manner that may affect UES-protected marine species or critical habitat to an extent, or in a manner not considered in the NMFS Final Biological Opinion; or
4. A new species is listed or critical habitat designated that may be affected by the action.

2.6 Alternatives Considered but not Carried Forward for Detailed Analysis

The following alternatives were considered, but not carried forward for detailed analysis in this EA/OEA as they did not meet the purpose and need for the Proposed Action and satisfy the reasonable alternative screening factors presented in Section 2.2.

2.6.1 Johnston Atoll

An alternative would be launching a STARS booster from Johnston Atoll with an impact in USAKA. Johnston Atoll is an unincorporated territory of the US, currently administered by the US Fish and Wildlife Service (USFWS). The Atoll is managed as part of the Pacific Remote Islands Marine National Monument, established in 2009. It had been formerly under control of the US DoD, but was closed in 2004. Johnston Atoll had been the site of various missile launches in the past, but that capability no longer exists. This alternative would not meet the purpose of the Proposed Action because the launch equipment has not been used or maintained since the facility closed in 2004 and therefore would not meet performance requirements. The cost and schedule that would be needed to refurbish or replace the launch facilities would significantly delay the completion of the Proposed Action.

2.6.2 Pacific Spaceport Complex Alaska

An alternative to the flight test between the KTF and USAKA would be to launch the STARS booster from the Pacific Spaceport Complex Alaska on the island of Kodiak, Alaska, with an impact in the BOA north of the PMRF. This alternative would not meet the purpose of the Proposed Action because there is no existing instrumentation in the BOA north of the PMRF to collect data that could verify the payload performance. The cost and schedule that would be needed to develop and test a new BOA instrumentation suite near PMRF would significantly delay the completion of the Proposed Action.

2.6.3 Farallon De Medinilla

Another alternative would be launching a STARS booster from the KTF at PMRF with an impact in the Farallon De Medinilla in the Northern Marianna Islands. This alternative would not meet the purpose of the Proposed Action because there is no existing instrumentation at Farallon De Medinilla to collect data that could verify the payload performance in support of capability needs. The cost and schedule that would be needed to develop and test a new BOA instrumentation suite near Farallon De Medinilla would significantly delay the completion of the Proposed Action.

3 Affected Environment

This chapter presents a description of the environmental resources and baseline conditions that could be affected from implementing the Proposed Action and any of the three impact scenarios.

All potentially relevant environmental resource areas were initially considered for analysis in this EA/OEA. In compliance with NEPA, CEQ, and 32 CFR part 775 guidelines, the discussion of the affected environment (i.e., existing conditions) focuses only on those resource areas potentially subject to impacts. Additionally, the level of detail used in describing a resource is commensurate with the anticipated level of potential environmental impact.

3.1 PMRF/Kauai Test Facility

This section includes air quality, water resources, biological resources, airspace, noise, public health and safety, and hazardous materials and wastes for potential environmental impacts to the PMRF/KTF launch site.

The potential impacts to the following resource areas are considered to be negligible or non-existent so they were not analyzed in detail in this EA/OEA:

Geological Resources: The Navy FE-1 flight test requires no ground-disturbing activities; thus no impacts to geological resources would be expected.

Cultural Resources: The Navy FE-1 flight test requires no ground-disturbing activities; thus no impacts to cultural resources would be expected.

Land Use: The Navy FE-1 flight test represents activities that are consistent with the mission and well within the limits of current operations of both PMRF and KTF. Thus, there would be no adverse effects on land use.

Infrastructure: The Navy FE-1 flight test represents activities that are consistent with the mission and well within the limits of current operations of both PMRF and KTF. Thus, there would be no adverse effects on infrastructure.

Transportation: The Navy FE-1 flight test represents activities that are consistent with the mission and well within the limits of current operations of both PMRF and KTF. Thus, there would be no adverse effects on transportation.

Socioeconomics: There would be little increase in personnel on base; thus no socioeconomic concerns are anticipated. Any increase would be temporary and only for the duration of the Proposed Action.

Environmental Justice: The Navy FE-1 flight test includes a launch trajectory, range safety regulations and procedures, and dispersing of noise over a wide area that precludes disproportionate impacts to minority populations and low-income populations under Executive Order 12898.

Visual Resources: The Navy FE-1 flight test does not require any new construction and the visual aesthetics of PMRF and KTF would not be changed.

Marine Sediments: The Navy FE-1 flight test does not require any new construction and the marine sediments of PMRF and KTF would not be changed.

3.1.1 Air Quality

This discussion of air quality includes criteria pollutants, standards, sources, permitting and greenhouse gases. Air quality in a given location is defined by the concentration of various pollutants in the atmosphere.

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 prevailing meteorological conditions.

Most air pollutants originate from human-made sources, including mobile sources (e.g., cars, trucks, buses) and stationary sources (e.g., factories, refineries, power plants), as well as indoor sources (e.g., some building materials and cleaning solvents). Air pollutants are also released from natural sources such as volcanic eruptions and forest fires.

3.1.1.1 Regulatory Setting

Criteria Pollutants and National Ambient Air Quality Standards

The principal pollutants defining the air quality, called "criteria pollutants," include carbon monoxide (CO), sulfur dioxide (SO₂), nitrogen dioxide (NO₂), ozone, suspended particulate matter less than or equal to 10 microns in diameter (PM₁₀), fine particulate matter less than or equal to 2.5 microns in diameter (PM_{2.5}), and lead (Pb). CO, SO₂, Pb, and some particulates are emitted directly into the atmosphere from emissions sources. Ozone, NO₂, and some particulates are formed through atmospheric chemical reactions that are influenced by weather, ultraviolet light, and other atmospheric processes.

Under the Clean Air Act (CAA), the USEPA has established National Ambient Air Quality Standards (NAAQS) (40 CFR part 50) for these pollutants. NAAQS are classified as primary or secondary. Primary standards protect against adverse health effects; secondary standards protect against welfare effects, such as damage to farm crops and vegetation and damage to buildings. Some pollutants have long-term and short-term standards. Short-term standards are designed to protect against acute, or short-term, health effects, while long-term standards were established to protect against chronic health effects.

Areas that are and have historically been in compliance with the NAAQS are designated as attainment areas. Areas that violate a federal air quality standard are designated as nonattainment areas. Areas that have transitioned from nonattainment to attainment are designated as maintenance areas and are required to adhere to maintenance plans to ensure continued attainment.

The CAA requires states to develop a general plan to attain and maintain the NAAQS in all areas of the country and a specific plan to attain the standards for each area designated nonattainment for a NAAQS. These plans, known as State Implementation Plans (SIPs), are developed by state and local air quality management agencies and submitted to USEPA for approval.

In addition to the NAAQS for criteria pollutants, national standards exist for hazardous air pollutants (HAPs), which are regulated under Section 112(b) of the 1990 CAA Amendments. The *National Emission Standards for Hazardous Air Pollutants* regulate HAP emissions from stationary sources (40 CFR part 61).

Mobile Sources

HAPs emitted from mobile sources are called Mobile Source Air Toxics (MSATs). MSATs are compounds emitted from highway vehicles and non-road equipment that are known or suspected to cause cancer or other serious health and environmental effects. In 2001, USEPA issued its first MSAT Rule, which identified 201 compounds as being HAPs that require regulation. A subset of six of the MSAT compounds was identified as having the greatest influence on health and included benzene, butadiene, formaldehyde, acrolein, acetaldehyde, and diesel particulate matter. More recently, USEPA issued a second MSAT Rule in February 2007, which generally supported the findings in the first rule and provided additional recommendations of compounds having the greatest impact on health. The rule also identified several engine emission certification standards that must be implemented (40 CFR parts 59, 80, 85, and 86; Federal

Register Volume 72, No. 37, pp. 8427–8570, 2007). Unlike the criteria pollutants, there are no NAAQS for benzene and other HAPs. The primary control methodologies for these pollutants for mobile sources involves reducing their content in fuel and altering the engine operating characteristics to reduce the volume of pollutant generated during combustion.

General Conformity

The USEPA General Conformity Rule applies to federal actions occurring in nonattainment or maintenance areas when the total direct and indirect emissions of nonattainment pollutants (or their precursors) exceed specified thresholds. The emissions thresholds that trigger requirements for a conformity analysis are called *de minimis* levels. *De minimis* levels (in tons per year [tpy]) vary by pollutant and also depend on the severity of the nonattainment status for the air quality management area in question.

A conformity applicability analysis is the first step of a conformity evaluation and assesses if a federal action must be supported by a conformity determination. This is typically done by quantifying applicable direct and indirect emissions that are projected to result due to implementation of the federal action. Indirect emissions are those emissions caused by the federal action and originating in the region of influence (ROI), but which can occur at a later time or in a different location from the action itself and are reasonably foreseeable. The federal agency can control and will maintain control over the indirect action due to a continuing program responsibility of the federal agency. Reasonably foreseeable emissions are projected future direct and indirect emissions that are identified at the time the conformity evaluation is performed. The location of such emissions is known and the emissions are quantifiable, as described and documented by the federal agency based on its own information and after reviewing any information presented to the federal agency. If the results of the applicability analysis indicate that the total emissions would not exceed the *de minimis* emissions thresholds, then the conformity evaluation process is completed. *De minimis* threshold emissions are presented in Table 3-1.

Permitting

New Source Review (Preconstruction Permit). New major stationary sources and major modifications at existing major stationary sources are required by the CAA to obtain an air pollution permit before commencing construction. This permitting process for major stationary sources is called New Source Review and is required whether the major source or major modification is planned for nonattainment areas or attainment and unclassifiable areas. In general, permits for sources in attainment areas and for other pollutants regulated under the major source program are referred to as Prevention of Significant Deterioration (PSD) permits, while permits for major sources emitting nonattainment pollutants and located in nonattainment areas are referred to as nonattainment new source review permits. In addition, a proposed project may have to meet the requirements of nonattainment new source review for the pollutants for which the area is designated as nonattainment and PSD for the pollutants for which the area is attainment. Additional PSD permitting thresholds apply to increases in stationary source greenhouse gas (GHG) emissions. PSD permitting can also apply to a new major stationary source (or any net emissions increase associated with a modification to an existing major stationary source) that is constructed within 10 km (6.2 miles) of a Class I area, and which would increase the 24-hour average concentration of any regulated pollutant in the Class I area by 1 microgram per cubic meter ($\mu\text{g}/\text{m}^3$) or more. Navy installations shall comply with applicable permit requirements under the PSD program per 40 CFR section 51.166.

Table 3-1 General Conformity De minimis Levels

Pollutant	Area Type	TPY
Ozone (VOC or NO_x)	Serious nonattainment	50
	Severe nonattainment	25
	Extreme nonattainment	10
	Other areas outside an ozone transport region	100
Ozone (NO_x)	Marginal and moderate nonattainment inside an ozone transport region	100
	Maintenance	100
Ozone (VOC)	Marginal and moderate nonattainment inside an ozone transport region	50
	Maintenance within an ozone transport region	50
	Maintenance outside an ozone transport region	100
Carbon monoxide, SO₂ and NO₂	All nonattainment & maintenance	100
PM₁₀	Serious nonattainment	70
	Moderate nonattainment and maintenance	100
PM_{2.5} Direct emissions, SO₂, NO_x (unless determined not to be a significant precursor), VOC or ammonia (if determined to be significant precursors)	All nonattainment & maintenance	100
Lead (Pb)	All nonattainment & maintenance	25

Source: US Navy, 2013

Title V (Operating Permit). The Title V Operating Permit Program consolidates all CAA requirements applicable to the operation of a source, including requirements from the SIP, preconstruction permits, and the air toxics program. It applies to stationary sources of air pollution that exceed the major stationary source emission thresholds, as well as other non-major sources specified in a particular regulation. The program includes a requirement for payment of permit fees to finance the operating permit program whether implemented by USEPA or a state or local regulator. Navy installations subject to Title V permitting shall comply with the requirements of the Title V Operating Permit Program, which are detailed in 40 CFR Part 70 and all specific requirements contained in their individual permits.

Greenhouse Gases

GHGs are gas emissions that trap heat in the atmosphere. These emissions occur from natural processes and human activities. Scientific evidence indicates a trend of increasing global temperature over the past century due to an increase in GHG emissions from human activities. The climate change associated with this global warming is predicted to produce negative economic and social consequences across the globe.

The CEQ released on August 1, 2016, final guidance on when and how Federal agencies should consider GHG emissions and climate change in NEPA analyses (CEQ, 2016). The guidance is primarily focused on projects that have large air quality implications. It also emphasizes a netting approach to GHG analysis. This threshold was carried forward to see if additional quantitative analysis would be required for the Proposed Action. The guidance recommends that agencies consider both the potential effects of a proposed action on climate change, as indicated by its estimated greenhouse gas emissions, and the implications of climate change for the environmental effects of a proposed action. The guidance also emphasizes that agency analyses should be commensurate with projected greenhouse gas emissions and climate impacts, and should employ appropriate quantitative or qualitative analytical methods to ensure useful information is available to inform the public and the decision-making process in distinguishing between alternatives and mitigations. Although not specifically identified in the final guidance, the prior draft guidance recommended that agencies consider 25,000 metric tons per year (27,558 tons per year) of carbon dioxide equivalent (CO₂e) emissions as a reference point below which a quantitative analysis of greenhouse gas is not recommended unless it is easily accomplished based on available tools and data.

The USEPA issued the *Final Mandatory Reporting of Greenhouse Gases Rule* on September 22, 2009. GHGs covered under the *Final Mandatory Reporting of Greenhouse Gases Rule* are carbon dioxide (CO₂), methane, nitrogen oxide (NO_x), hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and other fluorinated gases including nitrogen trifluoride and hydrofluorinated ethers. Each GHG is assigned a global warming potential. The global warming potential is the ability of a gas or aerosol to trap heat in the atmosphere. The global warming potential rating system is standardized to CO₂, which has a value of one. The equivalent CO₂ rate is calculated by multiplying the emissions of each GHG by its global warming potential and adding the results together to produce a single, combined emissions rate representing all GHGs. Under the rule, suppliers of fossil fuels or industrial GHGs, manufacturers of mobile sources and engines, and facilities that emit 25,000 metric tons or more per year of GHG emissions as CO₂e are required to submit annual reports to USEPA.

Hawai'i's 2007 Greenhouse Gas Emissions Inventory states that in both 1990 and 2007, emissions from transportation and electric power sources accounted for the vast majority (more than 85%) of GHG emissions in Hawai'i. At 91% of the total in 2007, CO₂ is the largest single contributor to GHG emissions from in-state sources. Oahu accounts for 71% of Hawai'i's GHG emissions; Kauai contributes 5% (Hawai'i Department of Business, Economic Development & Tourism, 2008).

The global annual temperature has increased at an average rate of 0.07 degrees (°) Celsius [C] (0.13° Fahrenheit [F]) per decade since 1880 and at an average rate of 0.17°C (0.31°F) per decade since 1970. The warmest global average temperatures on record have all occurred within the past 15 years, with the warmest years being 2010, 2013, 2014, and 2015 (NOAA, 2016). With this in mind, the Navy has established energy targets to reduce GHG by 2020. The targets of significance to this EA/OEA include: (1) by 2020, half of the Navy's energy consumption (ashore and afloat) will come from alternative sources; (2) by 2020, half of Navy installations will be net-zero energy consumers, using solar, wind, ocean, and geothermal power generated on base; (3) by 2015, the Navy will cut in half the amount of petroleum used in Government vehicles through phased adoption of hybrid, electric, and flex fuel vehicles; and (4) effective immediately, Navy contractors will be held contractually accountable for meeting energy efficiency targets.

In an effort to reduce energy consumption, reduce GHGs, reduce dependence on petroleum, and increase the use of renewable energy resources the Navy has implemented a number of renewable energy projects. The Navy has established Fiscal Year 2020 GHG emissions reduction targets of 34% from a FY 2008 baseline for direct GHG emissions and 13.5% for indirect emissions. Examples of Navy-wide GHG reduction projects

include energy efficient construction, thermal and photovoltaic solar systems, geothermal power plants, and the generation of electricity with wind energy. The Navy continues to promote and install new renewable energy projects.

3.1.1.2 Region of Influence (ROI)

Air Quality

Air quality in Hawai'i is defined with respect to compliance with primary and secondary National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50) established by the USEPA and adopted by the State of Hawai'i. The Clean Air Act (42 USC 7401-7671q), as amended, gives USEPA the responsibility to set safe concentration levels for six criteria pollutants: particulate matter measuring less than 10 and 2.5 microns in diameter (PM₁₀ and PM_{2.5}), sulfur dioxide, carbon monoxide, nitrogen oxides, lead, and 8-hour ozone (measured by its precursors, volatile organic compounds [VOCs] and nitrogen oxides).

For inert pollutants (all pollutants other than ozone and its precursors: VOCs and nitrogen oxides), the ROI is generally limited to an area extending several miles downwind from the source. Consequently, for the air quality analysis, the ROI for project activities is the existing airshed (the geographic area responsible for emitting 75% of the air pollution reaching a body of water) surrounding the various sites, which encompasses the KTF located on PMRF, Kauai, Hawai'i. The ROI for ozone may extend much farther downwind than the ROI for inert pollutants. As the project area has no heavy industry and relatively few automobiles, ozone and its precursors are not of concern. The ROI for ozone depleting gases and greenhouse gas (GHG) emissions is global.

Climate

Weather is an important factor in the disbursement of air pollutants. PMRF is located just south of the Tropic of Cancer and has a mild and semi-tropical climate. Typical temperatures for the area are 80 to 84 degrees Fahrenheit (°F) during the day and 65 to 68°F during the night. The trade winds are from the northeast and are typically light—mean trade winds between 18 to 21 miles per hour. Precipitation in the area averages 41 inches annually. Most of the rain falls during the October through April wet season. Relative humidity is approximately 60% during the day throughout the year.

Regional Air Quality

Air quality data in Hawai'i are collected by the Hawai'i State Department of Health, Clean Air Branch. In 2008, the state maintained 14 air monitoring stations on 3 islands (none on Kauai). Between 2004 and 2008, none of the monitored ambient air concentrations in the State exceeded the annual average Ambient Air Quality Standards (AAQS) (Hawai'i State Department of Health, Clean Air Branch, 2008). Therefore, Hawai'i is in attainment for all NAAQSs.

USEPA's general air conformity rule applies to Federal actions occurring in nonattainment or maintenance areas when the total indirect and direct emissions of the subject air pollutant exceed specific thresholds. An air conformity analysis is not required for the Proposed Action because as of 2010, the State of Hawai'i was in attainment for all NAAQS.

Existing Emission Sources

PMRF and KTF power is supplied by Kauai Island Utility Cooperative (KIUC) during non-testing times. KIUC is in the process of reducing power cost by decreasing use of imported fossil fuels and increasing the amount of energy generated from Kauai's own resources. The KIUC initiative is to generate 50 percent of its electricity from renewable sources by 2023. In 2016, 38 percent of the electricity generated on Kauai came

from a mix of solar, hydropower, and biomass sources. On the sunniest days, 60 percent of Kauai's daytime energy needs are met by solar. (KIUC, 2017).

The only major stationary sources of air emissions at PMRF are generators used by and permitted for PMRF/Main Base, KTF, the Advanced Radar Detection Laboratory, and the Aegis Ashore Missile Defense program during testing events and when electrical demand is high (Pacific Missile Range Facility, 2010)

Stationary emission sources at PMRF include three 320-kilowatt (kW) and the two 600-kW generators that are operational in addition to the KIUC power system. These generators are covered under the PMRF Title V Noncovered Source Permit. The Title V permit controls the nitrogen dioxide and sulfur dioxide emissions from each generator by restricting the hours of use and limiting the diesel fuel supplied for the generators to ultra-low sulfur diesel with a sulfur content not to exceed 0.0015% by weight.

Stationary emission sources at KTF include two standby 320-kW diesel engine generators that are permitted for operation by the State of Hawai'i under a Non-covered Source Permit. (Pacific Missile Range Facility, 2010)

Mobile sources from PMRF-associated testing include aircraft, missile launches, diesel-fueled vehicles, and vehicular traffic. Aircraft are operated and supported at PMRF Airfield. Missile launches are a source of mobile emissions at PMRF. Currently, there are as many as 46 missile launches per year from PMRF and KTF, which includes launches of interceptor missiles and target launches. These systems use both solid and liquid propellants. The most common exhaust components for typical missiles include aluminum oxide, carbon dioxide, carbon monoxide, hydrogen, hydrogen chloride, nitrogen, water, ferric chloride, ferric oxide, nitric oxide, chlorine, and sulfur dioxide.

3.1.2 Water Resources

This section describes the existing water resource conditions at the proposed sites. Water resources include those aspects of the natural environment related to the availability and characteristics of water. For the purposes of this document, water resources can be divided into three main sections: surface water, groundwater, and flood hazard areas.

Surface water includes discussions of runoff, changes to surface drainage, and general surface water quality. Surface water resources generally consist of wetlands, lakes, rivers, and streams. Surface water is important for its contributions to the economic, ecological, recreational, and human health of a community or locale. A Total Maximum Daily Load (TMDL) is the maximum amount of a substance that can be assimilated by a water body without causing impairment. A water body can be deemed impaired if water quality analyses conclude that exceedances of water quality standards occur.

Groundwater discussions focus on aquifer characteristics, general groundwater quality and water supply. Groundwater is water that flows or seeps downward and saturates soil or rock, supplying springs and wells.

Wetlands are jointly defined by USEPA and USACE as "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Wetlands generally include "swamps, marshes, bogs and similar areas" (40 CFR section 230.3[t] and 33 CFR section 328.3[b]).

Flood hazard area discussions center on floodplains. Floodplains are areas of low-level ground present along rivers, stream channels, large wetlands, or coastal waters. Floodplain ecosystem functions include natural moderation of floods, flood storage and conveyance, groundwater recharge, and nutrient cycling.

Floodplains also help to maintain water quality and are often home to a diverse array of plants and animals. In their natural vegetated state, floodplains slow the rate at which the incoming overland flow reaches the main water body. Floodplain boundaries are most often defined in terms of frequency of inundation, that is, the 100-year and 500-year flood. Floodplain delineation maps are produced by the Federal Emergency Management Agency and provide a basis for comparing the locale of the Proposed Action to the floodplains.

Sediments are the solid fragments of organic and inorganic matter created from weathering rock transported by water, wind, and ice (glaciers) and deposited at the bottom of bodies of water. Components of sediment range in size from boulders, cobble, and gravel to sand (particles 0.05 to 2.0 millimeters [mm] in diameter), silt (0.002 to 0.05 mm), and clay (less than or equal to 0.002 mm). Sediment deposited on the continental shelf is delivered mostly by rivers but also by local and regional currents and wind. Most sediment in nearshore areas and on the continental shelf is aluminum silicate derived from rocks on land that is deposited at rates of greater than ten centimeters per 1,000 years. Sediment may also be produced locally as nonliving particulate organic material ("detritus") that travels to the bottom (Hollister, 1973; Milliman et al., 1972). Some areas of the deep ocean contain an accumulation of the shells of marine microbes composed of silicon and calcium carbonate, termed biogenic ooze (Chester, 2003). Through the downward movement of organic and inorganic particles in the water column, substances that are otherwise scarce in the water column (e.g., metals) are concentrated in bottom sediment (Chapman et al., 2003; Kszos et al., 2003).

Where practicable, water resources are described quantitatively (volume, mineral concentrations, salinity, etc.); otherwise they are described qualitatively (good, poor, etc.) when necessary.

3.1.2.1 Regulatory Setting

Groundwater quality and quantity are regulated under several statutes and regulations, including the Safe Drinking Water Act.

The CWA establishes federal limits, through the National Pollutant Discharge Elimination System (NPDES) program, on the amounts of specific pollutants that can be discharged into surface waters to restore and maintain the chemical, physical, and biological integrity of the water. The NPDES program regulates the discharge of point (i.e., end of pipe) and nonpoint sources (i.e., storm water) of water pollution.

Waters of the United States are defined as (1) traditional navigable waters, (2) wetlands adjacent to navigable waters, (3) nonnavigable tributaries of traditional navigable waters that are relatively permanent where the tributaries typically flow perennially or have continuous flow at least seasonally (e.g., typically 3 months), and (4) wetlands that directly abut such tributaries under Section 404 of the CWA, as amended, and are regulated by USEPA and the USACE. The CWA requires that Hawai'i establish a Section 303(d) list to identify impaired waters and establish TMDLs for the sources causing the impairment.

Section 438 of the Energy Independence and Security Act (42 U.S.C. section 17094) establishes storm water design requirements for development and redevelopment projects. Under these requirements, federal facility projects larger than 465 m² (5,000 ft²) must "maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow."

Wetlands are currently regulated by the USACE under Section 404 of the CWA as a subset of all "Waters of the United States." The term "Waters of the United States" has a broad meaning under the CWA and incorporates deepwater aquatic habitats and special aquatic habitats, including wetlands. Jurisdictional Waters of the United States regulated under the CWA include coastal and inland waters, lakes, rivers, ponds,

streams, intermittent streams, and “other” waters that, if degraded or destroyed, could affect interstate commerce. The full regulatory definition of Waters of the United States is provided in the Clean Water Act.

Executive Order 11990, *Protection of Wetlands*, requires that federal agencies adopt a policy to avoid, to the extent possible, long- and short-term adverse impacts associated with destruction and modification of wetlands and to avoid the direct and indirect support of new construction in wetlands whenever there is a practicable alternative.

Section 404 of the CWA authorizes the Secretary of the Army, acting through the Chief of Engineers, to issue permits for the discharge of dredge or fill into wetlands and other Waters of the United States. Any discharge of dredge or fill into Waters of the United States requires a permit from the USACE.

Section 10 of the Rivers and Harbors Act provides for USACE permit requirements for any in-water construction. USACE and some states require a permit for any in-water construction. Permits are required for construction of piers, wharfs, bulkheads, pilings, marinas, docks, ramps, floats, moorings, and like structures; construction of wires and cables over the water, and pipes, cables, or tunnels under the water; dredging and excavation; any obstruction or alteration of navigable waters; depositing fill and dredged material; filling of wetlands adjacent or contiguous to waters of the US; construction of riprap, revetments, groins, breakwaters, and levees; and transportation of dredged material for dumping into ocean waters.

The National Wild and Scenic Rivers System was created by Congress in 1968 to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations. The Act is notable for safeguarding the special character of these rivers, while also recognizing the potential for their appropriate use and development. It encourages river management that crosses political boundaries and promotes public participation in developing goals for river protection.

Executive Order 11988, *Floodplain Management*, requires federal agencies to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development unless it is the only practicable alternative. Flood potential of a site is usually determined by the 100-year floodplain, which is defined as the area that has a 1% chance of inundation by a flood event in a given year. All of PMRF Barking Sands and the Mana Plain up to the foothills are now in the Tsunami Evacuation Zone which is coincident with the Federal Flood Hazard Zone (John Burger personal communication, 20 February 2017).

The Coastal Zone Management Act of 1972 (CZMA) provides assistance to states, in cooperation with federal and local agencies, for developing land and water use programs in coastal zones. Section 307 of the CZMA stipulates that where a federal project initiates reasonably foreseeable effects to any coastal use or resource (land or water use, or natural resource), the action must be consistent to the maximum extent practicable with the enforceable policies of the affected state’s federally approved coastal management plan. The Hawai’i Coastal Zone Management Program is the lead agency for coastal management and, along with State and county partners, is responsible for enforcing the State’s federally approved coastal management plan. However, Federal lands, which are “lands the use of which is by law subject solely to the discretion of...the Federal Government, its officers, or agents,” are statutorily excluded from the State’s “coastal zone”. If, however, the proposed federal activity affects coastal resources or uses beyond the boundaries of the federal property (i.e., has spillover effects), the CZMA Section 307 federal consistency requirement applies. As a federal agency, the Navy is required to determine whether its proposed activities would affect the coastal zone. This takes the form of either a Negative Determination or a Consistency Determination. Military testing and training at PMRF has been included in a list of US Navy de minimis activities under the

CZMA. The Hawai'i Coastal Zone Management Program determined the listed activities "are expected to have insignificant direct or indirect (cumulative and secondary) coastal effects, and should not be subject to further review by the Hawai'i CZM program." (Mayer, 2009)

The following discussions provide a description of the existing conditions for each of the categories under water quality resources at PMRF. Bathymetry is included in the Geological Resources section.

3.1.2.2 Region of Influence (ROI)

The ROI includes the area within and surrounding the PMRF property boundaries, including KTF and the restrictive easement. The Mana Plain and the Ground Hazard Area are also included.

Surface Water

The surface water within the PMRF boundary is in the canals that drain the agricultural areas east of PMRF. Apart from these drainages, no surface drainage has been established because the rain sinks into the permeable sand. There are numerous drains and several irrigation ponds in the agricultural land.

The waters in the irrigation ponds generally do not meet drinking water standards for chloride salts, but have near neutral to slightly alkaline pH. A surface water quality study for chloride was conducted in the Mana Plain/KTF area. The chloride levels do not indicate residual hydrochloric acid effects of the past launches at KTF (US Army Program Executive Office, 1995). Because the drainage ditches are designed to move water away from the agricultural fields during irrigation and rainfall, and to leach salts from the soil, no residual effects of past launches are expected (US Army Program Executive Office, 1995). The Agribusiness Development Corporation administers the activity on the agricultural aspects of the Mana Plain (John Burger, personal communication, 20 February 2017).

Surface water in the area of the restrictive easement on the Mana Plain is restricted to drains and agricultural irrigation ponds. Within the restrictive easement boundary, the surface water and storm water runoff drain onto former Amfac Sugar-Kauai lands and agricultural ponds below the Mana cliffs. The Mana Plain is drained by canals that flow seaward. Typically, the water from the canals that drain from the sugar cane fields is brackish. (US Army Space and Strategic Defense Command (USASSDC), 1993b)

The waters in the agricultural ponds along the Mana cliffs generally do not meet drinking water standards for chloride salts but are near neutral to slightly alkaline. The highest chloride salt levels, near those of seawater, were observed in water from the Mana Pond Wildlife Sanctuary near the north gate of PMRF. This may be due to the infiltration of brackish to saline groundwater into the pond basin or excessive evaporation to a low surface level. (USASSDC, 1993b)

Water quality along the PMRF shoreline was within Department of Health standards, with the exception of two locations where sugar cane irrigation water, pumped from the sugar cane fields, is discharged to the ocean (Belt Collins Hawai'i, 1994). In these areas, Department of Health water quality criteria are exceeded within 164 ft (50 m) of the shoreline. Mixing processes are sufficient to dilute the drainage water to near background levels within 164 to 328 ft (50 to 993 m) of the shoreline (Belt Collins Hawai'i, 1994). These outfall locations are currently monitored under a National Pollutant Discharge Elimination System Permit that is held by the Agribusiness Development Corporation (US Navy, 2010).

Groundwater

Bedrock, alluvium, and sand dunes make up hydraulically connected aquifers within the ROI. The bedrock (basement volcanics, primarily basalt) is highly permeable, containing brackish water that floats on seawater. (USASSDC, 1993b)

The overlying sediments are saturated, but they are not exploitable as an aquifer because of unfavorable hydraulic characteristics. The groundwater in the sediments originates as seepage from irrigation percolation and rainfall in the basalt aquifer, especially where the sediments are thin near the inland margin of the Mana Plain.

The dune sand aquifer on which PMRF/Main Base lies has a moderate hydraulic conductivity and moderate porosity of about 20%. It consists of a lens of brackish groundwater that floats on seawater and is recharged by rainfall and by seepage from the underlying sediments. The only record of an attempt to exploit this groundwater is of a well drilled for the Navy in 1974, 6.4 km to 8 km (4 to 5 miles) south of KTF. The well was drilled to a depth of 13 m (42 ft), and tested at 1,136 liters per minute (300 gallons per minute). In 1992, the water was too brackish for plants and animals to consume; consequently, the well is not used. (US Army Program Executive Office, 1995)

The nearest fresh groundwater sources are in the Napali formation at the inland edge of the coastal plain along the base of the Mana cliffs. Groundwater in the region is generally considered to be potable at the base of the cliffs, increasing in salinity closer to the coast. (USASSDC, 1993b)

Sampling for perchlorate was initiated at PMRF in 2006. USEPA adopted an oral reference dose for perchlorate in 2009, following a National Academy of Sciences recommendation that it not exceed 15 parts per billion in drinking water. Until USEPA promulgates standards for perchlorate, the DoD has established 15 parts per billion as the current level of concern for managing perchlorate (Office of the Under Secretary of Defense, 2009). This level has also been adopted in the Navy Perchlorate Sampling and Management Policy.

As part of the implementation of the Navy policy, perchlorate sampling has been conducted at two drinking water supply locations. One location is the "Mana well," which is the former Kekaha Sugar/AMFAC well from which PMRF obtains drinking water, referenced as "BS 335," and supplies the "north end" of PMRF. It is a hand-dug well, now concrete-lined, approximately 90 ft (27.4 m) deep, and is located at the base of the ridge near the Kamokala Caves. The pumps and electric motors are down in the well. The other location is the water tank at the southern end of the base identified as reference code "BS 820." Water in the tank comes from the County of Kauai. Perchlorate concentrations at both sites were less than the initial screening level of 4.0 parts per billion. Based on guidance PMRF received from Navy Region Hawai'i, since the two consecutive samples were less than 4 parts per billion, no further analysis was required.

Flood Hazard Areas

The primary flood hazard is from overflow of the ditches that drain the Mana Plain. Extended periods of heavy rainfall have resulted in minor flooding of low-lying areas of PMRF/Main Base. In addition, all of PMRF/Main Base is within the tsunami evacuation area.

3.1.3 Biological Resources at SNL/KTF

Biological resources include living, native, or naturalized plant and animal species and the habitats within which they occur. Plant associations are referred to generally as vegetation, and animal species are referred to generally as wildlife. Habitat can be defined as the resources and conditions present in an area that support a plant or animal. The biological resources at SNL/KTF were recently evaluated for launches in this area in the *Advanced Hypersonic Weapons Program Environmental Assessment* (USASMDC/ARSTRAT, 2011) and STARS system launches have been evaluated at PMRF in the *Hawaii Range Complex Final Environmental Impact Statement/Overseas Environmental Impact Statement* (HRC, 2008). This EA/OEA summarizes information on plant and animal species and their habitats, with emphasis on special-status species listed by State and Federal agencies.

Within this EA/OEA, biological resources are divided into four major categories: (1) terrestrial vegetation, (2) terrestrial wildlife, (3) marine vegetation, and (4) marine wildlife. Threatened, endangered, and other special status species are discussed in their respective categories. Table 3-2 lists all special status species that are potentially present at or near SNL/KTF.

3.1.3.1 Regulatory Setting at SNL/KTF

For the purposes of this EA/OEA, special-status species at or near SNL/KTF are those species listed as threatened or endangered under the Endangered Species Act (ESA) and species afforded federal protection under the Marine Mammal Protection Act (MMPA) or the Migratory Bird Treaty Act (MBTA).

The purpose of the ESA is to conserve the ecosystems upon which threatened and endangered species depend and to conserve and recover listed species. Section 7 of the ESA requires action proponents to consult with the US Fish and Wildlife Service (USFWS) or National Oceanic and Atmospheric Administration (NOAA) Fisheries to ensure that their actions are not likely to jeopardize the continued existence of federally listed threatened and endangered species, or result in the destruction or adverse modification of designated critical habitat. For all ESA listed species, the ESA defines "harm" as an act which kills or injures wildlife including significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering (16 USC, §§ 1531-1544). The ESA defines harassment as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to breeding, feeding, or sheltering.

All marine mammals are protected under the provisions of the MMPA. The MMPA prohibits any person or vessel from "taking" marine mammals in the United States or the high seas without authorization. As defined by the MMPA, level A harassment of cetaceans is any act which has the potential to injure a marine mammal or marine mammal stock in the wild. Level B harassment is defined as any act which has the potential to disturb a marine mammal or marine mammal stock in the wild by causing behavioral pattern disruptions, including but not limited to migration, breathing, nursing, breeding, feeding, or sheltering.

Birds, both migratory and most native-resident bird species, are protected under the MBTA, and their conservation by federal agencies is mandated by EO 13186 (Migratory Bird Conservation). Under the MBTA

Table 3-2 Special-status Species Known to Occur or Potentially Occurring at or near SNL/KTF and Critical Habitat Present at PMRF

<i>Common Name</i>	<i>Scientific Name</i>	<i>Federal Listing Status</i>	<i>Likelihood of Occurrence at or near KTF</i>	<i>Critical Habitat Present?</i>
Plants				
Lau'ehu	<i>Panicum niihauense</i>	E	U	Yes
Ohai	<i>Sesbania tomentosa</i>	E	U	Yes
Terrestrial Mammals				
Hawaiian hoary bat	<i>Lasiurus cinereus spp. Semotus</i>	E	P	
Marine Mammals				
Minke whale	<i>Balaenoptera acutorostrata</i>	-	P	
Sei whale	<i>B. borealis</i>	E	U	
Bryde's whale	<i>B. edeni</i>	-	P	
Blue whale	<i>B. musculus</i>	E	U	

Common Name	Scientific Name	Federal Listing Status	Likelihood of Occurrence at or near KTF	Critical Habitat Present?
Fin whale	<i>B. physalus</i>	E	U	
Pygmy killer whale	<i>Feresa attenuata</i>	-	P	
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	-	P	
Risso's dolphin	<i>Grampus griseus</i>	-	P	
Longman's beaked whale	<i>Indopacetus pacificus</i>	-	P	
Pygmy sperm whale	<i>Kogia breviceps</i>	-	P	
Dwarf sperm whale	<i>K. sima</i>	-	P	
Fraser's dolphin	<i>Lagenodelphis hosei</i>	-	U	
Humpback whale	<i>Megaptera novaeangliae</i>	¹	L	
Blainville's beaked whale	<i>Mesoplodon densirostris</i>	-	P	
Northern elephant seal	<i>Mirounga angustirostris</i>		U	
Hawaiian monk seal	<i>Neomonachus schauinslandi</i>	E	L	
Killer whale	<i>Orcinus orca</i>	-	P	
Melon-headed whale	<i>Peponocephala electra</i>	-	P	
Sperm whale	<i>Physeter macrocephalus</i>	E	P	
False killer whale	<i>Pseudorca crassidens</i>	E, Insular Hawaiian DPS	P	
Pantropical spotted dolphin	<i>Stenella attenuata</i>	-	P	
Striped dolphin	<i>S. coeruleoalba</i>	-	P	
Spinner dolphin	<i>S. longirostris</i>	-	L	
Rough-toothed dolphin	<i>Steno bredanensis</i>	-	P	
Bottlenose dolphin	<i>Tursiops truncatus</i>	-	P	
Cuvier's beaked whale	<i>Ziphius cavirostris</i>	-	P	
Birds				
Koloa maoli (Hawaiian duck)	<i>Anas wyvilliana</i>	E	L	
Nene (Hawaiian goose)	<i>Branta sandvicensis</i>	E	L	
`Alae ke`oke`o (Hawaiian coot)	<i>Fulica alai</i>	E	L	
`Alae `ula (Hawaiian common moorhen)	<i>Gallinula chloropus sandvicensis</i>	E	L	
Ae`o (Hawaiian black-necked stilt)	<i>Himantopus mexicanus knudseni</i>	E	L	
Band-rumped storm-petrel	<i>Oceanodroma castro</i>	Proposed E	P	
Short-tailed albatross	<i>Phoebastria albatrus</i>	E	U	
`Ua`u (Hawaiian petrel)	<i>Pterodroma phaeopygia sandwichensis</i>	E	P	
`A`o (Newell's Townsend's shearwater)	<i>Puffinus auricularis newelli</i>	T	P	
Sea Turtles				
Loggerhead turtle	<i>Caretta caretta</i>	E	P	
Green turtle	<i>Chelonia mydas</i>	T, Central	L	

Common Name	Scientific Name	Federal Listing Status	Likelihood of Occurrence at or near KTF	Critical Habitat Present?
		North Pacific DPS		
Leatherback turtle	<i>Dermochelys coriacea</i>	E	P	
Hawksbill turtle	<i>Eretmochelys imbricata</i>	E	L	
Olive ridley turtle	<i>Lepidochelys olivacea</i>	T	P	

Abbreviations: ESA = Endangered Species Act, E = federal endangered; T = federal threatened; L = Likely; P = Potential; U = Unlikely.

¹ The Hawai'i distinct population segment (DPS) is not listed under the ESA. The eastern north Pacific DPS is listed as endangered.

There is some evidence that eastern north Pacific DPS whales may winter in Hawai'i.

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 their nests or eggs at any time, unless permitted by regulation. The 2003 National Defense Authorization Act gave the Secretary of the Interior authority to prescribe regulations to exempt the Armed Forces from the incidental taking of migratory birds during authorized military readiness activities. The final rule authorizing the DoD to take migratory birds in such cases include a requirement that the Armed Forces must confer with the USFWS to develop and implement appropriate conservation measures to minimize or mitigate adverse effects of the proposed action if the action will have a significant negative effect on the sustainability of a population of a migratory bird species.

The Magnuson-Stevens Fishery Conservation and Management Act provides for the conservation and management of the fisheries. Under the Magnuson-Stevens Fishery Conservation and Management Act, essential fish habitat (EFH) consists of the waters and substrate needed by fish to spawn, breed, feed, or grow to maturity.

The Coastal Zone Management Act establishes a federal-state partnership to provide for the comprehensive management of coastal resources. Coastal states and territories develop management programs based on enforceable policies and mechanisms to balance resource protection and coastal development needs. Actions implemented on federal lands must ensure consistency with these plans and programs to the maximum extent practicable.

3.1.3.2 Region of Influence (ROI)

The following discussions provide a description of the existing conditions for each of the categories under biological resources at and near SNL/KTF, which is located on PMRF Main Base, Hawai'i. The ROI is the area within SNL/KTF boundaries and adjacent areas that may be affected by elevated sound levels, deposition of debris, hazardous chemicals, and increased human activity.

3.1.3.3 Vegetation at SNL/KTF

Vegetation includes terrestrial plant communities and constituent plant species. SNL/KTF is located in the northern portion of PMRF main base and is covered primarily with coastal dune vegetation. Naupaka, beach morning glory, and 'a'ali'i (*Dodonaea viscosa*) are common species at SNL/KTF (US Navy, 2008). PMRF also has areas of native scrub vegetation and coastal strand. In areas where natural vegetation has been disturbed within SNL/KTF, the habitat is managed by mowing (USASMDC/ARSTRAT, 2011). No threatened or endangered plants have been observed at SNL/KTF (USASMDC/ARSTRAT, 2011). Two ESA listed endangered plants have been observed north of PMRF, lau'ehu (*Panicum nihauense*) and ohai (*Sesbania tomentosa*; USASMDC/ARSTRAT, 2011). Critical habitat has been designated for these species and an area on the northwestern end of PMRF near Polihale Park is a portion of the critical habitat for the endangered ohai and

lau'ehu. In January 2002, the USFWS proposed additional critical habitat for the lau'ehu in the southern portion of PMRF (USASMDC/ARSTRAT, 2011). Although lau'ehu does not grow on PMRF/Main Base, the USFWS has determined that land on PMRF adjacent to Polihale State Park and dune areas along the southern portion of the range contain primary constituents necessary for the recovery of lau'ehu because not enough areas exist outside of PMRF (USASMDC/ARSTRAT, 2011).

3.1.3.4 Terrestrial Wildlife at SNL/KTF

Wildlife includes all animal species (i.e., insects and other invertebrates, fish, amphibians, reptiles, birds, and mammals) focusing on the species and habitat features of greatest importance or interest.

Mammals. The Hawaiian hoary bat (*Lasiurus cinereus semotus*) is the only strictly terrestrial special-status mammal species potentially found at SNL/KTF. This federally and Hawaiian state listed endangered species is the only land mammal endemic to Hawai'i. Hawaiian hoary bats generally occur in or near forest habitat, and apparently use native vegetation more frequently than non-native vegetation (USASMDC/ARSTRAT, 2011). Their diet consists of flying insects and Hawaiian hoary bats have been observed to forage over open fields, over open ocean near the mouths of river or stream outlets, and over streams and ponds (USASMDC/ARSTRAT, 2011). The current population size of Hawaiian hoary bats is unknown, but the greatest threats to populations are thought to be habitat loss, use of pesticides, and predation. This species has not been recorded at PMRF for over a decade and the abundance and distribution of this species in the area remains largely unknown (John Burger, personal communication, 20 February 2017). A group of four bats was observed foraging around the sewage treatment ponds, and another separate group of five bats was seen just offshore of northern PMRF (USASMDC/ARSTRAT, 2011).

Hawaiian monk seals (*Monachus schauinslandi*) are found on and near Kauai, especially in shallow waters within 12nm of the PMRF coastline. While these marine mammals do haul out on beaches and rock coastlines, the closest observed Hawaiian monk seal haul out area is approximately 1.6 km (1 mile) south of Launch Pad 42 (USASMDC/ARSTRAT, 2011). While critical habitat has been established for the Hawaiian Monk seal at Kauai and most other Hawaiian Islands, there is no designated critical habitat for this species at PMRF Main Base.

Birds. Birds on SNL/KTF include both resident and migratory bird species. Resident bird species include the red junglefowl (*Gallus gallus*), ring-necked pheasant (*Phasianus colchicus*), and northern mockingbird (*Mimus polyglottos*) (USASMDC/ARSTRAT, 2011). Migratory seabirds and shorebirds commonly observed at PMRF Main Base include brown boobies (*Sula leucogaster*), sanderlings (*Calidris alba*), wandering tattlers (*Tringa incana*), ruddy turnstones (*Arenaria interpres*), and Pacific golden plovers (*Pluvialis fulva*; USASMDC/ARSTRAT, 2011). Wedge-tailed shearwaters (*Puffinus pacificus*) nest in the Nohili dunes area and near the beach cottages (USASMDC/ARSTRAT, 2011). Laysan albatross also nest maintained disturbed areas at PMRF (USASMDC/ARSTRAT, 2011).

Nine species of ESA listed bird species occur or have the potential to occur at PMRF. While the endangered Hawaiian goose (*Branta sandvicensis*) is found on other areas of PMRF, the SNL/KTF area lacks suitable habitat for this species (USASMDC/ARSTRAT, 2011). Four endangered waterbirds, the Hawaiian coot (*Fulica alai*), Hawaiian black-necked stilt (*Himantopus mexicanus knudseni*), Hawaiian common moorhen (*Gallinula chloropus sandvicensis*), and Hawaiian duck (*Anas wyvilliana*) are potentially present or confirmed within or near the SNL/KTF area (USASMDC/ARSTRAT, 2011). The Hawaiian coot, black-necked stilt, and common moorhen are known to nest on the island of Kauai year-round (USASMDC/ARSTRAT, 2011). In March of 2000, an endangered juvenile short-tailed albatross (*Phoebastria albatrus*) was observed at PMRF, resting in the grass on the mountain side of the PMRF runway (USASMDC/ARSTRAT, 2011). While the band-rumped

storm petrel (*Oceanodroma castro*), Hawai'i petrel (*Pterodroma phaeopygia sandwichensis*), and Newell's Townsend's shearwater (*Puffinus auricularis newelli*) are not known to nest or roost at PMRF main base, they are known to fly over or near the area. Newell's shearwater breed only in the southeastern Hawaiian Islands where they nest in burrows on steep forested mountain slopes (Pyle and Pyle, 2009). Adults return to Hawai'i to breed in April and depart in leave in early fall (Pyle and Pyle 2009). In September 2016, PMRF instituted a "Dark Skies" program involving turning off all non-essential lighting on the base and modifying night time operations to prevent disorientation of sea birds during nocturnal flight.

No designated critical habitat for bird species is found at or near SNL/KTF.

Sea Turtles. Although five species of sea turtles potentially inhabit the nearshore and offshore area of Hawai'i, green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) turtles account for nearly all sightings in the area (Hanser et al. 2013). While sea turtle nesting at PMRF has been relatively rare, green sea turtles (*Chelonia mydas*) have regularly nested along the beachfront on PMRF in recent years. In 2015, at least 6 green sea turtle nests hatched successfully between July 18 and September 3, with a total of 468 hatchlings on PMRF (John Burger personal communication, 23 February 2017). No designated critical habitat for sea turtles is found at or near SNL/KTF.

3.1.3.5 Marine Vegetation at SNL/KTF

Common plants found in the rocky intertidal habitats offshore of PMRF include sea lettuce (*Ulva*), Sargasso or kala (*Sargassum*), coralline red algae (*Hydrolithon*), red fleshy algae (*Melanamansia*, *Pterocladia*, *Jania*), brown algae (*Padina*, *Turbinaria*, *Dictyota*), and fleshy green algae (*Neomeris*, *Halimeda*, and *Caulerpa*; US Navy, 2008). Algal species on the limestone bench fronting Nohili Point preferred by the green turtle include but are not limited to lipuupuu (*Dictyospheria versluysii*), kala-laununui (*Sargassum echinocarpum*), pahalahaha (*Ulva fasciatus*), and mane'one'o (*Laurencia nidifica*; US Navy, 2008). The algal and macroinvertebrate survey in Majors Bay noted that four macroalgal and eight macroinvertebrate species were present (US Navy, 2008). No special-status marine vegetation is located near SNL/KTF.

3.1.3.6 Marine Wildlife at SNL/KTF

Offshore areas near PMRF include a narrow fringing reef follows the coastline up to Nohili Point and Barking Sands (US Navy, 2008). Coral density is low in this area and is dominated by lobe coral (*Porites lobata*) and small stands of arborescent (branched or tree shaped) corals (US Navy, 2008). Broad uncolonized pavement (1,772 feet [ft] wide) and colonized pavement (2,297 ft wide) stretch along the coastline seaward of the fringing reef (US Navy, 2008). Uncolonized pavement is flat, low relief, solid carbonate rock often covered by a thin sand veneer. The surface of the pavement often has sparse coverage of macroalgae, hard coral, and other sessile invertebrates that does not obscure the underlying surface. Colonized pavement is flat, low-relief, solid carbonate rock with coverage of macroalgae, hard coral, and other sessile invertebrates that are dense enough to begin to obscure the underlying surface (US Navy, 2008). No designated critical habitat for any marine species is found on or near KTF.

Marine Mammals. Of the 26 species of marine mammals with the potential to occur near PMRF, the Hawaiian monk seal, humpback whale (*Megaptera noveangliae*), and spinner dolphin (*Stenella longirostris*) are the most likely species to be observed within 12 nm of the PMRF coastline. The endangered Hawaiian monk seal is an indigenous mammal that has been observed at PMRF. The primary occurrence of Hawaiian monk seals within the area is expected to be in a continuous band between Nihoa, Kaula, Niihau, and Kauai (US Navy, 2008). This band extends from the shore to around 273 fathoms and is based on the large number of sightings and births recorded in this area (US Navy, 2008). Hawaiian monk seals (*Monachus schauinslandi*) are found on and near Kauai, especially in shallow waters within 12 nm of the PMRF coastline. While critical

habitat has been established for the Hawaiian Monk seal at Kauai and most other Hawaiian Islands, there is no designated critical habitat for this species offshore of PMRF Main Base.

Spinner dolphins (*Stenella longirostris*) are the most commonly recorded cetaceans observed within 12 nm of the PMRF coastline. The spinner dolphin inhabits bays and protected waters, often in waters less than 40 ft deep (US Navy, 2008). Spinner dolphins are expected to occur in shallow water resting areas (about 162 ft deep or less) throughout the middle of the day, moving into deep waters offshore during the night to feed (US Navy, 2008).

The humpback whale peak abundance around the Hawaiian Islands is from late February through early April (US Navy, 2011). During the fall-winter period, primary occurrence is expected from the coast to 50 nm offshore, including the areas off PMRF (US Navy, 2008). There is some ambiguity as to which DPS the whales near Hawai'i belong. The Hawai'i DPS of humpback whales is not listed under the ESA. This DPS includes whales which remain near Hawaiian waters throughout the year. There are also humpback whales which winter in Hawaiian waters and migrate north to summer feeding grounds. These whales likely belong to the eastern north Pacific DPS (Muto et al., 2015) which also not listed under the ESA.

NOAA Fisheries maintains jurisdiction over marine mammals in the ROI.

Sea Turtles. Of the five sea turtle species that have the potential to occur near PMRF, Green and hawksbill turtles are the most common sea turtles in offshore waters around the Main Hawaiian Islands, as they prefer reef-type environments that are less than about 55 fathoms in depth (HRC, 2011). Green turtles have been observed offshore of Nohili Ditch, the only area where basking/haul-out activity on PMRF/Main Base is observed (US Navy, 2008). The PMRF Natural Resources Manager monitors sea turtle activity at PMRF. Security patrol reports include a record of the presence and locations of turtles. Any records of green turtle observation are maintained by the PMRF Environmental Office. The USFWS and NOAA Fisheries share federal jurisdiction for sea turtles with the USFWS having lead responsibility on the nesting beaches and NOAA Fisheries, the marine environment.

Fish. Fish are vital components of the marine ecosystem. They have great ecological and economic aspects. To protect this resource, NOAA Fisheries works with the regional fishery management councils to identify the essential habitat for every life stage of each federally managed species using the best available scientific information. Essential fish habitat (EFH) has been described for approximately 1,000 managed species to date. EFH includes all types of aquatic habitat including wetlands, coral reefs, seagrasses, and rivers; all locations where fish spawn, breed, feed, or grow to maturity.

Essential Fish Habitat. The Magnuson-Stevens Fishery Conservation Management Act (MSA) of 1976 mandates identification and conservation of EFH to help maintain productive fisheries and rebuild depleted fish stocks. All federal agencies whose work may affect fish habitats must assess potential project effects on EFH. Under the MSA, EFH is defined as "those waters and substrate necessary to fish for spawning, breeding or growth to maturity." An EFH may include US waters within exclusive economic zones (EEZ; seaward boundary out to a distance of 200 nm) and covers all fish species within in a fishery management unit (50 CFR §600.805). Under the MSA, an adverse effect means any impact that reduces quality and/or quantity of EFH (50 CFR §600.810). Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH (50 CFR §600.810).

The Western Pacific Regional Fishery Management Council (WPRFMC) has authority over the fisheries and EFH designation in and surrounding the State of Hawai'i, the Territory of American Samoa, the Territory of

Guam, the Commonwealth of the Northern Mariana Islands, and the US Pacific Remote Island Areas (Baker Island, Howland Island, Jarvis Island, Johnston Atoll, Kingman Reef, Wake Island, Palmyra Atoll, and Midway Atoll; Figure 3-1). The flight path for FE-1 crosses over waters designated as EFH near the Hawaiian Islands. Therefore the effects of the Proposed Action on EFH near the Hawaiian Islands are evaluated in this section of the EA/OEA. The effects of the Proposed Action on EFH near Johnson Atoll are discussed in section 3.2.2.

The WPRFMC developed EFH designations for Bottomfish and Seamount Groundfish, Crustaceans, and Precious Corals (approved by the Secretary of Commerce on February 3, 1999; 64 FR 19068) as well as for Coral Reef Ecosystem Management Unit Species (MUS; approved by the Secretary of Commerce on June 14, 2002; 69 FR 8336) (WPRFMC, 2009b). The EFH for these species management units which are summarized here are discussed in detail by WPRFMC in the Fishery Ecosystem Plan for the Hawai'i Archipelago (WPRFMC, 2009a), the Fishery Ecosystem Plan for the Pacific Remote Island Area (WPRFMC, 2009b), and the Fishery Ecosystem Plan for Pacific Pelagic Fisheries of the Western Pacific Region (WPRFMC, 2005). EFH in the Action Area is summarized in Table 3-3 and discussed below.

In addition to EFH, the WPRFMC (2009b) has identified habitat areas of particular concern (HAPCs) within the EFH for certain MUS. The HAPCs are specific areas within EFH that are essential to the life cycle of important coral reef species (WPRFMC, 2009b). These HAPCs must meet one of the following criteria: a) the ecological function provided by the habitat is important; b) the habitat is sensitive to human-induced environmental degradation, c) development activities are, or will be, stressing the habitat type; or d) the habitat type is rare (WPRFMC, 2009b). HAPCs within the Action Area are summarized in Table 3-3 and discussed below.

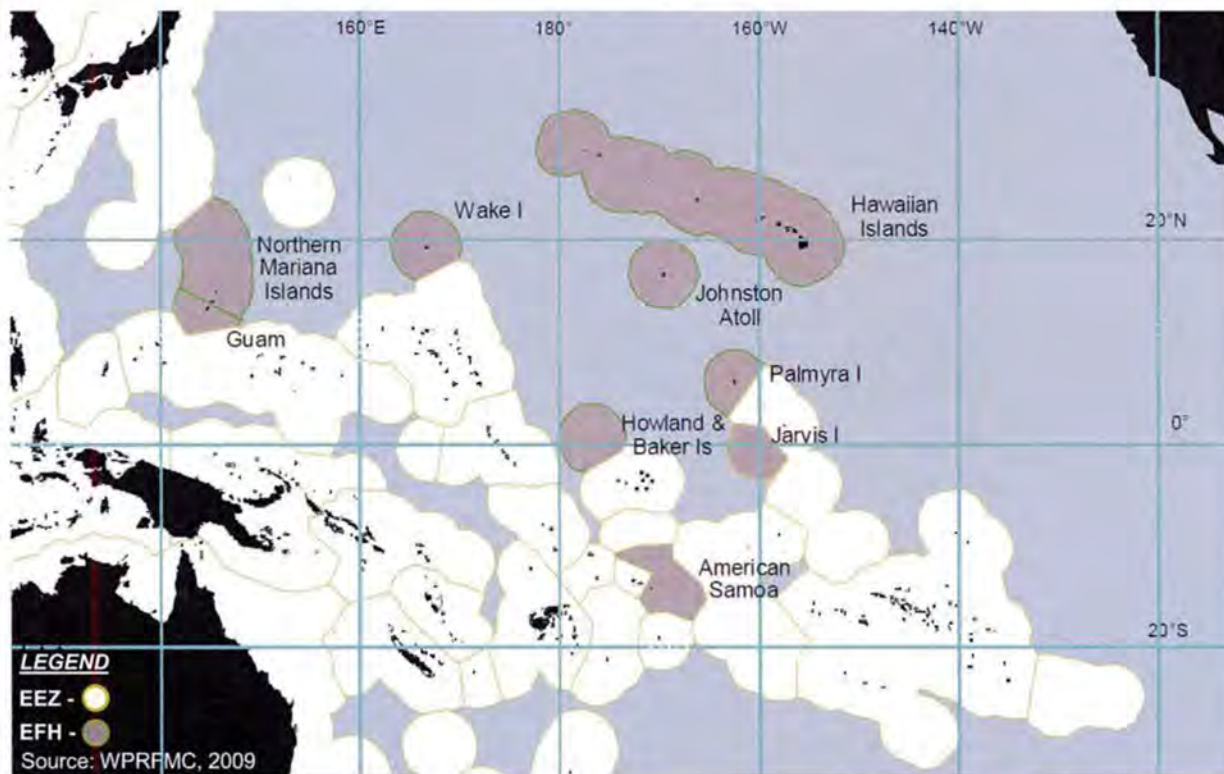


Figure 3-1 Exclusive Economic Zones and Extent of Essential Fish Habitat in the Western Pacific Region

Table 3-3 Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC) for Hawaiian Archipelago Management Unit Species ¹

Resource	Species Complex	EFH	HAPC
Bottomfish and Seamount Groundfish	Shallow-water species (0–50 fm): uku (<i>Aprion virescens</i>), thicklip trevally (<i>Pseudocaranx dentex</i>), black trevally (<i>Caranx lugubris</i>), amberjack (<i>Seriola dumerili</i>), taape (<i>Lutjanus kasmira</i>)	Eggs and larvae: the water column extending from the shoreline to the outer limit of the EEZ down to a depth of 400 m (200 fm). Juvenile/adults: the water column and all bottom habitat extending from the shoreline to a depth of 400 m (200 fm)	All slopes and escarpments between 40–280 m (20 and 140 fm) Three known areas of juvenile opakapaka habitat: two off Oahu and one off Molokai
Bottomfish and Seamount Groundfish	Deep-water species (50–200 fm): ehu (<i>Etelis carbunculus</i>), onaga (<i>Etelis coruscans</i>), opakapaka (<i>Pristipomoides filamentosus</i>), yellowtail kalekale (<i>P. auricilla</i>), , kalekale (<i>P. sieboldii</i>), gindai (<i>P. zonatus</i>), hapuupuu (<i>Epinephelus quernus</i>), lehi (<i>Aphareus rutilans</i>)	Eggs and larvae: the water column extending from the shoreline to the outer limit of the EEZ down to a depth of 400 m (200 fm) Juvenile/adults: the water column and all bottom habitat extending from the shoreline to a depth of 400 meters (200 fm)	All slopes and escarpments between 40–280 m (20 and 140 fm) Three known areas of juvenile opakapaka habitat: two off Oahu and one off Molokai
Bottomfish and Seamount Groundfish	Seamount groundfish species (50–200 fm): armorhead (<i>Pseudopentaceros richardsoni</i>), ratfish/butterfish (<i>Hyperoglyphe japonica</i>), alfonsin (<i>Beryx splendens</i>)	Eggs and larvae: the (epipelagic zone) water column down to a depth of 200 m (100 fm) of all EEZ waters bounded by latitude 29°–35° Juvenile/adults: all EEZ waters and bottom habitat bounded by latitude 29°–35° N and longitude 171° E–179° W between 200 and 600 m (100 and 300 fm)	No HAPC designated for seamount groundfish
Crustaceans	Spiny and slipper lobster complex: Hawaiian spiny lobster (<i>Panulirus marginatus</i>), spiny lobster (<i>P. penicillatus</i> , <i>P. spp.</i>), ridgeback slipper lobster (<i>Scyllarides haanii</i>), Chinese slipper lobster (<i>Parribacus antarcticus</i>) Kona crab: Kona crab (<i>Ranina ranina</i>)	Eggs and larvae: the water column from the shoreline to the outer limit of the EEZ down to a depth of 150 m (75 fm) Juvenile/adults: all of the bottom habitat from the shoreline to a depth of 100 m (50 fm)	All banks with summits less than or equal to 30 m (15 fathoms) from the surface
Crustaceans	Deepwater shrimp (<i>Heterocarpus</i> spp.)	Eggs and larvae: the water column and associated	No HAPC designated for deepwater shrimp.

Resource	Species Complex	EFH	HAPC
		outer reef slopes between 550 and 700 m Juvenile/adults: the outer reef slopes at depths between 300-700 m	
Precious Corals	Deep-water precious corals (150–750 fm): Pink coral (<i>Corallium secundum</i>), red coral (<i>C. regale</i>), pink coral (<i>C. laauense</i>), midway deepsea coral (<i>C. spp. nov.</i>), gold coral (<i>Gerardia sp.</i>), gold coral (<i>Callogorgia gilberti</i>), gold coral (<i>Narella spp.</i>), gold coral (<i>Calyptrophora spp.</i>), bamboo coral (<i>Lepidisis olapa</i>), bamboo coral (<i>Acanella spp.</i>) Shallow-water precious corals (10-50 fm): black coral (<i>Antipathes griggi</i>), black coral (<i>Antipathis grandis</i>), black coral (<i>Myriopathes ulex</i>)	EFH for Precious Corals is confined to six known precious coral beds located off Keahole Point, Makapuu, Kaena Point, Wespac bed, Brooks Bank, and 180 Fathom Bank EFH has also been designated for three beds known for black corals in the Main Hawaiian Islands between Milolii and South Point on the Big Island, the Auau Channel, and the southern border of Kauai	Includes the Makapuu bed, Wespac bed, Brooks Banks bed For Black Corals, the Auau Channel has been identified as a HAPC
Coral Reef Ecosystems	All Currently Harvested Coral Reef Taxa All Potentially Harvested Coral Reef Taxa	EFH for the Coral Reef Ecosystem Management Unit Species (MUS) includes the water column and all benthic substrate to a depth of 50 fathoms (fm) from the shoreline to the outer limit of the EEZ	Includes all no-take MPAs identified in the CRE-FMP, all Pacific remote islands, as well as numerous existing MPAs, research sites, and coral reef habitats throughout the western Pacific

¹ Source: WPRFMC 2009a, Table 34.

Bottomfish and Seamount Groundfish. Very little is known about the life histories, habitat utilization, diet, or reproductive behavior of most adult and juvenile bottomfish and seamount groundfish species (WPRFMC, 2009a).

Bottomfish MUS in the Western Pacific Region are found concentrated on steep slopes of deepwater banks near the 100-fathom isobath (WPRFMC, 2009a). Adult bottomfish are generally found in habitats with hard substrate with high structural complexity (WPRFMC, 2009a). Due to a lack of data on productivity of bottomfish in different habitats and the fishes utilization of these habitats, the WPRFMC has designated EFH for adult and juvenile bottomfish as the water column and all bottom habitat extending from the shoreline to a depth of 400 m (1,312 ft) encompassing the steep drop-offs and high-relief habitats that are important for bottomfish in the Western Pacific Region (WPRFMC, 2009a).

Eggs and larva of bottomfish MUS are pelagic and therefore subject to ocean currents (WPRFMC, 2009a). Since little is known about the distribution of egg and larval life stages, the WPRFMC has designated EFH for

egg and larval bottomfish as the water column extending from the shoreline to the outer boundary of the EEZ to a depth of 400 m (1,312 ft) throughout the Western Pacific Region (WPRFMC, 2009a).

The WPRFMC (2009a) designated EFH for adult seamount groundfish MUS as all waters and bottom habitat bounded by latitude 29°-35° N and longitude 171° E-179° W between 80 and 600 m (262 and 1,969 ft). For seamount groundfish eggs, larvae, and juveniles, designated EFH includes the epipelagic zone (200 m in depth) of all waters bounded by latitude 29°-35° N and longitude 171° E-179° W (WPRFMC 2009a). All escarpments/slopes between 40-280 m throughout the Western Pacific Region are designated as HAPCs for bottomfish (WPRFMC 2009a).

Crustaceans. The WPRFMC (2009a) has designated EFH for two crustacean species assemblages; a spiny lobster, slipper lobster, and kona crab complex and a shrimp complex.

Spiny lobsters of the genus *Panulirus* are found throughout the Western Pacific Region including 13 species distributed in tropical and subtropical Pacific waters, 3 species which are absent from many island nations, and the Hawaiian spiny lobster (*P. marginatus*) which is endemic to Hawai'i and Johnston Atoll (WPRFMC 2009b). The slipper lobsters belong to a closely related family, Scyllaridae (WPRFMC, 2009a).

In Hawai'i, spiny lobsters are typically found in crevices and under rocks in well protected, rocky areas (WPRFMC, 2009a). The EFH for adult and juvenile spiny lobster is designated at the bottom habitat from the shoreline to a depth of 100 m (328 ft) throughout the Western Pacific Region (WPRFMC, 2009a).

Little is known about spiny lobster egg production or larval settlement, however, the WPRFMC (2009b) has designated EFH for spiny lobster larvae as the water column from the shoreline to the outer limit of the EEZ down to a depth of 150 m (492 ft) throughout the Western Pacific Region (WPRFMC, 2009a).

The EFH for deepwater shrimp eggs and larvae is designated at the water column and associated outer reef slopes between 550 and 700 m (1,640 and 2,267 ft) and the EFH for juveniles and adults is designated as the outer reef slopes at depth between 300 and 700 m (984 and 2,267 ft; WPRFMC, 2009a).

Precious Corals. Precious corals are divided into deep- and shallow-water species complexes (WPRFMC, 2009b). Deep-water species such as pin coral (*Corallium secundum*), gold coral (*Gerardi* sp. and *Parazoanthus* sp.), and bamboo coral (*Lepidistis olapa*), are generally found between 350 and 1,500 m (1,148 and 4,921 ft) deep (WPRFMC, 2009a). Shallow-water species include three species of black coral (*Antipathes griggi*, *A. grandis*, and *Myriopathes ulex*, which occur between 30 and 100 m (98 and 328 ft) deep (WPRFMC, 2009b). These corals are non-reef building and are found on solid substrate in areas with moderate to strong bottom currents which keep the area swept free of accumulated sediments which would prevent settlement of new larvae (WPRFMC, 2009b). In the Hawaiian Islands, large beds of pink, gold, and bamboo corals are found in deep interisland channels in the Hawaiian Islands and the WPRFMC (2009b) has designated six known beds of precious corals as EFH. These beds are found at Keahole Point, Makapuu, Kaena Point, Wespac, Brooks Bank, and 180 Fathom Bank. Black corals are typically found under vertical drop-offs where they host unique communities of marine life including crustaceans, bivalves, and fish (WPRFMC, 2009a). The EFH and HPAC designations for these precious corals are detailed in Table 3-3.

Coral Reef Ecosystems. For coral reef ecosystem MUS, the WPRFMC (2009a) has designated EFH based on habitat, including sand, live coral, seagrass beds, mangrove, and open ocean, for each life history stage where EFH is consistent with the depth of the ecosystem to 91 m (300 ft) and out to the limit of the EEZ. Since little data are available concerning life history, habitat utilization, food habits, and spawning behavior of most coral reef associated species, these species are farther divided into currently harvested coral reef taxa MUS and potentially harvested coral reef taxa MUS (WPRFMC, 2009ba).

Detailed information concerning species assemblages for these MUS and known habitat usage for adults, spawners, juveniles, larvae, and eggs are available in the Fishery Ecosystem Plan for the Hawai'i Archipelago (WPRFMC, 2009a). Currently harvested coral reef taxa MUS include certain species of surgeonfish and unicornfish (Acanthuridae), triggerfish (Balistidae), jacks (Carangidae), reef sharks (Carcharhinidae), soldierfish and squirrelfish (Holocentridae), flagtails (Kuhliidae), rudderfish (Kyphosidae), wrasses (Labridae), goatfish (Mullidae), octopuses (Octopodidae), mullets (Mugilidae), moray eels (Muraenidae), threadfins (Polynemidae), bigeyes (Priacanthidae), parrotfishes (Scaridae), barracudas (Sphyraenidae), surgeonfishes (Acanthuridae), the Moorish idol (Zanclidae), the dragon moray (Muraenidae), hawkfishes (Cirrhitidae), butterflyfishes (Chaetodontidae), damselfishes (Pomacentridae), and feather-duster worms (Sabellidae; see WPRFMC 2009a Table 30 for detailed species list). Potentially harvested coral reef taxa MUS include species in over 36 families of ray-finned fish, 5 families of sharks and rays, stony corals, azooxanthellate corals, mushroom corals (Fungiidae), soft corals, anemones, zooanthids, sponges, hydrozoans, lace corals (Stylasteridae), hydroid fans (Solanderidae), bryozoans, tunicates, feather worms (Sabellidae), echinoderms, sea snails (Gastropoda), sea slugs (Opisthobranchs), giant clams (Tridacnidae) Trochus, sea slugs (Opisthobranchs) black lipped pearl oyster (*Pinctada margaritifera*) and other bivalves, cephalopods, octopuses, lobsters, shrimp, crabs, annelid worms, and algae species (see WPRFMC 2009a Table 32 for details). While the EFH differs slightly for some species assemblages/complexes, taken together, the EFH for all life stages of both currently harvested coral reef taxa MUS and potentially harvested coral reef taxa MUS encompasses the water column and bottom habitat from the shoreline to the outer boundary of the EEZ to a depth of 50 fathoms (WPRFMC, 2009a).

Coral. Corals are invertebrates that are related to anemones, jellyfish, and hydras. They are made of invertebrate polyps and can generally be categorized as either hard or soft. Hard corals have calcium carbonate skeletons, grow in colonies, and are reef-building animals that live in symbiosis with phytoplankton called zooxanthellae. Soft corals are flexible, have calcareous particles in their body walls for structural support, can be found in both tropical and cold ocean waters, do not grow in colonies or build reefs, and do not always contain zooxanthellae.

Total coral cover in the Nohili Sector north of PMRF Main Base ranges from 32% to 39% of bottom cover (US Navy, 2008). The most abundant coral species are lobe coral, rose or cauliflower coral (*Pocillopora meandrina*), and ringed rice coral (*Montipora patula*). Along the central portion of PMRF, living coral is sparsely distributed, approximately one half of that found in the Nohili area (US Navy, 2008). The dominant species is lobe coral. Coral cover further south in the Major's Bay Sector is less than 2% (US Navy, 2008). Further offshore, the predominant coral is antler coral (*Pocillopora eydouxi*), which occurs as single large branching colonies (US Navy, 2008). Other corals found in this area are primarily smaller species which have a collective coverage of about 5% of bottom cover: rose or cauliflower coral, lobe coral, corrugated coral (*Pavona varians*), flat lobe coral (*P. duerdeni*), blue rice coral (*Montipora flabellata*), ringed rice coral, Verrill's ringed rice coral (*M. verrilli*), rice coral (*M. capitata*), crust coral (*Leptastrea purpurea*), and mushroom coral (*Fungia scutaria*; US Navy, 2008).

No known special-status coral are found in the ROI near KTF.

Non-coral Invertebrates. Animals that live on the sea floor are called benthos. Most of these animals lack a backbone and are called invertebrates. Typical benthic invertebrates found near PMRF include sea anemones, sponges, corals, sea stars, sea urchins, worms, bivalves, crabs, and many more (US Navy, 2008). Common animals found in rocky intertidal habitats include limpets, periwinkles, littorine snails, rock crabs, gastropods, and rock urchins (USASMDC/ARSTRAT, 2011). Further offshore in coral reef habitats, macroinvertebrates include the rock oyster (*Spondylus tenebrosus*), cone shells (*Conus* spp.), sea urchins

(*Echinometra mathaei*), and sea cucumbers (*Holothuria atra*; US Navy, 2008). No known special-status invertebrates are found in the ROI near KTF.

3.1.4 Airspace

This discussion of airspace includes current uses and controls of the airspace. The Federal Aviation Administration (FAA) manages all airspace within the United States and the US territories. Airspace, which is defined in vertical and horizontal dimensions and also by time, is considered to be a finite resource that must be managed for the benefit of all aviation sectors including commercial, general, and military aviation.

3.1.4.1 **Regulatory Setting**

Airspace, or that space which lies above a nation and comes under its jurisdiction, is generally viewed as being unlimited. However, it is a finite resource that can be defined vertically and horizontally, as well as temporally, when describing its use for aviation purposes. The time dimension is a very important factor in airspace management and air traffic control.

Under Public Law (PL) 85-725, Federal Aviation Act of 1958, the Federal Aviation Administration (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 US 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."

Specific aviation and airspace management procedures and policies to be used by the Navy are provided by OPNAVINST 3710.7, *Naval Aviation Training and Operating Procedure Standardization*. Other applicable regulations regarding special use airspace management include FAA Order 7490, "*Policies and Procedures for Air Traffic Environmental Actions*;" FAA Order 7610.4H, "*Special Military Operations*;" and the Memorandum of Understanding Between the Federal Aviation Administration and the Department of the Defense Concerning Special Use Airspace Environmental Actions (January 26, 1998).

3.1.4.2 **Region of Influence (ROI)**

The affected airspace use environment in the PMRF/KTF ROI is described below in terms of its principal attributes: controlled and uncontrolled airspace, special use airspace, en route airways and jet routes, airports and airfields, and air traffic control. There are no military training routes in the ROI.

The ROI for airspace includes the airspace over and surrounding the islands of Kauai and Niihau. Figure 3-2 shows a view of the airspace within the PMRF/Main Base ROI, including the PMRF Aircraft Operational Areas, the R-3101 Restricted Area, and surrounding airspace off the western and northwestern coast of Kauai.

The affected airspace use environment in the PMRF/KTF ROI is described below in terms of its principal attributes: controlled and uncontrolled airspace, special use airspace, en route airways and jet routes, airports and airfields, and air traffic control. There are no military training routes in the ROI.

Controlled and Uncontrolled Airspace

The airspace outside the special use airspace identified below is essentially international airspace controlled by the Honolulu Control Facility and Oakland Air Route Traffic Control Center (ARTCC). Class D airspace (generally that airspace surrounding those airports that have an operational control tower) surrounds the PMRF/Main Base airfield with a ceiling of 2,500 ft (762 m). It is surrounded to the north, south, and east by

Class D airspace with a floor 700 ft (713 m) above the surface (Figure 3-2). Lihue Airport, located approximately 15 nm (27.8 km) east of PMRF, includes Class D, surface Class E (controlled airspace not in the other classes), and additional Class E airspace with a floor 700 ft (713 m) above the surface. There is no Class B (US terminal control areas) airspace (which usually surrounds the nation's busiest airports) or Class C (operational control tower and radar approach control) airspace in the ROI.

Special Use Airspace

A restricted area is airspace designated under Part 73 within which the flight of aircraft, while not wholly prohibited, is subject to restriction. A warning area is airspace of defined dimensions, extending from 3 nm outward from the coast of the United States that contains activity that may be hazardous to nonparticipating aircraft. The purpose of such warning areas is to warn nonparticipating pilots of the potential danger. A warning area may be located over domestic or international waters or both. (14 CFR Title 14 Part 1.1, 2006)

The special use airspace in the ROI (Figure 3-3) consists of Restricted Area R-3101, which lies immediately above PMRF/Main Base and to the west of Kauai, portions of Warning Area W-188 north of Kauai, and Warning Area W-186 southwest of Kauai, all controlled by PMRF. Restricted Area R-3107 over Kaula, a small uninhabited rocky islet 19 nm southwest of Niihau that is used for fixed- and rotary-wing aircraft gunnery practice, and which lies within the W-187 Warning Area, is also special use airspace within the ROI.

Restricted Area R-3107 and Warning Area W-187 are scheduled through the Navy Fleet and Area Control and Surveillance Facility Pearl Harbor (FACSFACPH). PMRF and FACSFACPH each coordinate with the FAA Honolulu Control Facility regarding special use airspace. The Honolulu Control Facility is the location in which the ARTCC, the Honolulu control tower, and the Combined Radar Approach Control are collocated.

Table 3-5 lists the affected Restricted Areas and Warning Areas and their effective altitudes, times used, and their manager or scheduler. There are no Prohibited or Alert special use airspace areas in the PMRF airspace use ROI.

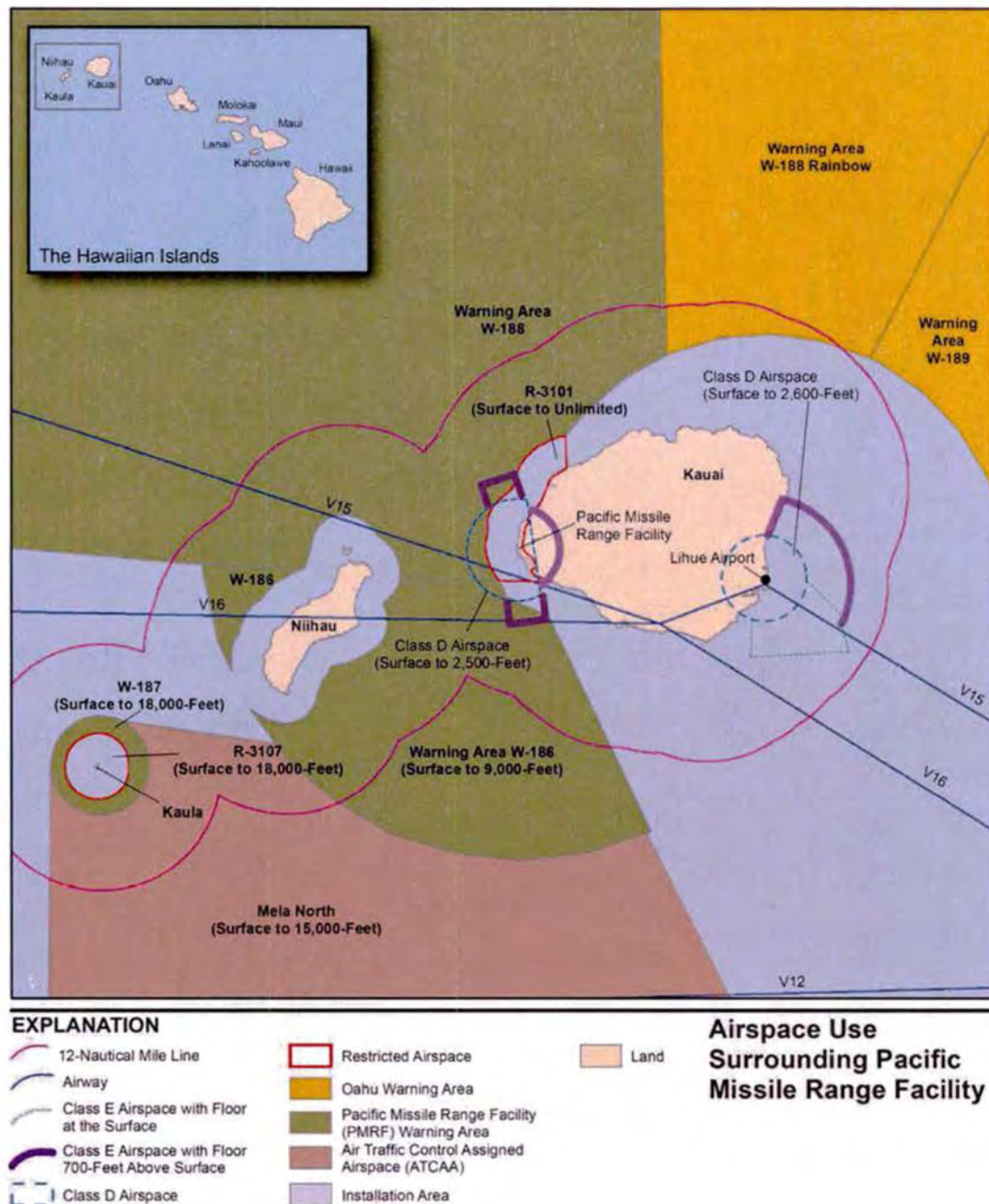
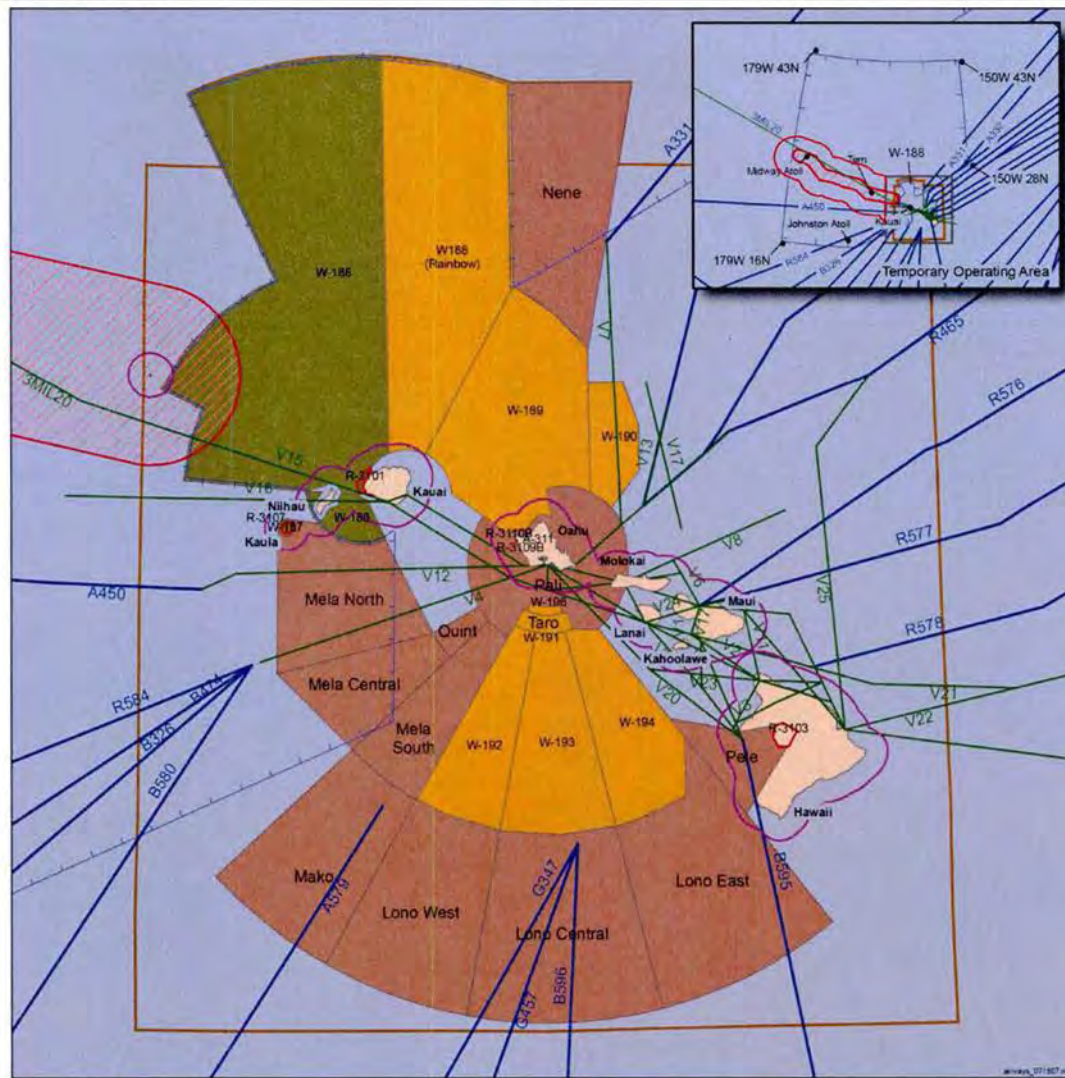


Figure 3-2 Airspace Use Surrounding Pacific Missile Range Facility

**EXPLANATION**

- Air Traffic Services (ATS) Route
- Oceanic Route
- Temporary Operating Area (TOA)
- Hawaii Operating Area (OPAREA)
- Restricted Airspace

- Papahānaumokuākea National Marine Monument and Expansion
- Air Traffic Control Assigned Airspace (ATCAA)
- Oahu Warning Area
- Pacific Missile Range Facility (PMRF) Warning Area

Airways and Special Use Airspace

Land



NORTH

0 50 100 200 Nautical Miles

Source: US Navy, 2008. Note: Area of Papahānaumokuākea Marine National Monument was expanded in August 2016.

Figure 3-3 Airways and Special Use Airspace

Table 3-4 Special Use Airspace in the PMRF/Main Base Airspace Use Region of Influence (ROI)

Number	Location	Altitude	Time of Use		Controlling Airspace
			Days	Hours	
R-3101	PMRF	To Unlimited	M-F	0600-1800	PMRF
W-186	Southwest of PMRF	To 9,000	Continuous	Continuous	PMRF
W-188	Northwest of PMRF	To Unlimited	Continuous	Continuous	PMRF/HCF

Source: AHW Program EA, 2011. Notes: R=Restricted; W=Warning; PMRF = Pacific Missile Range Facility; HCF = Honolulu Combined Facility, the location in which the Air Route Traffic Control Center (ARTCC), the Honolulu control tower, and the Combined Radar Approach Control are co-located.

Other types of airspace, and special airspace use procedures used by the military to meet its particular needs, include Air Traffic Control Assigned Airspace (ATCAA) and Altitude Reservation (ALTRV) procedures: (1) ATCAA, or airspace of defined vertical and lateral limits, is assigned by air traffic control to provide air traffic segregation between specified activities being conducted within the assigned airspace and other instrument flight rules (IFR) air traffic. ATCAAs are usually established in conjunction with Military Operations Areas, and serve as an extension of Military Operations Area airspace to the higher altitudes required. These airspace areas support high altitude operations such as intercepts, certain flight test operations, and air refueling operations; (2) ALTRV Procedures are used as authorized by the Central Altitude Reservation Function, an air traffic service facility, or appropriate ARTCC, under certain circumstances, for airspace utilization under prescribed conditions. An ALTRV receives special handling from FAA facilities. According to FAA Handbook 7610.4H, Chapter 3, ALTRVs are classified as either moving or stationary, with the latter normally defining the fixed airspace area to be occupied as well as the specific altitude(s) and time period(s) the area will be in use. ALTRVs may encompass certain rocket and missile activities and other special operations as may be authorized by FAA approval procedures.

To ensure safe operations, PMRF requests use of specific areas of airspace from the FAA during missile defense testing. The FAA issues a NOTAM to avoid specific areas of airspace until testing is complete. The NOTAM System is a telecommunication system designed to distribute unanticipated or temporary changes in the National Airspace System or until aeronautical charts and other publications can be amended. This information is distributed in the Notice to Airmen Publication.

To further ensure aircraft safety, if aircraft are seen in an impact area, safety regulations dictate that hazardous activities will be suspended when it is known that any non-participating aircraft has entered any part of the danger zone until the non-participating entrant has left the area or a thorough check of the suspected area has been performed. Models run sequentially or in parallel are designed to compute risks based on estimating both the probabilities and consequences of launch failures as a function of time into the mission. Databases include data on mission profile, launch vehicle specifics, local weather conditions, and the surrounding population distribution. Given a mission profile, the risks would vary in time and space. Therefore, a launch trajectory optimization is performed by the range for each proposed launch, subject to risk minimization and mission objectives constraints. The debris impact probabilities and lethality are then

estimated for each launch considering the geographic setting, normal jettisons, failure debris, and demographic data to define destruct lines to confine and/or minimize the potential risk of injury to humans or property damage.

En Route Airways and Jet Routes

Although relatively remote from the majority of jet routes that crisscross the Pacific, the airspace use ROI has two IFR en route low altitude airways used by commercial air traffic that pass through the ROI: V15, which passes east to west through the southernmost part of Warning Area W-188, and V16, which passes east to west through the northern part of Warning Area W-186 and over Niihau (Figure 3-2). An accounting of the number of flights using each airway is not maintained.

The airspace use ROI, located to the west, northwest, and north of Kauai, is far removed from the low altitude airways carrying commercial traffic between Kauai and Oahu and the other Hawaiian islands, all of which lie to the southeast of Kauai. There is a high volume of island helicopter sightseeing flights along the Na Pali coastline and over the Waimea Canyon, inland and to the east of PMRF, particularly out of Port Allen near Hanapepe on Kauai's southern coastline and other tourist and resort towns on the island. However, these do not fly over PMRF or into Restricted Area R-3101 (National Aeronautical Charting Office, 2007).

Airports and Airfields

With the exception of the airfield at PMRF and the Kekaha airstrip approximately 5 km (3 mi) to the southeast of PMRF and 3 km (2 mi) northwest of Kekaha, there are no airfields or airports in the airspace use ROI. Lihue Airport is located 20 nm east of PMRF, outside the ROI. In addition to helicopter and fixed-wing aircraft landings associated with PMRF's mission, the PMRF airfield serves as a training facility for landings and takeoffs. The overall number of air operations was 13,395 for 2004. The 2009 air operations were estimated to be 25,486, an increase of about 90%. (US Department of the Navy, Engineering Field Activity Chesapeake, 2006)

Air Traffic Control

Use of the airspace by the FAA and PMRF is established by a Letter of Agreement between the two agencies. Under this agreement, PMRF is required to notify the FAA by 2:00 p.m. the day before range operations would infringe on the designated airspace. Range Control and the FAA are in direct real-time communication to ensure safety of all aircraft using the airways and jet routes and the special use airspace. Within the special use airspace, military activities in Warning Areas W-186 and W-188 are under PMRF control, and the PMRF Range Control Officer is solely authorized and responsible for administering range safety criteria, the surveillance and clearance of the range, and the issuance of range RED (no firing) and GREEN (clearance to fire) status (Pacific Missile Range Facility, Barking Sands, Hawai'i, 1991). Warning Area W-187 is scheduled through the FACSFACPH.

As Warning Areas are located in international airspace, the procedures of the International Civil Aviation Organization (ICAO), outlined in ICAO Document 444, Rules of the Air and Air Traffic Services, are followed. ICAO Document 444 is the equivalent air traffic control manual to FAA Handbook 7110.65, Air Traffic Control. The FAA acts as the US agent for aeronautical information to the ICAO, and air traffic in the ROI is managed by the Honolulu ARTCCs.

3.1.5 Noise

This discussion of noise includes the types or sources of noise and the associated sensitive receptors in the human environment. Noise in relation to biological resources and wildlife species is discussed in the Biological Resources section.

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air or water, and are sensed by the human ear. Sound is all around us. The perception and evaluation of sound involves three basic physical characteristics:

- Intensity – the acoustic energy, which is expressed in terms of sound pressure, in decibels (dB)
- Frequency – the number of cycles per second the air vibrates, in Hertz (Hz)
- Duration – the length of time the sound can be detected

Noise is defined as unwanted or annoying sound that interferes with or disrupts normal human activities. Although continuous and extended exposure to high noise levels (e.g., through occupational exposure) can cause hearing loss, the principal human response to noise is annoyance. The response of different individuals to similar noise events is diverse and is influenced by the type of noise, perceived importance of the noise, its appropriateness in the setting, time of day, type of activity during which the noise occurs, and sensitivity of the individual. While aircraft are not the only sources of noise in an urban or suburban environment, they are readily identified by their noise output and are given special attention in this EA/OEA.

Basics of Sound and A-weighted Sound Level

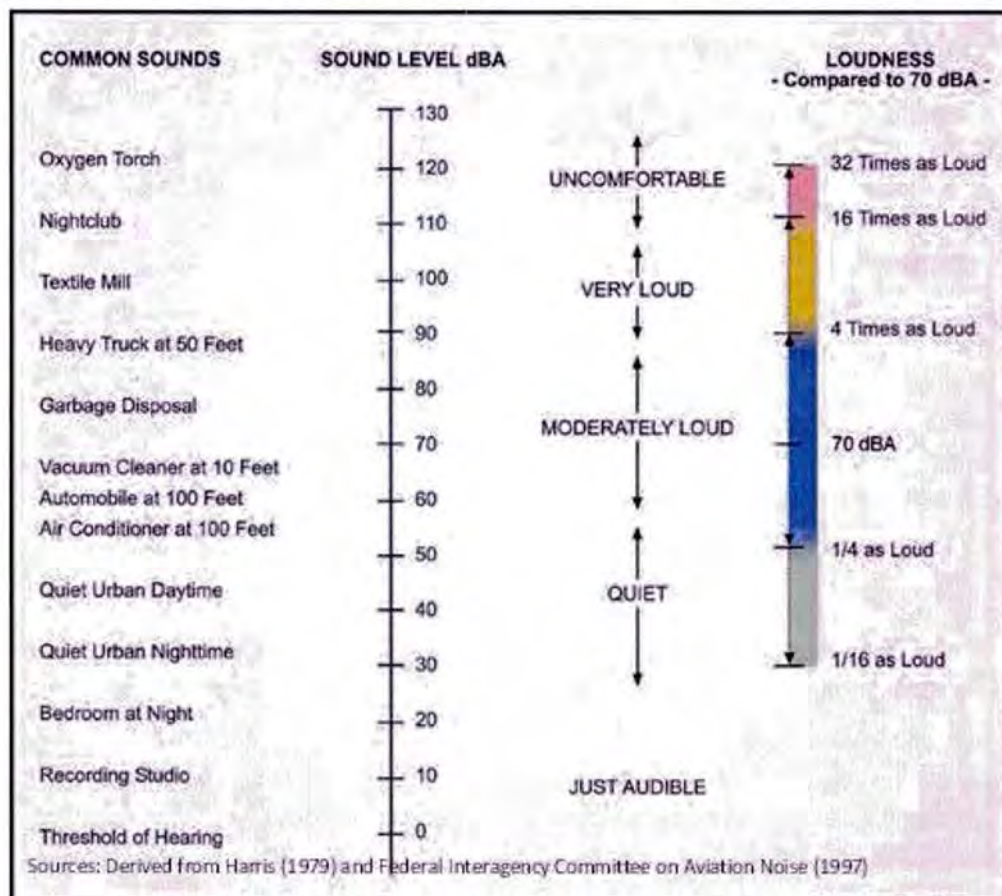
The loudest sounds that can be detected comfortably by the human ear have intensities that are a trillion times higher than those of sounds that can barely be detected. This vast range means that using a linear scale to represent sound intensity is not feasible. The dB is a logarithmic unit used to represent the intensity of a sound, also referred to as the sound level. All sounds have a spectral content, which means their magnitude or level changes with frequency, where frequency is measured in cycles per second or Hz. To mimic the human ear's non-linear sensitivity and perception of different frequencies of sound, the spectral content is weighted. For example, environmental noise measurements are usually on an "A-weighted" scale that filters out very low and very high frequencies in order to replicate human sensitivity. It is common to add the "A" to the measurement unit in order to identify that the measurement has been made with this filtering process (dBA). In this document, the dB unit refers to A-weighted sound levels. Table 3-5 provides a comparison of how the human ear perceives changes in loudness on the logarithmic scale.

Figure 3-4 provides a chart of A-weighted sound levels from typical noise sources. Some noise sources (e.g., air conditioner, vacuum cleaner) are continuous sounds that maintain a constant sound level for some period of time. Other sources (e.g., automobile, heavy truck) are the maximum sound produced during an event like a vehicle pass-by. Other sounds (e.g., urban daytime, urban nighttime) are averages taken over extended periods of time. A variety of noise metrics have been developed to describe noise over different time periods, as discussed below.

Table 3-5 Subjective Responses to Changes in A-Weighted Decibels

<i>Actual Change</i>	<i>Change in Perceived Loudness</i>
3 dB	Barely perceptible
5 dB	Quite noticeable
10 dB	Dramatic – twice or half as loud
20 dB	Striking – fourfold change

Noise levels from aircraft operations that exceed background noise levels at an airfield typically occur beneath main approach and departure corridors, in local air traffic patterns around the airfield, and in areas immediately adjacent to parking ramps and aircraft staging areas. As aircraft in flight gain altitude, their noise contributions drop to lower levels, often becoming indistinguishable from the background noise.

**Figure 3-4 A-Weighted Sound Levels from Typical Sources**

Noise Metrics

A metric is a system for measuring or quantifying a particular characteristic of a subject. Since noise is a complex physical phenomenon, different noise metrics help to quantify the noise environment. The noise metrics used in this EA/OEA are described in summary format below. While the Day-Night Average Sound Level (DNL) and Community Noise Equivalent Level (CNEL) noise metrics are the most commonly used tools

for analyzing noise generated at an airfield, the DoD has been developing additional metrics (and analysis techniques). These supplemental metrics and analysis tools provide more detailed noise exposure information for the decision process and improve the discussion regarding noise exposure. The DoD Noise Working Group product, *Improving Aviation Noise Planning, Analysis and Public Communication with Supplemental Metrics* (DoD Noise Working Group, 2009) was used to determine the appropriate metrics and analysis tools for this EA/OEA.

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). DNL values are average quantities, mathematically representing the continuous sound level that would be present if all of the variations in sound level that occur over a 24-hour period were averaged to have the same total sound energy. The DNL metric quantifies the total sound energy received and is therefore a cumulative measure, but it does not provide specific information on the number of noise events or the individual sound levels that occur during the 24-hour day. DNL is the standard noise metric used by the US Department of Housing and Urban Development, FAA, USEPA, and DoD. Studies of community annoyance in response to numerous types of environmental noise show that DNL correlates well with impact assessments; there is a consistent relationship between DNL and the level of annoyance. Most people are exposed to sound levels of 50 to 55 DNL or higher on a daily basis.

Research has indicated that about 87% of the population is not highly annoyed by outdoor sound levels below 65 dB DNL (Federal Interagency Committee on Urban Noise, 1980). Therefore, the 65 dB DNL noise contour is used to help determine compatibility of military aircraft operations with local land use, particularly for land use associated with airfields.

Community Noise Equivalent Level

CNEL is a noise metric adopted as a standard by the state of California. The CNEL metric is similar to the DNL metric and is also an energy-averaged sound level measurement. DNL and CNEL provide average noise levels taking into consideration and applying penalties for annoyance from intrusive events that occur during evening and nighttime hours. Both DNL and CNEL are measures of cumulative noise exposure over a 24-hour period, with adjustments to reflect the added intrusiveness of noise during certain times of the day. However, while DNL considers one adjustment period, CNEL reflects two adjustment periods. DNL includes a single adjustment period for night, in which each aircraft noise event at night (defined as 10 p.m. to 7 a.m.) is counted 10 times. CNEL adds a second adjustment period where each aircraft noise event in the evening (defined as 7 p.m. to 10 p.m.) is counted three times. The nighttime adjustment is equivalent to increasing the noise levels during that time interval by 10 dB. Similarly, the evening adjustment increases the noise levels by approximately 5 dB.

Equivalent Sound Level

A cumulative noise metric useful in describing noise is the Equivalent Sound Level (Leq). Leq is the continuous sound level that would be present if all of the variations in sound level occurring over a specified time period were smoothed out as to contain the same total sound energy. The same calculation for a daily average time period such as DNL or CNEL but without the penalties is a 24 hour equivalent sound level, abbreviated Leq(24). Other typical time periods for Leq are 1 hour and 8 hours.

Sound Exposure Level

The Sound Exposure Level (SEL) metric is a composite metric that represents both the intensity of a sound and its duration. Individual time-varying noise events (e.g., aircraft overflights) have two main characteristics: a sound level that changes throughout the event and a period of time during which the event is heard. SEL provides a measure of total sound energy of the entire acoustic event, but it does not directly represent the sound level heard at any given time. During an aircraft flyover, SEL captures the total sound energy from the beginning of the acoustic event to the point when the receiver no longer hears the sound. It then condenses that energy into a 1-second period of time and the metric represents the total sound exposure received. The SEL has proven to be a good metric to compare the relative exposure of transient sounds, such as aircraft overflights, and is the recommended metric for sleep disturbance analysis (DoD Noise Working Group, 2009). In this EA/OEA, SEL is used in aircraft comparison and sleep disturbance analyses.

Maximum Sound Level

The highest A-weighted sound level measured during a single event where the sound level changes value with time (e.g., an aircraft overflight) is called the maximum A-weighted sound level or L_{max}. During an aircraft overflight, the noise level starts at the ambient or background noise level, rises to the maximum level as the aircraft flies closest to the observer, and returns to the background level as the aircraft recedes into the distance. L_{max} defines the maximum sound level occurring for a fraction of a second. For aircraft noise, the "fraction of a second" over which the maximum level is defined is generally 1/8 second (American National Standards Institute, 1988). For sound from aircraft overflights, the SEL is usually greater than the L_{max} because an individual overflight takes seconds and the L_{max} occurs instantaneously. In this EA/OEA, L_{max} is used in the analysis of aircraft comparison and speech interference.

Number of Events Above a Threshold Level

The Number of Events Above a Threshold Level metric provides the total number of noise events that exceed a selected noise level threshold during a specified period of time (DoD Noise Working Group, 2009). Combined with the selected noise metric, Lmax or SEL, the Number of Events Above metric is symbolized as NAXXmetric (NA = number of events above, XX = dB level, metric = Lmax or SEL). For example, the Lmax and SEL Number of Events Above metrics are symbolized as NA75Lmax and NA75SEL, respectively, with 75 dB as the example dB level. In this EA/OEA, an Lmax threshold is selected to analyze speech interference and an SEL threshold is selected for analysis of sleep disturbance.

Noise Effects

An extensive amount of research has been conducted regarding noise effects including annoyance, speech interference, sleep disturbance, noise-induced hearing impairment, nonauditory health effects, performance effects, noise effects on children, effects on domestic animals and wildlife, property values, structures, terrain, and archaeological sites. These effects are summarized below.

Annoyance

As previously noted, the primary effect of aircraft noise on exposed communities is long-term annoyance, defined by USEPA as any negative subjective reaction on the part of an individual or group. The scientific community has adopted the use of long-term annoyance as a primary indicator of community response and there is a consistent relationship between DNL/CNEL and the level of community annoyance (Federal Interagency Committee on Noise, 1992).

Potential Hearing Loss

People living in high noise environments for an extended period of time (40 years) can be at risk for hearing loss called Noise Induced Permanent Threshold Shift (NIPTS). The NIPTS defines a permanent change in hearing level, or threshold, caused by exposure to noise (United States Environmental Protection Agency, 1982). According to USEPA (1974), changes in hearing level of less than 5 dB are generally not considered noticeable. There is no known evidence that an NIPTS of less than 5 dB is perceptible or has any practical significance for the individual affected. Furthermore, the variability in audiometric testing is generally assumed to be plus or minus 5 dB. The preponderance of available information on hearing loss risk is from the workplace with continuous exposure throughout the day for many years.

Based on a report by Ludlow and Sixsmith (1999), there were no major differences in audiometric test results between military personnel, who as children, had lived in or near installations where fast jet operations were based, and a similar group who had no such exposure as children. Hence, for the purposes of this EA/OEA, the limited data are considered applicable to the general population, including children, and are used to provide a conservative estimate of the risk of potential hearing loss.

DoD policy directive requires that hearing loss risk be estimated for the at-risk population, defined as the population exposed to DNL greater than or equal to 80 dB (Defense, 2009). To assess the potential for NIPTS, the Navy generally uses the 80 dB DNL noise contour (or in California 80 dB CNEL) as a threshold to identify the exposed population who may be at the most risk of possible hearing loss from aircraft noise (USEPA, 1982; DoD Noise Working Group, 2009). However, it should be recognized that characterizing noise exposure in terms of DNL and CNEL overestimates hearing loss risk but suffices when nighttime operations are 5% or less than the total operations. When nighttime operations are greater than 5%, Leq(24) is recommended for calculating potential hearing loss since hearing loss is a physical phenomenon due to the sound level and independent of annoyance. Thus, the additional penalties applied by CNEL for evening and

nighttime operations do not accurately portray the NIPTS. This EA/OEA calculates potential hearing loss using Leq(24) to get the accuracy necessary for the larger amount of nighttime and evening operations.

Speech Interference

Speech interference associated with aircraft noise is a primary cause of annoyance for communities. Speech interference can cause disruption of routine activities, such as enjoyment of radio or television programs, telephone use, or family conversation, giving rise to frustration or irritation. In extreme cases, speech interference may cause fatigue and vocal strain to individuals who try to communicate over the noise. In this EA/OEA, speech interference is measured by the number of daily indoor events (from 7 a.m. to 10 p.m.) that exceed 50 dB Lmax at selected locations. This metric also accounts for noise level reduction provided by buildings with windows open or closed.

Classroom Criteria and Noise Effects on Children

Research suggests that environments with sustained high background noise can have variable effects, including effects on learning and cognitive abilities and various noise-related physiological changes. Research on the impacts of aircraft noise, and noise in general, on the cognitive abilities of school-aged children has received more attention in recent years. Several studies suggest that aircraft noise can affect the academic performance of school children. Physiological effects in children exposed to aircraft noise and the potential for health effects have been the focus of limited investigation (DoD Noise Working Group, 2009).

Analyses for school-aged children are similar to speech interference by using the indoor number of events exceeding 50 dB Lmax, but also has the added restriction of using an outdoor equivalent noise level of 60 dB Leq(9 hr). This represents a level that a person with normal hearing can clearly hear a speaker (teacher) speaking at a level of 50 dB indoors in a classroom setting.

Sleep Disturbance

The disturbance of sleep is a major concern for communities exposed to nighttime aircraft noise. In this EA/OEA, sleep disturbance uses the SEL noise metric and calculates the probability of awakening from single aircraft overflights. These are based upon the particular type of aircraft, flight profile, power setting, speed, and altitude relative to the receptor. The results are then presented as a percent probability of people awakening (United States Environmental Protection Agency, 1974).

Workplace Noise

In 1972, the National Institute for Occupational Safety and Health (NIOSH) published a criteria document with a recommended exposure limit of 85 dBA as an 8-hour time-weighted average. This exposure limit was reevaluated in 1998 when NIOSH made recommendations that went beyond conserving hearing by focusing on the prevention of occupational hearing loss. Following the reevaluation using a new risk assessment technique, NIOSH published another criteria document in 1998, which reaffirmed the 85 dB recommended exposure limit (National Institute for Occupational Health and Safety, 1998).

Nonauditory Health Effects

Studies have been conducted to examine the nonauditory health effects of aircraft noise exposure, focusing primarily on stress response, blood pressure, birth weight, mortality rates, and cardiovascular health. Exposure to noise levels higher than those normally produced by aircraft in the community can elevate blood pressure and also stress hormone levels. However, the response to such loud noise is typically short in duration: after the noise goes away, the physiological effects reverse and levels return to normal. In the case

of repeated exposure to aircraft noise, the connection is not as clear. The results of most cited studies are inconclusive, and it cannot be conclusively stated that a causal link exists between aircraft noise exposure and the various type of nonauditory health effects that were studied (DoD Noise Working Group, 2009).

Noise Effects on Children

A review of the scientific literature indicated that there has not been a tremendous amount of research in the area of aircraft noise effects on children. The research reviewed does suggest that environments with sustained high background noise can have variable effects, including effects on learning and cognitive abilities and various noise-related physiological changes. Research on the impacts of aircraft noise, and noise in general, on the cognitive abilities of school-aged children has received more attention in recent years. Several studies suggest that aircraft noise can affect the academic performance of schoolchildren. Physiological effects in children exposed to aircraft noise and the potential for health effects have been the focus of limited investigation (DoD Noise Working Group, 2009).

Noise Modeling

Computer modeling provides a tool to assess potential noise impacts. DNL/CNEL noise contours are generated by a computer model that draws from a library of actual aircraft noise measurements. Noise contours produced by the model allow a comparison of existing conditions and proposed changes or alternative actions, even when the aircraft studied are not currently operating from the installation. For these reasons, on-site noise monitoring is seldom used at military air installations, especially when the aircraft mix and operational tempo are not uniform.

The noise environment for this EA/OEA was modeled using NOISEMAP. NOISEMAP analyzes all the operational data (types of aircraft, number of operations, flight tracks, altitude, speed of aircraft, engine power settings, and engine maintenance run-ups), environmental data (average humidity and temperature), and surface hardness and terrain. The result of the modeling is noise contours; lines connecting points of equal value (e.g., 65 dB CNEL and 70 dB CNEL). Noise zones cover an area between two noise contours and are usually shown in 5-dB increments (e.g., 65–69 dB CNEL, 70–74 dB CNEL, and 75–79 dB CNEL). As stated earlier, since the two home basing alternatives considered are in California, CNEL is the standard used for noise calculations in this EA/OEA.

A newer model, called the Advanced Acoustic Model, has not yet been approved for use by the DoD. Per Chief of Naval Operations Instruction (OPNAVINST) 11010.36C, Air Installations Compatible Use Zones (AICUZ) Program, NOISEMAP is to be used for developing noise contours and is the best noise modeling science available today for fixed-wing aircraft until the Advanced Acoustic Model is approved.

Under the Noise Control Act of 1972, the Occupational Safety and Health Administration (OSHA) established workplace standards for noise. The minimum requirement states that constant noise exposure must not exceed 90 A-weighted decibels (dBA) over an 8-hour period. The highest allowable sound level to which workers can be constantly exposed is 115 dBA and exposure to this level must not exceed 15 minutes within an 8-hour period. The standards limit instantaneous exposure, such as impact noise, to 140 dBA. If noise levels exceed these standards, employers are required to provide hearing protection equipment that will reduce sound levels to acceptable limits.

The joint instruction, OPNAVINST 11010.36C and Marine Corps Order 11010.16, provides guidance administering the AICUZ program which recommends land uses that are compatible with aircraft noise levels. OPNAVINST 3550.1A and Marine Corps Order 3550.11 provide guidance for a similar program, RAICUZ. This program includes range safety and noise analyses, and provides land use recommendations

which will be compatible with Range Compatibility Zones and noise levels associated with military range operations.

3.1.5.1 Regulatory Setting

Under the Noise Control Act of 1972, the Occupational Safety and Health Administration (OSHA) established workplace standards for noise. The minimum requirement states that constant noise exposure must not exceed 90 A-weighted decibels (dBA) over an 8-hour period. The highest allowable sound level to which workers can be constantly exposed is 115 dBA and exposure to this level must not exceed 15 minutes within an 8-hour period. The standards limit instantaneous exposure, such as impact noise, to 140 dBA. If noise levels exceed these standards, employers are required to provide hearing protection equipment that will reduce sound levels to acceptable limits.

3.1.5.2 Region of Influence (ROI)

The ROI for noise analysis is the area within and surrounding PMRF/Main Base in which humans and wildlife may suffer annoyance or disturbance from noise sources at KTF. This would include areas on PMRF, KTF, and the town of Kekaha.

Primary sources of noise on PMRF/Main Base include airfield and range operations and missile, rocket, and drone launches. Airfield operations include take-offs and landings of high performance and cargo/passenger aircraft, as well as helicopter operations. Range operations include training and research and development activities support. Ambient noise levels from natural sources include wind, surf, and birds.

Noise generated at the PMRF airfield stem from one active runway, four helicopter operating spots, and maintenance operations. Noise levels produced by airfield operations tend to have a continuous impact on PMRF/Main Base. Existing noise levels near the runway may average as high as 75 A-weighted decibels (dBA). Buildings in this area are insulated to achieve a noise reduction of up to 35 dBA. Noise levels farther away from the runway are more characteristic of a commercial park, with levels not exceeding 65 dBA. Airfield noise zones have been established to safeguard the public and all station personnel from the effects of noise from air operations. The Final Noise and Accident Potential Zone Study for the Pacific Missile Range Facility Barking Sands determined that noise levels around the airfield are low due to the relatively few annual air operations, 13,395 for 2004 (US Navy, 2008). The noise study determined that 1 acre of land was affected by 75-decibel (dB) noise levels and that no housing units or populations are impacted. (US Department of the Navy, Engineering Field Activity Chesapeake, 2006)

Range operations that may impact the sound environment include, but are not limited to, power generation, training and research and development activities support, maintenance operations, and construction or renovation.

The activity with the most noticeable sound events is the launch of missiles, rockets, and drones. These launches result in high-intensity, short-duration sound events. Typical launches at PMRF/Main Base (including KTF launch sites) include the STARS, Terminal High Altitude Area Defense, and Strypi missile launches and have resulted in no public noise complaints. Table 3-6 lists the noise levels monitored for previous STARS launches at PMRF/Main Base.

Table 3-6 Noise Levels Monitored for STARS Launches at PMRF/Main Base

<i>Distance m (ft)</i>	<i>Measured Average Peak (decibel)</i>
175.3 (575)	125.3
243.8 (800)	123.0
268.5 (881)	121.8
372.5 (1,222)	118.2
482.8 (1,584)	115.3
3,048 (10,000; approx. 2 miles)	97.1
10,668 (35,000; approx. 6.5 miles)	54.0

Source: US Army Strategic Defense Command, 1992

The nearest on-base housing area is located approximately 8 km (5 mi) south of the northern KTF and PMRF launch areas. The nearest off-base residential area is Kekaha, which is approximately 12.9 km (8 mi) south of the northern KTF and PMRF launch areas.

KTF supports a variety of sounding rocket missions; therefore, occasional rocket, missile, or drone launches produce high-intensity, short-duration sound events. Data collected in the nearest town of Kekaha indicated that levels were no louder than noise generated from passing vehicles on a nearby highway. No noise-sensitive land uses are affected by existing noise levels. (Sandia National Laboratories, 2006)

In addition to the noise from the rocket engine, launch vehicles can also generate sonic booms during flight. A sonic boom is a sound that resembles rolling thunder, and is produced by a shock wave that forms at the nose and at the exhaust plume of a missile that is traveling faster than the speed of sound. Shock waves that form at the nose and at the exhaust plume of a missile travelling faster than the speed of sound produce an audible sonic boom when they reach the ground. The sonic boom occurs some distance downrange of the launch site. The uprange boundary of the sonic boom carpet forms a parabola pointing downrange. Most of the region subjected to any sonic boom from launches at PMRF is the surface of the ocean. Thus, land based population centers are not affected. Under suitable atmospheric conditions and depending on the trajectory of the missile, low level sonic booms may reach the northern portion of Niihau, as is the case for current operations from PMRF. (ACTA, 2009)

Noise impacts on wildlife receptors at the KTF and PMRF/Main Base area are discussed in the Biological Resources section.

3.1.6 Public Health and Safety

This discussion of public health and safety includes consideration for any activities, occurrences, or operations that have the potential to affect the safety, well-being, or health of members of the public. The primary goal is to identify and prevent potential accidents or impacts on the general public.

A safe environment is one in which there is no, or optimally reduced, potential for death, serious bodily injury or illness, or property damage. Human health and safety addresses public safety during construction, demolition, and renovation activities; and during subsequent operations of those facilities. Various stressors in the environment can adversely affect human health and safety. Identification and control or elimination of these stressors can reduce risks to health and safety to acceptable levels or eliminate risk entirely.

Emergency services are organizations which ensure public safety and health by addressing different emergencies. The three main emergency service functions include police, fire and rescue service, and emergency medical service.

The AICUZ Program, which is discussed in Section 3.6, delineates accident potential zones (APZs), which are areas around an airfield where an aircraft mishap is most likely to happen. APZs are not predictors of accidents nor do they reflect accident probability. The DoD defines an APZ as a planning tool for local planning agencies. The APZs follow departure, arrival, and flight pattern tracks from an airfield and are based upon historical accident data. RAICUZ, which is discussed in Section 3.6 addresses range safety.

The US Notice to Mariners provides timely marine safety information for the correction of all US Government navigation charts and publications from a wide variety of sources, both foreign and domestic. To ensure the safety of life at sea, the information published in the Notice to Mariners is designed to provide for the correction of unclassified nautical charts, the unclassified NGA/DLIS Catalog of Hydrographic Products, United States Coast Pilots, NGA List of Lights, USCG Light Lists, and other related nautical publications produced by NGA, NOS and the USCG.

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.

3.1.6.1 Regulatory Setting

Aircraft safety is based on the physical risks associated with aircraft flight. Military aircraft fly in accordance with Federal Aviation Regulations (FAR) Part 91, General Operating and Flight Rules, which govern such things as operating near other aircraft, right-of-way rules, aircraft speed, and minimum safe altitudes. These rules include the use of tactical training and maintenance test flight areas, arrival and departure routes, and airspace restrictions as appropriate to help control air operations. In addition, naval aviators must also adhere to the flight rules, ATC, and safety procedures provided in Navy guidance.

Executive Order 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.”

3.1.6.2 Region on Influence

Health and safety includes consideration of 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-base population. Also included within this category are hazards to equipment and structures.

The ROI for potential impacts related to the health and safety of workers includes work areas associated with FE-1 flight test launch operations. The population of concern includes the workers employed at PMRF, including SNL/KTF, but also other personnel directly involved with range operation and training activities currently occurring at PMRF/KTF.

The ROI for potential impact related to public health and safety also includes the areas of Kauai County adjacent to SNL/KTF that could be affected by the proposed launch. These areas include the PMRF overwater training areas. The population of concern consists of visitors to Kauai and permanent residents living in Kauai County.

PMRF takes every reasonable precaution during the planning and execution of the range operations training and test activities to prevent injury to human life or property. In addition to explosive, physical impact, and electromagnetic hazards, potential hazards from chemical contamination, ionizing and non-ionizing radiation, radioactive materials, and lasers are studied by PMRF Range Safety Office to determine safety restrictions.

SNL/KTF Operations

KTF is a launch facility operated by Sandia National Laboratories for the Department of Energy on PMRF/Main Base through Inter-Service Support Agreements (US Department of the Navy, 1998). SNL/KTF notifies PMRF Operations, Security, Fire Department, and Ordnance/Explosive Disposal as required prior to launch and other hazardous operations. (Sandia National Laboratories, 2006)

All hazardous operations at SNL/KTF are performed under strict adherence to existing SOPs. A site SOP provides general requirements and guidance for all range operations at SNL/KTF, including ordnance safety, pre-launch and hazardous operations control, ordnance handling and storage facilities, liquid fuels storage and handling, and launch pad operations.

KTF rocket motors and other ordnance components are stored in explosive storage magazines by PMRF, except when needed by SNL/KTF for processing, assembly, and launch. The movement of explosives and other hazardous materials between PMRF and KSNL/TF is conducted in accordance with PMRF procedures and DoD Explosives Safety Standards.

PMRF provides fire protection and firefighting services to SNL/KTF, and enforces base safety regulations and programs on SNL/KTF.

Range Safety. Range Safety at PMRF is controlled by Range Control, which is responsible for hazard area surveillance and clearance and control of all PMRF operational areas. Range Control maintains real time surveillance, clearance, and safety at all PMRF areas including SNL/KTF. PMRF sets requirements for minimally acceptable risk criteria to occupational and non-occupational personnel, test facilities, and non-military assets during range operations. For all range operations at PMRF, the Range Control Officer requires a safety plan. A Range Safety Operation Plan is generated by PMRF Range Safety personnel prior to range operations.

The PMRF Range Safety Office is responsible for establishing Ground Hazard Areas and Launch Hazard Areas over water beyond which no debris from early flight termination is expected to fall. The Ground and Launch Hazard Areas for missile launches are determined by size and flight characteristics of the missile, as well as individual flight profiles of each flight test. Data processed by ground-based or onboard missile computer systems may be used to recognize malfunctions and terminate missile flight. Before a launch is allowed to proceed, the range is determined cleared using input from ship sensors, visual surveillance from aircraft and range safety boats, radar data, and acoustic information.

All range users must: (1) provide a list of project materials, items, or test conditions that could present hazards to personnel or material through toxicity, combustion, blast, acoustics, fragmentation, electromagnetic radiation, radioactivity, ionization, or other means; (2) describe radiation, toxic, explosive, or ionization problems that could accumulate as a result of their tests; (3) provide aerodynamic and flight

control information, and destruct system information and parameters; (4) submit plans, specifications, and procedural or functional steps for events and activities involving explosives to conform to criteria in the PMRF instruction; and (5) provide complete operational specifications of any laser to be used and a detailed description of its planned use. (US Department of the Navy, 1998; 2008)

Missile Flight Analysis. PMRF conducts missile flight safety in accordance with Naval Air Warfare Center Weapons Division Instruction. Missile flight safety includes analysis of missile performance capabilities and limitations, of hazards inherent in missile operations and destruct systems, and of the electronic characteristics of missiles and instrumentation. It also includes computation and review of missile trajectories, launch azimuths, kinetic energy intercept debris impact areas, and hazard area dimensions, review and approval of destruct systems proposals, and preparation of the Range Safety Operation Plan required of all programs at PMRF. These plans are prepared by the PMRF Safety Office for each mission and must be approved by the Commanding Office prior to any launch. Launch is only allowed when the risk levels are less than the acceptable risk criteria in PMRF Instruction 8020.16, which are equivalent to the criteria developed by the Range Commanders Council (RCC) (e.g., RCC 321).

Ground Safety. The Range Control Officer using PMRF assets is solely responsible for determining range status and setting RED (no firing – unsafe condition due to a fouled firing area) and GREEN (range is clear and support units are ready to begin the event) range firing conditions. The Range Safety Approval and the Range Safety Operation Plan documents are required for all weapons systems using PMRF (US Department of the Navy, 1998). PMRF uses RCC 321, Common Risk Criteria for National Test Ranges. RCC 321 sets requirements for minimally acceptable risk criteria to occupational and non-occupational personnel, test facilities, and nonmilitary assets during range operations. Under RCC 321, the general public shall not be exposed to a probability of casualty greater than 1 in 10 million for each individual during any single mission and a total expectation of casualty must be less than 30 in 1 million. (Range Commanders Council, Range Safety Group, 2002)

To ensure the protection of all persons and property, Standard Operating Procedures (SOPs) have been established and implemented for the Ground Hazard Areas. These SOPs include establishing road control points and clearing the area using vehicles and helicopters (if necessary). Road control points are established 3 hours prior to launches. This allows security forces to monitor traffic that passes through the Ground Hazard Areas. At 20 minutes before a launch, the Ground Hazard Area is cleared of the public to ensure that, in the unlikely event of early flight termination, no injuries or damage to persons or property would occur. After the Range Safety Officer declares the area safe, the security force gives the all-clear signal, and the public is allowed to reenter the area. (US Department of the Navy, 1998) No inhabited structures are located within the off-base sections of the Ground Hazard Area. The potential for launch-associated hazards are further minimized through the use of the PMRF Missile Accident Emergency Team. This team is assembled for all launches from PMRF facilities and on-call for all PMRF launches in accordance with PMRF Instruction 5100.1F.

Ordnance Management and Safety. Ordnance safety includes procedures to prevent premature, unintentional, or unauthorized detonation of ordnance. Any program using a new type of ordnance device for which proven safety procedures have not been established requires an Explosive Safety Approval before the ordnance is allowed on PMRF or used on a test range. This approval involves a detailed analysis of the explosives and of the proposed test activities, procedures, and facilities for surveillance and control, an adequacy analysis of movement and control procedures, and a design review of the facilities where the ordnance items will be handled.

Ordnance management procedures are found in PMRFINST 8020.5, Explosive Safety Criteria for Range Users Ordnance Operations. The Range Control Branch of the Range Programs Division is responsible for: (1) providing detailed analysis of all proposals concerning missiles or explosives and their proposed operation on the range; (2) establishing procedures for surveillance and control of traffic within and entering hazard areas; (3) reviewing the design of facilities in which ordnance items are to be handled to ensure that safety protection meets the requirements of Naval Sea System Command Publication (NAVSEAOP) -5, Ammunition and Explosives Ashore; Safety Regulations for Handling, Storing, Production, Renovation, and Shipping, Chapter 4; (4) training, certifying, and providing Launch Control Officers, Safety Monitors, and Ordnance personnel for activities involving explosive ordnance; (5) assuming responsibility for the control of all emergency facilities, equipment, and personnel required in the event of a hazardous situation from a missile inadvertently impacting on a land area; (6) providing positive control of the ordering, receipt, issue, transport, and storage of all ordnance items; and (7) ensuring that only properly certified handling personnel are employed in any handling of ordnance.

Ordnance is either delivered to PMRF/Main Base by aircraft to the on-base airfield or by ship to Nawiliwili Harbor, and then over land by truck transport along Highway 50 to the base. The barges carrying explosives are met at Nawiliwili Harbor by trained ordnance personnel and special vehicles for transit to and delivery at PMRF/Main Base. All ordnance is transported in accordance with US Department of Transportation regulations. The STARS is stored in a specially constructed facility on KTF. No mishaps involving the use or handling of ordnance have occurred at PMRF.

PMRF/Main Base has defined explosive safety-quantity distance (ESQD) arcs. The arcs are generated by launch pads, the Kamokala Magazine ordnance storage area, the Interim Ordnance Handling Pad, and the Missile Assembly/Test Buildings 573, 590, and 685. Only the ESQD arcs generated by the Interim Ordnance Handling Pad and Building 573 are covered by a waiver or exemption. The Sandia Launcher site and Missile Assembly Buildings (647 and 685) can accommodate a 1,250-foot ESQD arc.

Ocean Area Clearance. Range Safety officials manage operational safety for projectiles, targets, missiles, and other hazardous activities into PMRF operational areas. The operational areas consist of two Warning Areas (W-186 and W-188) and one Restricted Area (R-3101) under the local control of PMRF. The Warning Areas are in international waters and are not restricted; however, the surface area of the Warning Areas is listed as "HOT" (actively in use) 24 hours a day. PMRF publishes dedicated warning NOTMARs and NOTAMs 1 week before hazardous operations. In addition, a 24-hour recorded message is updated on the hotline daily by Range Operations to inform the public when and where hazardous operations will take place.

Prior to a hazardous operation proceeding, the range is determined to be cleared using inputs from ship sensors, visual surveillance of the range from aircraft and range safety boats, radar data, and acoustic information from a comprehensive system of sensors and surveillance from shore.

Transportation Safety. PMRF transports ordnance by truck from Nawiliwili Harbor to PMRF along Highway 50. The barges carrying explosives are met at Nawiliwili Harbor by trained ordnance personnel and special vehicles for transit to and delivery at PMRF. All ordnance is transported in accordance with US Department of Transportation regulations. PMRF has established PMRFINST 8023.G, which covers the handling and transportation of ammunition, explosives, and hazardous materials on the facility.

In addition, liquid fuels (e.g., nitrogen tetroxide and unsymmetrical dimethylhydrazine) are transported to KTF. These fuels can be shipped to the site by truck, aircraft or barge, which do not affect transportation routes on the island of Kauai. Transportation of these materials is conducted in accordance with US Department of Transportation regulations and specific safety procedures developed for the location.

Range Control and the FAA are in direct communication in real time to ensure the safety of all aircraft using the airways and the Warning Areas. Within the Special Use Airspace, military activities in Warning Areas W-186 and W-188 are under PMRF control. Warning Areas W-189, W-187, and W-190 are scheduled through the Fleet Area Control and Surveillance Facility.

Because the Warning Areas are located in international airspace, the procedures of the ICAO are followed. The FAA acts as the US agent for aeronautical information to the ICAO, and air traffic in the ROI is managed by the Honolulu Control Facility and Oakland ARTCC.

Fire and Crash Safety. The Navy has developed standards that dictate the amount of fire/crash equipment and staffing that must be present based on the number and types of aircraft stationed on base, and the types and total square footage of base structures and housing. PMRF Crash/Fire is located in the base of the Air Traffic Control Tower, Building 300. Personnel are trained to respond to activities such as aircraft fire fighting and rescue in support of airfield operations, hazardous material incidents, confined space rescue, and hypergolic fuel releases, plus structure and brush fire fighting, fire prevention instruction, and fire inspections.

Ambulance and Class II Emergency Medical Technician services are provided by Emergency Medical Technicians assigned to Crash/Fire. These contractor-operated services are available to military, civil service, and non-government personnel at PMRF, 24 hours a day, 7 days a week. More extensive emergency medical services are available from the West Kauai Medical Center in Waimea, 16 km (10 miles) from the Main Gate at Barking Sands.

3.1.7 Hazardous Materials and Wastes

This section discusses hazardous materials, hazardous waste, toxic substances, and contaminated sites.

In general, hazardous materials and wastes are defined as those substances that, because of their quantity, concentration, or physical, chemical, or infectious characteristics, would present substantial danger to public health and welfare or to the environment when released into the environment.

As defined by the Department of Transportation, a hazardous material is a material that is capable of posing an unreasonable risk to health, safety, or property when transported in commerce and has been so designated. Hazardous waste is further defined by the USEPA as any solid waste not specifically excluded in 40 CFR 261.2 of the Resource Conservation and Recovery Act regulations, which meets specified concentrations of chemical constituents or has certain toxicity, ignitability, corrosivity, or reactivity characteristics.

3.1.7.1 Regulatory Setting

Hazardous materials are defined by 49 CFR section 171.8 as “hazardous substances, hazardous wastes, marine pollutants, elevated temperature materials, materials designated as hazardous in the Hazardous Materials Table, and materials that meet the defining criteria for hazard classes and divisions” in 49 CFR part 173. Transportation of hazardous materials is regulated by the US Department of Transportation regulations.

Hazardous wastes are defined by the Resource Conservation and Recovery Act (RCRA), as amended by the Hazardous and Solid Waste Amendments, as: “a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may (A) cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or (B) pose a substantial present or potential hazard to human health or the environment

when improperly treated, stored, transported, or disposed of, or otherwise managed.” Certain types of hazardous wastes are subject to special management provisions intended to ease the management burden and facilitate the recycling of such materials. These are called universal wastes and their associated regulatory requirements are specified in 40 CFR part 273. Four types of waste are currently covered under the universal wastes regulations: hazardous waste batteries, hazardous waste pesticides that are either recalled or collected in waste pesticide collection programs, hazardous waste thermostats, and hazardous waste lamps.

Special hazards are those substances that might pose a risk to human health and are addressed separately from other hazardous substances. Special hazards include asbestos-containing material (ACM), polychlorinated biphenyls (PCBs), and lead-based paint. The USEPA is given authority to regulate special hazard substances by the Toxic Substances Control Act (TSCA). Asbestos is also regulated by USEPA under the Clean Air Act, and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

The DoD established the Defense Environmental Restoration Program (DERP) to facilitate thorough investigation and cleanup of contaminated sites on military installations (active installations, installations subject to Base Realignment and Closure, and formerly used defense sites). The Installation Restoration Program and the Military Munitions Response Program are components of the DERP. The Installation Restoration Program requires each DoD installation to identify, investigate, and clean up hazardous waste disposal or release sites. The Military Munitions Response Program addresses nonoperational rangelands that are suspected or known to contain unexploded ordnance, discarded military munitions, or munitions constituent contamination. The Environmental Restoration Program is the Navy’s initiative to address DERP.

3.1.7.2 Region of Influence (ROI)

The Navy has implemented a strict Hazardous Material Control and Management Program and a Hazardous Waste Minimization Program for all activities. These programs are governed Navy-wide by applicable OPNAV instructions and at the installation by specific instructions issued by the Base Commander. The Navy continuously monitors its operations to find ways to minimize the use of hazardous materials and to reduce the generation of hazardous wastes.

The ROI for hazardous materials and hazardous waste would be limited to areas of PMRF, including KTF, to be used for launch preparation, launch, and post-launch activities and in areas where hazardous materials are stored and handled.

Hazardous Materials

PMRF manages hazardous materials through the Navy’s Consolidated Hazardous Materials Reutilization and Inventory Management Program (CHRIMP). CHRIMP mandates procedures to control, track, and reduce the variety and quantities of hazardous materials in use at facilities. The CHRIMP concept established Hazardous Materials Minimization Centers as the inventory controllers for Navy facilities. All departments, tenant commands, and work centers must order hazardous materials from the Hazardous Materials Minimization Centers, where all such transactions are recorded and tracked. The exception to this is KTF, which obtains its hazardous materials through Department of Energy channels. Hazardous materials on PMRF are managed by the operations and maintenance contractor through CHRIMP. Hazardous materials managed through the CHRIMP program other than fuels are stored in Building 338. Typical materials used on PMRF/Main Base and stored at Building 338 include cleaning agents, solvents, and lubricating oils.

PMRF has developed programs to comply with the requirements of the Superfund Amendments and Reauthorization Act Title III and Emergency Planning and Community Right-to-Know Act. This effort has included submission to the State and local emergency planning committees of annual Tier II forms, which are an updated inventory of chemicals or extremely hazardous substances in excess of threshold limits. These chemicals at PMRF include jet fuel, diesel fuel, propane, gasoline, aqueous firefighting foam, chlorine, used oil, paint/oils, and paint.

Hazardous Waste

PMRF/Main Base is a large-quantity hazardous waste generator with a USEPA identification number. Hazardous waste on PMRF is not stored beyond the 90-day collection period. PMRF/Main Base has two storage areas on base for hazardous wastes: Building 392 and Building 419. Building 392 stores all base waste except for OTTO (torpedo) fuel, a liquid monopropellant. Building 419 is the torpedo repair shop. At present, both buildings are not used at their maximum hazardous waste storage capacity.

KTF is a small-quantity hazardous waste generator and has a USEPA identification number. There is one hazardous waste storage area on KTF.

PMRF outlines management and disposal procedures for used oils and fuels in the Hazardous Waste Management Plan. PMRF maintains a Used Oil transporter/Processor Permit through the Hawai'i Department of Health. Additionally, degraded jet fuel is used in crash-fire training events. The majority of wastes are collected and containerized at PMRF/Main Base for direct offsite disposal through the Defense Reutilization and Marketing Office (DRMO) at Pearl Harbor within 90 days. The DRMO provides for the transportation and disposal of the wastes to the final disposal facility.

Pollution Prevention/Recycling/Waste Minimization

PMRF has a pollution prevention plan in place for the Main Base and all sites on Kauai, which follows CHRIMP procedures for controlling, tracking, and reducing hazardous materials use and waste generation. PMRF/Main Base currently has three hazardous waste elimination programs in place. These involve recycling toner cartridges, mercury from mercury lamps, and acid/lead batteries.

Installation Restoration Program

KTF has no Environmental Restoration sites. Three Environmental Restoration sites were identified in 1995 and were given a No Further Action determination by USEPA in 1996 (Sandia National Laboratories, 2006).

Underground and Aboveground Storage Tanks

There is one underground storage tank and one 10,000-gal aboveground fuel tank at KTF. KTF complies with PMRF's management plans for oil and hazardous materials outlined in the PMRF Spill Prevention Control and Countermeasures Plan and the Installation Spill Contingency Plan. (Sandia National Laboratories, 2006)

Asbestos, Lead-Based Paint, and Polychlorinated Biphenyls

PMRF manages asbestos in accordance with the Base Operations Support contractor's asbestos management plan. Prior to any construction projects, areas to be disturbed are surveyed for asbestos, and any asbestos is removed, before disturbance, by a certified asbestos contractor. The handling of hazardous materials and the potential generation and disposal of hazardous wastes follow ongoing, standard, and applicable regulations and procedures at PMRF.

All facilities associated with PMRF follow basic lead management principles and policies. The exception is KTF, which follows Department of Energy plans for the removal of lead-based paint wastes. The

transformers on the KTF site have been tested and are free of polychlorinated biphenyls, and there are no asbestos issues at the site (Sandia National Laboratories, 2006).

Liquid Fuels and Other Toxic Fuels

PMRF uses gasoline and diesel fuels to power range trucks and equipment. Aircraft at PMRF use jet fuel and Jet-A. Jet-A is available at the fuel farm near the airfield. Both aircraft fuels are delivered to the flight line in refuelers.

3.2 Over-Ocean Flight Corridor

This section includes air quality and biological resources within the Pacific BOA along the over-ocean flight corridor for the FE-1 flight test.

The potential impacts to the following resource areas are considered to be negligible or non-existent so they were not analyzed in detail in this EA/OEA:

Water Resources: There are no groundwater or surface water resources along the over-ocean flight corridor that would be affected by the FE-1 flight test. There would be no disturbance to ocean waters beyond the settling of the individual booster stages hundreds of kilometers (miles) apart as they come to rest on the sea floor after splashing into the ocean along the flight path and slowly sinking thousands of meters (feet). No impacts would occur to water resources within the over-ocean flight corridor from the FE-1 flight test.

Geological Resources: There would be no drilling, mining, or construction in the open ocean and no sediment disturbance beyond the settling of the individual rocket booster stages hundreds of kilometers (miles) apart as they come to rest on the sea floor after splashing into the ocean along the flight path and slowly sinking thousands of meters (feet). There would be no impacts to geological resources in the over-ocean flight corridor from the FE-1 flight test.

Cultural Resources: There are no identified cultural resources along the flight path within the over-ocean flight corridor; therefore, there would be no impacts to cultural resources within that area from the FE-1 flight test.

Land Use: The FE-1 flight path would avoid populated land masses with their associated assigned land uses. There would be no changes, and therefore, no impacts, from the FE-1 flight test to land use along the flight path over the over-ocean flight corridor.

Airspace: The over-ocean flight corridor is located over international airspace and, therefore, has no formal airspace restrictions governing it. Over-ocean flight tests must comply with DOD Instruction 4540.01, *Use of International Airspace by US Military Aircraft and for Missile/Projectile Firings*. Commercial and private aircraft would be notified through NOTAMs issued through the FAA in advance of the FE-1 flight test launch at the request of RTS as part of their routine operations. Test flight operations would be conducted in accordance with Western Range procedures and would not expand or alter currently controlled airspace. There would be no impacts to airspace from the FE-1 flight test.

Noise: The FE-1 flight would occur at high altitude where it would be generally undetected by vessels or aircraft at the ocean's surface. Sonic booms are generated following launch and during terminal flight and impact; these areas are not within the over-ocean flight corridor. Therefore, there would be no impacts to noise within the over-ocean flight corridor from the FE-1 flight test.

Infrastructure: No changes would occur to infrastructure in the over-ocean flight corridor from the FE-1 flight test; therefore, there would be no impacts to infrastructure in the over-ocean flight corridor.

Transportation: Transportation services would be unaffected by the FE-1 flight test over the open ocean. The payload flight would occur at high altitude where it would be generally undetected by vessels or aircraft. Public NOTAMS and NOTMARS would be issued along the flight path to ensure the safety of both aircraft and vessels. Components would drop over pre-determined open ocean areas to ensure, along with the public notices, that there would be no vessels or aircraft in the vicinity. There would be no impacts from the FE-1 flight test to transportation along the flight path over the open ocean.

Public Health and Safety: The FE-1 flight would occur at high altitudes where it would be generally undetected by vessels or aircraft. NOTAMS and NOTMARS would be issued along the flight path to ensure the safety of personnel on aircraft and vessels. Components would drop over pre-determined open ocean areas to ensure, along with the public notices, that there would be no vessels or aircraft in the vicinities. Range Safety at PMRF would monitor the flight until takeover by RTS range safety as the payload comes into USAKA. If the FE-1 flight strays outside its designated corridor, it would be considered to be malfunctioning and to constitute an imminent safety hazard. The destruct package, which is installed in all flight vehicles capable of impacting inhabited areas, would be activated. This effectively halts powered flight, causing the remaining hardware to fall into the ocean along a ballistic trajectory. The low potential for a flight failure, combined with the low density of vessels in the open ocean, make any potential impact discountable. There would be no impacts from the FE-1 flight test to public health and safety along the flight path over the over-ocean flight corridor.

Hazardous Materials and Wastes: Each of the three rocket motor boosters would exhaust on-board propellant before dropping into the ocean, while fairings would not carry hazardous materials. *De minimus* residual quantities of other materials may remain on the boosters and fairings; these would be carried to the ocean floor by the sinking components. There would be no impacts to hazardous materials and wastes along the over-ocean flight corridor from the FE-1 flight test.

Socioeconomics: Use of USAKA by the US Army is maintained under the MUORA and Compact of Free Association, with lease payments made to the Marshallese landowners. The current lease is valid through 2066 with an additional option through 2086. Personnel conducting the FE-1 flight test would reside only temporarily at USAKA, and the FE-1 flight test would not employ any Marshallese citizens or contribute to the local Marshallese economy. There is no resident population at Illeginni Islet. Therefore, there would be no impacts to socioeconomics from the FE-1 flight test.

Environmental Justice: USAKA does not include any population centers such that minorities or low income populations would be subject to disproportionate impacts from the FE-1 flight test. Range safety regulations and procedures protective of health and safety would be applied throughout the flight corridor. There would be no disproportionate impacts within the over-ocean flight corridor to minority populations or low-income populations under Executive Order 12898 from the FE-1 flight test.

Visual Resources: The FE-1 flight would occur at high altitude where it would be generally undetected by vessels or aircraft. There would be no changes from the FE-1 flight test to visual resources along the flight path over the over-ocean flight corridor.

Marine Sediments: There would be no marine sediment disturbance beyond the settling of the rocket components as they come to rest on the sea floor after splashing into the ocean along the flight path and slowly sinking thousands of meters (feet). There would be no impacts to marine sediments in the over-ocean flight corridor from the FE-1 flight test.

3.2.1 Air Quality, Greenhouse Gases and Climate Change

3.2.1.1 Regulatory Setting

Because of the potential global effects of testing rockets over the ocean and through the Earth's atmosphere, this EA/OEA considers the environmental effects on the global environment in accordance with the requirements of Executive Order (EO) 12114, *Environmental Effects of Major Federal Actions*, DODD 6050.7, *Environmental Effects Abroad of Major Department of Defense Actions*; and EO 13693, *Planning for Federal Sustainability in the Next Decade*, which outlines policies to ensure that Federal agencies evaluate climate-change risks and vulnerabilities, and to manage the short- and long-term effects of climate change on their operations and mission. This EO specifically requires DoD agencies to measure, report, and reduce their GHG emissions from both their direct and indirect activities (DoD, 2016). This section describes the baseline conditions within the Pacific BOA over-ocean flight corridor (Figure 2-5) that may be affected by the proposed FE-1 flight test.

Air Quality

The stratosphere, which extends from 6 mi (10 km) to approximately 30 mi (50 km) in altitude, contains the Earth's ozone layer (National Oceanic and Atmospheric Administration [NOAA], 2008). The ozone layer plays a vital role in absorbing harmful ultraviolet radiation from the sun. Over the last 20 years, anthropogenic (human-made) gases released into the atmosphere—primarily chlorine related substances—have threatened ozone concentrations in the stratosphere which filter harmful ultraviolet sunlight. Such materials include chlorofluorocarbons (CFCs), which have been widely used in electronics and refrigeration systems, and the lesser-used halons, which are extremely effective fire extinguishing agents. Once released, the motions of the atmosphere mix the gases worldwide until they reach the stratosphere, where ultraviolet radiation releases their chlorine and bromine components.

Through global compliance with the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer and amendments, the worldwide production of CFCs and other ozone-depleting substances has been drastically reduced and banned in many countries. A continuation of these compliance efforts is expected to allow for a slow recovery of the ozone layer (World Meteorological Organization [WMO], 2016).

Atomic chlorine produced from emissions of HCl during high-temperature afterburning reactions in the exhaust plume of solid propellant rocket motors can contribute to overall global chlorine loading, which contributes to long-term ozone depletion. Stratospheric HCl is diffused through the troposphere and dissipates with a half-life of about 2.3 years; however, HCl from rocket emissions could have longer lifetimes because part of the emission occurs at atmospheric levels above the stratosphere. Studies have shown that Al_2O_3 , which is emitted from the rocket exhaust as solid particles, could contribute to ozone depletion via activation of chlorine in the atmosphere. Emissions of NO_x produced in the exhaust plume of rockets can also contribute to stratospheric ozone depletion. Table 3-7 presents typical emissions from a single STARS booster launch.

Impacts of the FE-1 flight test launch on global warming and ozone depletion in the atmosphere have also been considered as part of cumulative impacts in Section 5.

Greenhouse Gases

As described in 3.1.1.1, the CEQ final guidance (2016) recommended that agencies use projected GHG emissions as a proxy for assessing potential climate change effects or include a qualitative analysis when quantifications is not reasonably available when preparing NEPA documents. The guidance is primarily focused on projects that have large air quality implications and emphasizes a netting approach to GHG

analysis. Although not specifically identified in the final guidance, the prior draft guidance included a reference point of 27,558 tons per year (25,000 metric tons per year) of CO₂ equivalent emissions for discussion and disclosure of such emissions from larger federal actions that may have appreciable GHG emissions (CEQ 2014). This threshold was carried forward to determine if additional quantitative analysis would be required for the FE-1 flight test within this EA/OEA.

In an effort to reduce energy consumption, reduce GHGs, reduce dependence on petroleum, and increase the use of renewable energy resources the Navy has implemented a number of renewable energy projects. The Navy continues to promote and install new renewable energy projects.

Climate Change

Current global climate changes are scientifically attributable to global warming occurring from GHG emissions. The global annual temperature has increased at an average rate of 0.07° Celsius [C] (0.13° Fahrenheit [F]) per decade since 1880 and at an average rate of 0.17°C (0.31°F) per decade since 1970. The warmest global average temperatures on record have all occurred within the past 15 years, with the warmest years being 2010, 2013, 2014, and 2015 (NOAA, 2016). With this in mind, the Navy is poised to support climate-changing initiatives globally, while preserving military operations, sustainability, and readiness by working, where possible, to reduce GHG emissions.

Table 3-7 Total Emissions from a STARS Booster

<i>Emission Component</i>	<i>First Stage Kg (Lbs)</i>	<i>Second Stage Kg (Lbs)</i>	<i>Third Stage Kg (Lbs)</i>
Water (H ₂ O)	598.16 (1318.70)	252.02 (555.60)	22.62 (49.87)
Carbon Dioxide (CO ₂)	211.34 (465.91)	171.46 (378.00)	9.03 (19.91)
Hydrogen (H ₂)	219.83 (484.63)	58.87 (129.80)	9.48 (20.91)
Nitrogen (N ₂)	894.42 (1971.82)	741.64 (1635.00)	47.37 (104.44)
Hydrogen Chloride (HCl)	1576.55 (3475.64)	62.05 (136.80)	23.56 (162.18)
Aluminum Oxide (Al ₂ O ₃)	3558.80 (7845.67)	1391.92 (3068.60)	155.04 (341.82)
Carbon Monoxide (CO)	2355.86 (5193.70)	1346.74 (2969.00)	92.90 (204.80)
Chlorine (Cl)	19.81 (43.68)	4.03 (8.90)	0.20 (0.45)

Source: STARS EA, 1990

Sea level rise from global warming is primarily ascribed to water flowing into the sea from melting freshwater ice on land and the expansion of sea water as it warms. Tracked by satellites (1993-2016) and as measured along coast lines (1870-2000), according to the US National Aeronautics and Space Administration (NASA, 2016) the current rate of sea level rise is 3.41 millimeters (0.13 inches) per year.

3.2.1.2 Region of Influence (ROI)

Over-Ocean Flight Corridor

Dominant during much of the year, trade winds effectively disperse air emissions along the over-ocean flight corridor. Studies in Pacific locations have shown seasonal variations in the concentrations of man-made emissions, consisting of sulfate, nitrate, and dust. Each spring, large quantities of pollution, aerosols, and mineral dust are carried eastward out of Asia and transported over a broad region of the northern Pacific Ocean. Although an increasing trend in emission levels was occurring from the early 1980s to the mid-1990s, a more recent downward trend was recorded through 2000. Because of the lack of local air pollution sources, the dispersal of emissions by trade winds, and the lack of topographic features that inhibit dispersion, air quality along the Pacific BOA over-ocean flight corridor is considered good. Unlike the continental US, tropospheric ozone is not a concern in this general area. (USAF, 2013)

Changes in sea level have occurred throughout history, with the primary influences being global temperatures; Arctic, Antarctic, and glacial ice masses; and changes in the shape of the oceanic basins and land/sea distribution. Generally, with rising global temperatures, less ice is created or maintained throughout the Earth and sea levels rise. Currently, small islands located within the over-ocean flight corridor may be affected by rising sea levels from global climate change.

3.2.2 Biological Resources in the Over-Ocean Flight Corridor

Biological resources and habitat are defined as in section 3.1.3. Within the over-ocean flight corridor, existing information on biological resources, specifically marine wildlife, was reviewed. Threatened, endangered, and other special status species are discussed in their respective categories. Table 3-8 lists all special status species that are potentially present in the over-ocean flight corridor. Detailed descriptions and analyses for these consultation marine species are included in the Navy SSP FE-1 Biological Assessment (BA; US Navy and USASMDC, 2017).

3.2.2.1 Regulatory Setting

For the purposes of this EA/OEA, special-status species in the over-ocean flight corridor are those species listed as threatened or endangered under the Endangered Species Act (ESA) and species afforded federal protection under the Marine Mammal Protection Act (MMPA) or the Migratory Bird Treaty Act (MBTA). The purposes of the ESA, MMPA, and MBTA as well as relevant definitions under these acts are as described in section 3.1.3.1.

Table 3-8 Special-Status Species Known to Occur or Potentially Occurring in the BOA of the Over-Ocean Flight Corridor

Common Name	Scientific Name	ESA Listing Status	Protection Status	Likelihood of Occurrence in the BOA
Cetaceans				
Minke whale	<i>Balaenoptera acutorostrata</i>	-	MMPA	L
Sei whale	<i>B. borealis</i>	E	MMPA-Depleted	L
Bryde's whale	<i>B. edeni</i>	-	MMPA	L
Blue whale	<i>B. musculus</i>	E	MMPA-Depleted	L
Fin whale	<i>B. physalus</i>	E	MMPA-Depleted	P
Short-beaked common dolphin	<i>Delphinus delphis</i>	-	MMPA	U
Pygmy killer whale	<i>Feresa attenuata</i>	-	MMPA	P
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	-	MMPA	L
Risso's dolphin	<i>Grampus griseus</i>	-	MMPA	P
Longman's beaked whale	<i>Indopacetus pacificus</i>	-	MMPA	P
Pygmy sperm whale	<i>Kogia breviceps</i>	-	MMPA	P
Dwarf sperm whale	<i>K. sima</i>	-	MMPA	P
Fraser's dolphin	<i>Lagenodelphis hosei</i>	-	MMPA	P
Pacific white-sided dolphin	<i>Lagenorhynchus obliquidens</i>	-	MMPA	P
Humpback whale	<i>Megaptera novaeangliae</i>	E	MMPA-Depleted	P
Blainville's beaked whale	<i>Mesoplodon densirostris</i>	-	MMPA	P
Killer whale	<i>Orcinus orca</i>	-	MMPA	P
Melon-headed whale	<i>Peponocephala electra</i>	-	MMPA	L
Sperm whale	<i>Physeter macrocephalus</i>	E	MMPA-Depleted	L

Common Name	Scientific Name	ESA Listing Status	Protection Status	Likelihood of Occurrence in the BOA
False killer whale	<i>Pseudorca crassidens</i>	E, Insular Hawaiian DPS	MMPA-Depleted	P
Pantropical spotted dolphin	<i>Stenella attenuata</i>	-	MMPA-Depleted	L
Striped dolphin	<i>S. coeruleoalba</i>	-	MMPA	L
Spinner dolphin	<i>S. longirostris</i>	-	MMPA-Depleted	P
Rough-toothed dolphin	<i>Steno bredanensis</i>	-	MMPA	P
Bottlenose dolphin	<i>Tursiops truncatus</i>	-	MMPA-Depleted	P
Cuvier's beaked whale	<i>Ziphius cavirostris</i>	-	MMPA	P
Pinnipeds				
Hawaiian monk seal	<i>Neomonachus schauinslandi</i>	E	MMPA-Depleted	P
Birds				
'A'o (Newell's Townsend's shearwater)	<i>Puffinus auricularis newelli</i>	T	ESA	P
Sea Turtles				
Loggerhead turtle	<i>Caretta caretta</i>	E	ESA	P
Green turtle	<i>Chelonia mydas</i>	E, Central West Pacific DPS	ESA	L
Leatherback turtle	<i>Dermochelys coriacea</i>	E	ESA	L
Hawksbill turtle	<i>Enetmochelys imbricata</i>	E	ESA	L
Olive ridley turtle	<i>Lepidochelys olivacea</i>	T	ESA	P
Fish				
Bigeye thresher shark	<i>Alopias superciliosus</i>	C	ESA	L
Oceanic whitetip shark	<i>Carcharhinus longimanus</i>	C	ESA	L
Oceanic giant manta ray	<i>Manta birostris</i>	C	ESA	P
Pacific bluefin tuna	<i>Thunnus orientalis</i>	C	ESA	P

Abbreviations: ESA = Endangered Species Act, C = candidate species for federal ESA listing; E = federal endangered; T = federal threatened; MMPA = Marine Mammal Protection Act; L = Likely; P = Potential; U = Unlikely.

The Magnuson-Stevens Fishery Conservation and Management Act provides for the conservation and management of the fisheries. Under the Magnuson-Stevens Fishery Conservation and Management Act, essential fish habitat (EFH) consists of the waters and substrate needed by fish to spawn, breed, feed, or grow to maturity. The effect area for the Proposed Action includes the waters designated as EFH around Johnson Atoll. EFH in this area is discussed in detail in Section 3.2.2.2

3.2.2.2 Region of Influence (ROI)

The following discussions provide a description of the existing conditions for each of the categories of biological resources in the over-ocean flight corridor. The waters of the over-ocean flight corridor consist of BOAs. The depth within much of the over-ocean flight corridor is over 3,056 m (10,000 ft) and consists of pelagic and benthic areas. Pelagic areas support communities of organisms including both planktonic (drifting) and nektonic (swimming) marine organisms. Benthic communities are made up of marine organisms that live on or near the sea floor such as bottom dwelling fish, shrimp, worms, snails, and sea stars.

The north-central Pacific Ocean contains a number of threatened, endangered, and other protected species, including cetaceans (whales, dolphins, and porpoises), sea turtles, and fish. These species are listed in Table 3-8 for deep ocean areas within the over-ocean flight corridor. Many of these species can be found near the Hawaiian Islands or other islands, but they are sometimes seasonal in occurrence because of unique migration patterns. Some species, particularly the larger cetaceans, can occur hundreds or thousands of miles from land. For most of the over-ocean flight corridor, there are no accurate population estimates or migratory routes for listed marine wildlife species.

No designated critical habitat for any assessed species occurs in the over-ocean flight corridor. Critical habitat for the Hawaiian Monk Seal has been designated around many Hawaiian Islands including the Northwest Hawaiian Islands including most terrestrial habitat 5 m (16 ft) inland and the bottom 10 m (33 ft) of habitat from the shore out to the 200 m (656 ft) depth contour. The ROI for spent motor splashdown does not intersect any designated critical habitat for the Hawaiian Monk Seal (Figure 3-5); therefore, the action would not result in any destruction or adverse modification of critical habitat.

Marine Mammals

Cetaceans and Hawaiian monk seals are the only special-status marine mammals that have been documented in the over-ocean flight corridor. Nine cetacean species are considered likely to occur in the BOA portion of the ROI between the Hawaiian Islands and Kwajalein Atoll: minke whale, sei whale, Bryde's whale, blue whale, short-finned pilot whale, melon headed whale, sperm whale, pantropical spotted dolphin, and striped dolphin (Table 3-8). Fifteen other cetaceans are considered to have the potential to occur in the BOA of the ROI. Some of these species occur only seasonally for breeding or during particular points in the migration patterns. Migratory paths of these species were considered when determining the likelihood of occurrence in the BOA. Six of these cetacean species are listed under the ESA as endangered. All marine mammals discussed in this section are also protected under the MMPA (16 USC, § 1361 et seq.).

Any species listed as threatened or endangered under the ESA is considered a depleted stock by the MMPA. The term depleted is further defined by the MMPA as any case in which a species or population stock is determined to be below its optimum sustainable population. In addition to those species listed as depleted under the MMPA because they are listed as threatened or endangered under the ESA. Three other cetacean species are also listed as depleted under the MMPA even though these species are not ESA listed (Table 3-8).

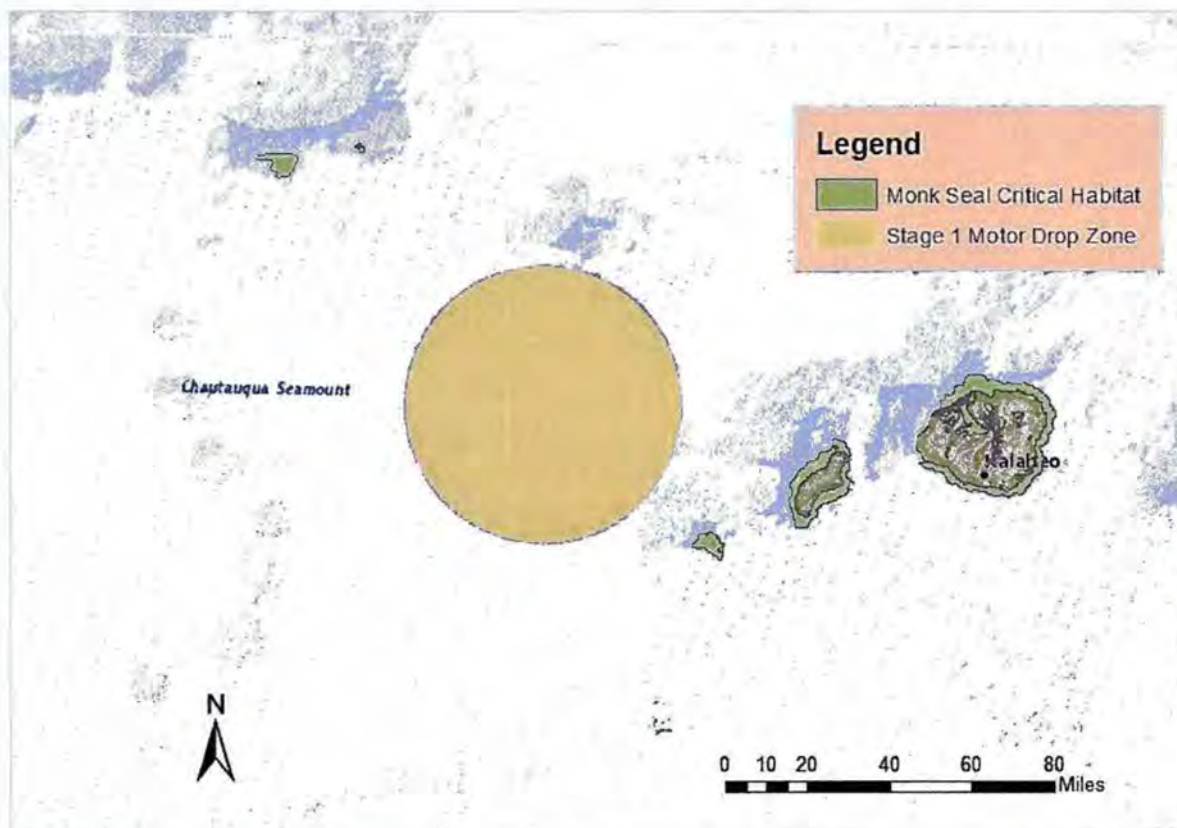


Figure 3-5 Representative Stage 1 Spent Motor Drop Zone and Hawaiian Monk Seal Critical Habitat

Potential threats to cetacean species in the BOA and deep ocean waters near the RMI include ingestion of marine debris, entanglement in fishing nets or other marine debris, collision with vessels, loss of prey species due to new seasonal shifts in prey species or overfishing, excessive noise above baseline levels in a given area, chemical and physical pollution of the marine environment, and changing sea surface temperatures due to global climate change. These threats are not particular to ESA or UES listed species, but the death of an individual is a higher cost to populations with low numbers.

Regarding noise exposure, there are many different sources of noise in the marine environment, both natural and anthropogenic. Biologically produced sounds include whale songs, dolphin clicks, and fish vocalizations. Natural geophysical sources include wind-generated waves, earthquakes, precipitation, wave action, and lightning storms. Anthropogenic sounds are generated by a variety of activities, including commercial shipping, geophysical surveys, oil drilling and production, dredging and construction, sonar, DoD test activities and training maneuvers, and oceanographic research (USAF, 2006).

While measurements for sound pressure levels in air are referenced to (re) 20 micro-Pascals (μPa), underwater sound levels are normalized to 1 μPa at 1 m (3.3 ft) from the source, a standard used in underwater sound measurement. In the BOA, some of the loudest underwater sounds generated are most likely to originate from storms, ships, and some marine mammals. Thunder can have source levels of up to 260 dB (re to 1 μPa). A passing supertanker can generate up to 190 dB (re to 1 μPa) of low frequency sound.

Jurisdiction over marine mammals such as whales, dolphins, porpoises, seals, and sea lions is maintained by NOAA Fisheries.

Birds

While no terrestrial habitat occurs in the BOA portion of the ROI, many pelagic sea birds may use this area for foraging and resting. One species of bird, the Newell's shearwater, is known to use the BOA southwest of Hawai'i for foraging (John Burger personal communication, 9 January 2017). Newell's shearwater breed only in the southeastern Hawaiian Islands where they nest in burrows on steep forested mountain slopes (Pyle and Pyle, 2009). Adults return to Hawai'i to breed in April and depart in leave in early fall (Pyle and Pyle 2009). Little is known about their winter range or about their pelagic foraging distribution. Newell's shearwaters have been primarily recorded in the tropical Pacific between 9-12° N and 160-120° W; however, these birds have been observed and collected at Guam, Saipan, Wake Island, Johnston Atoll, and American Samoa (Pyle and Pyle 2009).

The Newell's shearwater forages in BOA and offshore waters near breeding grounds where it feeds primarily on squid (NMFS, 2016). While little is known about these birds in the BOA, researchers have recorded Newell's shearwaters in low numbers in offshore waters near Hawai'i (Pyle and Pyle, 2009). These researchers observed the highest numbers of shearwaters in the spring and within 370 km (200 nm) of Kauai (Pyle and Pyle 2009). Primary threats to Newell's shearwater are terrestrial in nature and include nest predation by barn owls (*Tyto alba*), introduced terrestrial mammals, and artificially lighting which disorients fledgling birds (NMFS, 2016).

The USFWS maintains jurisdiction over migratory birds in the BOA of the ROI.

Sea Turtles

Five species of sea turtle: green, hawksbill, leatherback, loggerhead, and olive ridley, all of which are listed under the ESA (Table 3-8), occur in the BOA portion of the ROI. Much of the sea turtle research in the BOA has been conducted on the beaches and near shore waters of Hawai'i; thus, much of the data documenting the species' occurrence in the BOA is limited to that region.

Though each of the sea turtle species in the ROI has unique life history characteristics and preferred habitat, many environmental factors are common among all species. Bycatch in commercial fisheries, ship strikes, and marine debris are primary threats to sea turtles in the BOA (Lutcavage et al., 1997). One comprehensive study estimated that worldwide, 447,000 turtles are killed each year from bycatch in commercial fisheries (Wallace et al., 2010). Precise data are lacking for sea turtle deaths directly caused by ship strikes; however, live and dead turtles are often found with deep cuts and fractures indicative of a collision with a boat hull or propeller (Hazel et al., 2007; Lutcavage et al., 1997). Marine debris can also be a problem for sea turtles through entanglement or ingestion. Sea turtles can mistake debris for prey; one study found 37% of dead leatherbacks to have ingested various types of plastic (Mrosovsky et al., 2009). Other marine debris, including derelict fishing gear and cargo nets, can entangle and drown turtles in all life stages.

Aquatic degradation issues, such as poor water quality and invasive species, can alter ecosystems, limit food availability, and decrease survival rates (NMFS, 2016). Environmental degradation can also increase susceptibility to diseases, such as fibropapillomatosis, a debilitating tumor-forming disease that primarily affects green turtles (Santos et al. 2010). Fibropapillomatosis causes tumor-like growths (fibropapillomas), resulting in reduced vision, disorientation, blindness, physical obstruction to swimming and feeding, and increased susceptibility to parasites (NMFS and USFWS, 1998b; Santos et al., 2010).

Global climate change, with predictions of increased ocean and air temperatures and sea level rise, may also negatively impact turtles in all life stages, from egg to adult (Griffin et al., 2007; Poloczanska et al., 2009). Effects include embryo death caused by high nest temperatures, skewed sex ratios due to increased sand

temperature, loss of nesting habitat to beach erosion, coastal habitat degradation (e.g., increased water temperature and disease), as well as, alteration of the marine food web, which can decrease the amount of prey species.

Sea turtles' long life expectancy and site fidelity may make them vulnerable to chronic exposure to marine contaminants (Woodrom Rudrud et al., 2007). Sea turtles may also be vulnerable to the bioaccumulation of heavy metals in their tissues (Sakai et al., 2000). At this time, the amount of contaminants in the marine environment has not been measured, and sea turtles have not been tested for heavy metal levels in blood or tissues. Damage to coral reefs can reduce foraging habitat for hawksbill turtles, and damage to seagrass beds and declines in seagrass distribution can reduce near shore foraging habitat for green turtles in the RMI (NMFS and USFWS, 2007c, 1991).

Sea turtle auditory sensitivity is not well studied. The range of maximum sensitivity for sea turtles appears to be 200 to 800 Hz (Lenhardt, 1994; Moein et al., 1994). Hearing below 80 Hz is less sensitive but still potentially usable to the turtle (Lenhardt, 1994). Ridgway et al. (1969) concluded that green turtles have a useful hearing span of 60 to 1,000 Hz, but they hear best from 200 Hz up to 700 Hz, with sensitivity falling off considerably below 400 Hz. Because their anatomy is similar to that of green turtles, other sea turtle species are thought to have the same sensitivity ranges.

The USFWS and NOAA Fisheries share federal jurisdiction for sea turtles with the USFWS having lead responsibility on the nesting beaches and NOAA Fisheries, the marine environment.

Fish

Four species of ESA candidate fish have the potential to occur in the BOA of the ROI (Table 3-8). The bigeye thresher shark, oceanic whitetip shark, oceanic giant manta ray, and Pacific bluefin tuna are primarily open ocean species and have the potential to occur in the BOA.

Due to their differing life histories, these fish species have many species specific threats. All of these species are threatened by overutilization due to targeted fishing as well as capture as bycatch in commercial fisheries.

While little is known about the specific hearing capabilities of fish in the ROI, most fish are able to detect a wide range of sounds from below 50 Hz up to 500-1500 Hz (Popper and Hastings 2009). Potential responses to sound disturbance in fish include temporary behavioral changes, stress, hearing loss (temporary or permanent), tissue damage (such as damage to the swim bladder), or mortality (Popper and Hastings, 2009). In studies of other fish, short duration sounds with peaks less than 176 dB re 1 μ Pa were found to temporarily alter fish behavior, cause temporary threshold shifts (temporary hearing alteration), but caused no observable physical damage (Popper and Hastings, 2009). It is important to note that the effects of sound on these fishes are largely unknown as are sound effects on the eggs and larvae of these fish. Some researchers suggest that threshold guidelines of a peak exposure of 206 dB for physical injury of fish, a 189 dB sound exposure level for auditory tissue damage, and 150 dB for behavioral effects (Oestman et al., 2009).

Fish are vital components of the marine ecosystem. They have great ecological and economic aspects. To protect this resource, NOAA Fisheries works with the regional fishery management councils to identify the essential habitat for every life stage of each federally managed species using the best available scientific information. Essential fish habitat (EFH) has been described for approximately 1,000 managed species to date. EFH includes all types of aquatic habitat including wetlands, coral reefs, seagrasses, and rivers; all locations where fish spawn, breed, feed, or grow to maturity.

Essential Fish Habitat. The MSA of 1976 mandates identification and conservation of EFH to help maintain productive fisheries and rebuild depleted fish stocks. All federal agencies whose work may affect fish habitats must assess potential project effects on EFH. Under the MSA, EFH is defined as “those waters and substrate necessary to fish for spawning, breeding or growth to maturity.” An EFH may include US waters within exclusive economic zones (EEZ; seaward boundary out to a distance of 200 nm) and covers all fish species within in a fishery management unit (50 CFR §600.805). Under the MSA, an adverse effect means any impact that reduces quality and/or quantity of EFH (50 CFR §600.810). Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH (50 CFR §600.810).

The Western Pacific Regional Fishery Management Council (WPRFMC) has authority over the fisheries and EFH designation in and surrounding the State of Hawai‘i, the Territory of American Samoa, the Territory of Guam, the Commonwealth of the Northern Mariana Islands, and the US Pacific Remote Island Areas (Baker Island, Howland Island, Jarvis Island, Johnston Atoll, Kingman Reef, Wake Island, Palmyra Atoll, and Midway Atoll; Figure 3-1). The flight path for FE-1 crosses over waters designated as EFH near the Hawaiian Islands and the over-ocean flight corridor effect area extends into waters designated as EFH at Johnson Atoll (in the Pacific Remote Islands Area). The effects of the Proposed Action on EFH near both the Hawaiian Islands and near Johnson Atoll are evaluated in this section of the EA/OEA.

The WPRFMC developed EFH designations for Bottomfish and Seamount Groundfish, Crustaceans, and Precious Corals (approved by the Secretary of Commerce on February 3, 1999; 64 FR 19068) as well as for Coral Reef Ecosystem Management Unit Species (MUS; approved by the Secretary of Commerce on June 14, 2002; 69 FR 8336) (WPRFMC, 2009b). The EFH for these species management units which are summarized here are discussed in detail by WPRFMC in the Fishery Ecosystem Plan for the Hawai‘i Archipelago (WPRFMC, 2009a), the Fishery Ecosystem Plan for the Pacific Remote Island Area (WPRFMC, 2009b), and the Fishery Ecosystem Plan for Pacific Pelagic Fisheries of the Western Pacific Region (WPRFMC, 2005). EFH in the Action Area is summarized in Table 3-9 and discussed below.

In addition to EFH, the WPRFMC (2009b) has identified habitat areas of particular concern (HAPCs) within the EFH for certain MUS. The HAPCs are specific areas within EFH that are essential to the life cycle of important coral reef species (WPRFMC, 2009b). These HAPCs must meet one of the following criteria: a) the ecological function provided by the habitat is important; b) the habitat is sensitive to human-induced environmental degradation, c) development activities are, or will be, stressing the habitat type; or d) the habitat type is rare (WPRFMC, 2009b). HAPCs within the Action Area are summarized in Table 3-9 and discussed below.

Table 3-9 Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC) for All Western Pacific Archipelagic Management Unit Species (including the Pacific Remote Islands Area)¹

Resource	Species Complex	EFH	HAPC
Bottomfish and Seamount Groundfish	Shallow-water species (0–50 fm): uku (<i>Aprion virescens</i>), thicklip trevally (<i>Pseudocaranx dentex</i>), lunartail grouper (<i>Variola louti</i>), blacktip grouper (<i>Epinephelus fasciatus</i>), ambon emperor (<i>Lethrinus amboinensis</i>), redgill emperor (<i>Lethrinus rubrioperculatus</i>), giant trevally (<i>Caranx ignobilis</i>), black trevally (<i>Caranx lugubris</i>), amberjack (<i>Seriola dumerili</i>), taape (<i>Lutjanus kasmira</i>)	Eggs and larvae: the water column extending from the shoreline to the outer limit of the EEZ down to a depth of 400 m (200 fm). Juvenile/adults: the water column and all bottom habitat extending from the shoreline to a depth of 400 m (200 fm)	All slopes and escarpments between 40–280 m (20 and 140 fm) Three known areas of juvenile opakapaka habitat: two off Oahu and one off Molokai
Bottomfish and Seamount Groundfish	Deep-water species (50–200 fm): ehu (<i>Etelis carbunculus</i>), onaga (<i>Etelis coruscans</i>), opakapaka (<i>Pristipomoides filamentosus</i>), yellowtail kalekale (<i>P. auricilla</i>), yelloweye opakapaka (<i>P. flavipinnis</i>), kalekale (<i>P. sieboldii</i>), gindai (<i>P. zonatus</i>), hapuupuu (<i>Epinephelus quernus</i>), lehi (<i>Aphareus rutilans</i>)	Eggs and larvae: the water column extending from the shoreline to the outer limit of the EEZ down to a depth of 400 m (200 fm) Juvenile/adults: the water column and all bottom habitat extending from the shoreline to a depth of 400 meters (200 fm)	All slopes and escarpments between 40–280 m (20 and 140 fm) Three known areas of juvenile opakapaka habitat: two off Oahu and one off Molokai
Bottomfish and Seamount Groundfish	Seamount groundfish species (50–200 fm): armorhead (<i>Pseudopentaceros richardsoni</i>), ratfish/butterfish (<i>Hyperoglyphe japonica</i>), alfonsin (<i>Beryx splendens</i>)	Eggs and larvae: the (epipelagic zone) water column down to a depth of 200 m (100 fm) of all EEZ waters bounded by latitude 29°–35° Juvenile/adults: all EEZ waters and bottom habitat bounded by latitude 29°–35° N and longitude 171° E–179° W between 200 and 600 m (100 and 300 fm)	No HAPC designated for seamount groundfish
Crustaceans	Spiny and slipper lobster complex: Hawaiian spiny lobster (<i>Panulirus marginatus</i>), spiny lobster (<i>P. penicillatus</i> , <i>P. spp.</i>), ridgeback slipper lobster (<i>Scyllarides haanii</i>), Chinese slipper lobster (<i>Parribacus antarticus</i>) Kona crab: Kona crab (<i>Ranina ranina</i>)	Eggs and larvae: the water column from the shoreline to the outer limit of the EEZ down to a depth of 150 m (75 fm) Juvenile/adults: all of the bottom habitat from the shoreline to a depth of 100 m (50 fm)	All banks with summits less than or equal to 30 m (15 fathoms) from the surface
Crustaceans	Deepwater shrimp (<i>Heterocarpus</i> spp.)	Eggs and larvae: the water column and associated	No HAPC designated for deepwater shrimp.

Resource	Species Complex	EFH	HAPC
		outer reef slopes between 550 and 700 m Juvenile/adults: the outer reef slopes at depths between 300-700 m	
Precious Corals	Deep-water precious corals (150–750 fm): Pink coral (<i>Corallium secundum</i>), red coral (<i>C. regale</i>), pink coral (<i>C. laauense</i>), midway deepsea coral (<i>C. spp. nov.</i>), gold coral (<i>Gerardia sp.</i>), gold coral (<i>Callogorgia gilberti</i>), gold coral (<i>Narella spp.</i>), gold coral (<i>Calyptraphora spp.</i>), bamboo coral (<i>Lepidisis olapa</i>), bamboo coral (<i>Acanella spp.</i>) Shallow-water precious corals (10-50 fm): black coral (<i>Antipathes griggi</i>), black coral (<i>Antipathes grandis</i>), black coral (<i>Myriopathes ulex</i>)	EFH for Precious Corals is confined to six known precious coral beds located off Keahole Point, Makapuu, Kaena Point, Wespac bed, Brooks Bank, and 180 Fathom Bank EFH has also been designated for three beds known for black corals in the Main Hawaiian Islands between Milolii and South Point on the Big Island, the Auau Channel, and the southern border of Kauai	Includes the Makapuu bed, Wespac bed, Brooks Banks bed For Black Corals, the Auau Channel has been identified as a HAPC
Coral Reef Ecosystems	All Currently Harvested Coral Reef Taxa All Potentially Harvested Coral Reef Taxa	EFH for the Coral Reef Ecosystem Management Unit Species (MUS) includes the water column and all benthic substrate to a depth of 50 fathoms (fm) from the shoreline to the outer limit of the EEZ	Includes all no-take MPAs identified in the CRE-FMP, all Pacific remote islands, as well as numerous existing MPAs, research sites, and coral reef habitats throughout the western Pacific

¹ Source: WPRFMC 2009b, Table 16.

Bottomfish and Seamount Groundfish. Very little is known about the life histories, habitat utilization, diet, or reproductive behavior of most adult and juvenile bottomfish and seamount groundfish species (WPRFMC, 2009b).

Bottomfish MUS in the Western Pacific Region are found concentrated on steep slopes of deepwater banks near the 100-fathom isobath (WPRFMC, 2009b). Adult bottomfish are generally found in habitats with hard substrate with high structural complexity (WPRFMC, 2009b). Due to a lack of data on productivity of bottomfish in different habitats and the fishes utilization of these habitats, the WPRFMC has designated EFH for adult and juvenile bottomfish as the water column and all bottom habitat extending from the shoreline to a depth of 400 m (1,312 ft) encompassing the steep drop-offs and high-relief habitats that are important for bottomfish in the Western Pacific Region (WPRFMC, 2009b).

Eggs and larva of bottomfish MUS are pelagic and therefore subject to ocean currents (WPRFMC, 2009b). Since little is known about the distribution of egg and larval life stages, the WPRFMC has designated EFH for egg and larval bottomfish as the water column extending from the shoreline to the outer boundary of the EEZ to a depth of 400 m (1,312 ft) throughout the Western Pacific Region (WPRFMC, 2009b).

The WPRFMC (2009b) designated EFH for adult seamount groundfish MUS as all waters and bottom habitat bounded by latitude 29°-35° N and longitude 171° E-179° W between 80 and 600 m (262 and 1,969 ft). For seamount groundfish eggs, larvae, and juveniles, designated EFH includes the epipelagic zone (200 m in depth) of all waters bounded by latitude 29°-35° N and longitude 171° E-179° W (WPRFMC 2009b). All escarpments/slopes between 40-280 m throughout the Western Pacific Region are designated as HAPCs for bottomfish (WPRFMC 2009b).

Crustaceans. The WPRFMC (2009b) has designated EFH for two crustacean species assemblages; a spiny lobster, slipper lobster, and kona crab complex and a shrimp complex.

Spiny lobsters of the genus *Panulirus* are found throughout the Western Pacific Region including 13 species distributed in tropical and subtropical Pacific waters, 3 species which are absent from many island nations, and the Hawaiian spiny lobster (*P. marginatus*) which is endemic to Hawai'i and Johnston Atoll (WPRFMC 2009b). The slipper lobsters belong to a closely related family, Scyllaridae (WPRFMC, 2009b).

In the Main Hawaiian Islands, commercial catch landings of spiny lobsters in the EEZ are between 3,175 and 5,443 kg (7,000 and 12,000 lbs) annually while recreational and subsistence catch in these areas remains unknown (WPRFMC, 2009b). In the southwestern Pacific, spiny lobsters are typically found in association with coral reefs where they inhabit the rocky shelters in the windward surf zones of oceanic reefs and move to reef flats at night to forage (WPRFMC, 2009b). The EFH for adult and juvenile spiny lobster is designated at the bottom habitat from the shoreline to a depth of 100 m (328 ft) throughout the Western Pacific Region.

Little is known about spiny lobster egg production or larval settlement, however, the WPRFMC (2009b) has designated EFH for spiny lobster larvae as the water column from the shoreline to the outer limit of the EEZ down to a depth of 150 m (492 ft) throughout the Western Pacific Region.

The EFH for deepwater shrimp eggs and larvae is designated at the water column and associated outer reef slopes between 550 and 700 m (1,640 and 2,267 ft) and the EFH for juveniles and adults is designated as the outer reef slopes at depth between 300 and 700 m (984 and 2,267 ft; WPRFMC, 2009b).

Precious Corals. Precious corals are divided into deep- and shallow-water species complexes (WPRFMC, 2009b). Deep-water species such as pin coral (*Corallium secundum*), gold coral (*Gerardi* sp. and *Parazoanthus* sp.), and bamboo coral (*Lepidistis olapa*), are generally found between 350 and 1,500 m (1,148 and 4,921 ft) deep (WPRFMC, 2009b). Shallow-water species include three species of black coral (*Antipathes griggi*, *A. grandis*, and *Myriopathes ulex*, which occur between 30 and 100 m (98 and 328 ft) deep (WPRFMC, 2009b). These corals are non-reef building and are found on solid substrate in areas with moderate to strong bottom currents which keep the area swept free of accumulated sediments which would prevent settlement of new larvae (WPRFMC, 2009b). In the Hawaiian Islands, large beds of precious corals are found in deep interisland channels in the Hawaiian Islands and the WPRFMC (2009b) has designated six known beds of precious corals as EFH. These beds are found at Keahole Point, Makapuu, Kaena Point, Wespac, Brooks Bank, and 180 Fathom Bank.

Coral Reef Ecosystems. For coral reef ecosystem MUS, the WPRFMC (2009b) has designated EFH based on habitat, including sand, live coral, seagrass beds, mangrove, and open ocean, for each life history stage where EFH is consistent with the depth of the ecosystem to 91 m (300 ft) and out to the limit of the EEZ. Since little data are available concerning life history, habitat utilization, food habits, and spawning behavior of most coral reef associated species, these species are farther divided into currently harvested coral reef taxa MUS and potentially harvested coral reef taxa MUS (WPRFMC, 2009b).

Detailed information concerning species assemblages for these MUS and known habitat usage for adults, spawners, juveniles, larvae, and eggs are available in the Fishery Ecosystem Plan for the Pacific Remote Island Area (WPRFMC, 2009b). Currently harvested coral reef taxa MUS include certain species of surgeonfish and unicornfish (Acanthuridae), triggerfish (Balistidae), jacks (Carangidae), reef sharks (Carcharhinidae), soldierfish and squirrelfish (Holocentridae), flagtails (Kuhliidae), rudderfish (Kyphosidae), wrasses (Labridae), goatfish (Mullidae), octopuses (Octopodidae), mullets (Mugilidae), moray eels (Muraenidae), threadfins (Polynemidae), bigeyes (Priacanthidae), rabbitfish (Siganidae), parrotfishes (Scaridae), tuna and mackerel (Scombridae), barracudas (Sphyraenidae), and turban shells (Turbinidae; see WPRFMC 2009b Table 12 for detailed species list). Potentially harvested coral reef taxa MUS include species in over 45 families of ray-finned fish, 4 families of sharks and rays, stony corals, blue corals (*Helipora*), organpipe (Tubipora), azooxanthellate corals, mushroom corals (Fungiidae), polyped corals, firecorals (*Millepora*), soft corals, anemones, zooanthids, sponges, hydrozoans, lace corals (Stylasteridae), bryozoans, tunicates, feather worms (Sabellidae), echinoderms, sea snails (Gastropoda), Trochus, sea slugs (Opisthobranchs), black lipped pearl oyster (*Pinctada margaritifera*) and other bivalves, cephalopods, octopuses, lobsters, shrimp, crabs, annelid worms, and algae species (see WPRFMC 2009b Table 14 for details). While the EFH differs slightly for some species assemblages/complexes, taken together, the EFH for all life stages of both currently harvested coral reef taxa MUS and potentially harvested coral reef taxa MUS encompasses the water column and bottom habitat from the shoreline to the outer boundary of the EEZ to a depth of 50 fathoms (WPRFMC, 2009b).

Coral. Corals are invertebrates that are related to anemones, jellyfish, and hydras. They are made of invertebrate polyps and can generally be categorized as either hard or soft. Hard corals have calcium carbonate skeletons, grow in colonies, and are reef-building animals that live in symbiosis with phytoplankton called zooxanthellae. Soft corals are flexible, have calcareous particles in their body walls for structural support, can be found in both tropical and cold ocean waters, do not grow in colonies or build reefs, and do not always contain zooxanthellae.

Total coral cover in the Nohili Sector north of PMRF Main Base ranges from 32% to 39% of bottom cover (US Navy, 2008). The most abundant coral species are lobe coral, rose or cauliflower coral (*Pocillopora meandrina*), and ringed rice coral (*Montipora patula*). Along the central portion of PMRF, living coral is sparsely distributed, approximately one half of that found in the Nohili area (US Navy, 2008). The dominant species is lobe coral. Coral cover further south in the Major's Bay Sector is less than 2% (US Navy, 2008). Further offshore, the predominant coral is antler coral (*Pocillopora eydouxi*), which occurs as single large branching colonies (US Navy, 2008). Other corals found in this area are primarily smaller species which have a collective coverage of about 5% of bottom cover: rose or cauliflower coral, lobe coral, corrugated coral (*Pavona varians*), flat lobe coral (*P. duerdeni*), blue rice coral (*Montipora flabellata*), ringed rice coral, Verrill's ringed rice coral (*M. verrilli*), rice coral (*M. capitata*), crust coral (*Leptastrea purpurea*), and mushroom coral (*Fungia scutaria*; US Navy, 2008).

No known special-status coral are found in the ROI near KTF.

Non-coral Invertebrates. Animals that live on the sea floor are called benthos. Most of these animals lack a backbone and are called invertebrates. Typical benthic invertebrates found near PMRF include sea anemones, sponges, corals, sea stars, sea urchins, worms, bivalves, crabs, and many more (US Navy, 2008). Common animals found in rocky intertidal habitats include limpets, periwinkles, littorine snails, rock crabs, gastropods, and rock urchins (USASMD/ARSTRAT, 2011). Further offshore in coral reef habitats, macroinvertebrates include the rock oyster (*Spondylus tenebrosus*), cone shells (*Conus* spp.), sea urchins

(*Echinometra mathaei*), and sea cucumbers (*Holothuria atra*; US Navy, 2008). No known special-status invertebrates are found in the ROI near KTF.

Coral

Corals are invertebrates that are related to anemones, jellyfish, and hydras. They are made of invertebrate polyps and can generally be categorized as either hard or soft. Hard corals have calcium carbonate skeletons, may live as solitary individuals or in colonies, and many are reef-building animals that live in symbiosis with phytoplankton called zooxanthellae. Soft corals are flexible, have calcareous particles in their body walls for structural support, can be found in both tropical and cold ocean waters, may be solitary or colonial, and do not always contain zooxanthellae.

Special status adult shallow-water reef-associated corals do not occur in the BOA portion of the ROI because their required shallow habitat is absent. At various times of the year the gametes (eggs and sperm) and larvae of reef-associated invertebrates may occur in the BOA. For corals, this is generally July to December and particularly the week following the August and September full moons. The densities of coral larvae are difficult to predict, but studies of coral larvae during peak spawning report 0.1 to 1 planktonic larvae m^{-3} in waters 5 km away from the reef, and 1.6 m^{-3} (brooding species) to 16 m^{-3} (spawning species) in waters directly over the reef during reproduction (Hodgson, 1985). Because of the relatively large distances between reefs and the BOA, larval density in the BOA is likely to be near the lower range. Eggs, larvae, and planulae are not homogeneously distributed but sometimes travel in semi-coherent aggregations (slicks) or become concentrated along oceanic fronts (Hughes et al., 2000; Jones et al., 2009). It would be unlikely that these shallow-water reef-associated larvae would occur in spent motor drop zones in the BOA because they are so far up current from sources of larvae.

Non-coral Benthic Invertebrates

Animals that live on the sea floor are called benthos. Most of these animals lack a backbone and are called invertebrates. Typical benthic invertebrates include sea anemones, sponges, corals, sea stars, sea urchins, worms, bivalves, crabs, and many more.

There are two special status mollusk species in the ROI: the commercial top snail and the black-lipped pearl oyster. The commercial top snail (*Tectus niloticus*) is regulated by Marshall Islands Revised Code 1990, Chapter 3. The black-lipped pearl oyster (*Pinctada margaritifera*) is regulated by Marshall Islands Revised Code 1990, Chapter 1, § 5.

Adult shallow-water reef-associated mollusks that require consultation do not occur in the BOA of the ROI because their required shallow habitat is absent. At various times of the year the gametes (eggs and sperm) and larvae of reef-associated invertebrates may occur in the BOA. The densities of mollusk larvae are difficult to predict as there is much variation in life histories both among species and among individuals within a species (Hadfield and Strathmann, 1996). Researchers have found that marine invertebrate species have variation in both timing and duration of breeding seasons with latitude and annual environmental conditions (Hadfield and Strathmann, 1996). Marine invertebrate species may also have variation in the duration of the pelagic larval phase depending on life history characteristics, environmental conditions such as water temperatures, and ultimately, presence of suitable substrate to induce metamorphosis (Hadfield and Strathmann, 1996; Scheltema, 1971). Because of the relatively large distances between reefs and the BOA, overall larval density in the BOA is likely to be much lower. However, eggs and larvae are not homogeneously distributed and sometimes travel in semi-coherent aggregations (slicks) or become concentrated along oceanic fronts (Hughes et al., 2000; Jones et al., 2009). It would be unlikely that shallow-

water, reef-associated invertebrate larvae would occur in spent motor drop zones because they are so far up current from their sources.

3.3 US Army Kwajalein Atoll (USAKA), Republic of the Marshall Islands

This section includes detailed descriptions of cultural resources, biological resources, noise, public health and safety, and hazardous materials and wastes.

The potential impacts to the following resource areas within this geographical area are considered to be negligible or non-existent so they were not analyzed in detail in this EA/OEA:

Air Quality, Greenhouse Gases, and Climate Change: Because of the relatively small numbers and types of local air-pollution sources, the dispersion caused by trade winds, and the lack of topographic features that inhibit dispersion, air quality at USAKA is considered good. The primary activities at USAKA contributing to air pollution are combustion sources that produce particulates, nitrous oxide, sulfur dioxide, carbon monoxide, and hydrocarbon emissions. (UES§1-5.3, 2016) Most of these sources are located on Kwajalein Island and are regulated under the current version Air Emissions from Major, Synthetic Minor, and Industrial Boiler Stationary Sources Document of Environmental Protection 2013 (Air DEP). There are no ongoing, regulated primary air emission activities at Illeginni Islet or in the BOA proposed impact locations and there would be no change to air emissions on Kwajalein from the Proposed Action.

The developmental payload would not emit HAPs during flight or impact in USAKA and no major stationary emission sources would be involved or affected. Fugitive dust from a land impact would be temporary and quickly dispersed by trade winds. Prior to debris recovery at Illeginni Islet, the area would be wetted with freshwater to minimize fugitive dust. Although global sea level is documented to be rising based on climate change and the islands within USAKA are of low elevations, the subtle effects of rising sea level and climate change would not affect the single flight test within a year after signing of the FONSI, if approved, nor would the FE-1 flight test affect climate change. No impacts to air quality, greenhouse gases, or climate change would be expected from the FE-1 flight test.

Water Resources: Illeginni has no surface water; groundwater is very limited in quantity, and is saline and non-potable. Fresh water used to minimize fugitive dust following impact would not be allowed to flow to the lagoon or ocean and would evaporate in place. In the unlikely event of an accidental release of a hazardous material or petroleum product at the impact site, emergency response personnel would comply with the UES Kwajalein Environmental Emergency Plan (KEEP). No impacts to water resources would be expected.

Geological Resources: There would be no mining or quarrying and little, if any, surface disturbance during the placement of equipment prior to the flight test. While a temporary crater would be created at impact on Illeginni Islet, the crater would be refilled with ejecta and the site topography restored. No impact would occur to geological resources from the FE-1 flight test.

Land Use: No changes to land use would occur from the FE-1 flight test. Illeginni Islet has served as the flight termination site for numerous ballistic and target test flights. The FE-1 flight test activities are consistent with the RTS mission and are well within the limits of current operations of RTS and USAG-KA.

Airspace: Illeginni Islet and the two BOA locations are located under international airspace and, therefore, have no formal airspace restrictions governing them. No new special use airspace would be required, expanded, or altered for the FE-1 flight test. Local airport operations would not be affected. Commercial and private aircraft would be notified through FAA NOTAMs in advance of the launch at the request of RTS as

part of their routine operations. Flight operations would be conducted in accordance with Western Range and RTS procedures. There would be no impacts to airspace from the FE-1 flight test.

Infrastructure: There would be no changes and, therefore, no impacts to infrastructure at USAKA. The Proposed Action represents activities that are consistent with the mission and well within the limits of current operations of RTS and USAG-KA.

Transportation: Transportation services would be unaffected by the FE-1 flight test at Kwajalein Atoll. Public NOTAMs and NOTMARS would be issued along the flight path, to include Kwajalein Atoll, to protect the safety of aircraft and vessels. The payload would impact at Illeginni Islet where there is no resident population, to ensure, along with the public notices, that there would be no unauthorized vessels or aircraft in the vicinity. Transport of FE-1 flight test materials, equipment and personnel to and from USAKA and the impact site would occur using existing transportation methods. The flight test activities are consistent with the mission and well within the limits of current operations of RTS and USAG-KA. There would be no impacts from the FE-1 flight test to transportation at Kwajalein Atoll.

Socioeconomics: Use of USAKA by the US Army is maintained under the MUORA and Compact of Free Association, with lease payments made to the Marshallese landowners. The current lease is valid through 2066 with an additional option through 2086. Personnel conducting the FE-1 flight test would reside only temporarily at USAKA, and the flight test would not employ any Marshallese citizens or contribute to the local Marshallese economy. There currently is no resident population at Illeginni Islet. Therefore, there would be no impacts to socioeconomics from the FE-1 flight test.

Environmental Justice: Illeginni Islet does not include any population centers; there currently is no resident population at Illeginni Islet. Therefore, there would be no disproportionate impacts from the FE-1 flight test Flight Test to minority populations and low-income populations as defined under Executive Order 12898.

Visual Resources: There would be no changes to and, therefore, no impacts to the visual aesthetics at USAKA from the FE-1 flight test.

Marine Sediments: For a deep water impact, there would be no marine sediment disturbance beyond the settling of the payload as it comes to rest on the sea floor after splashing into the ocean at impact and sinking thousands of meters (feet). For an Illeginni Islet impact, which is the Preferred Alternative, some ejecta may be thrown into shallow waters. There would be no impacts to marine sediments in USAKA from the FE-1 flight test.

3.3.1 Cultural Resources

Cultural resources are material remains of human activity that are significant in the history, prehistory, architecture, or archaeology of the RMI. They include prehistoric resources (produced by preliterate indigenous people) and historic resources (produced since the advent of written records).

3.3.1.1 Regulatory Setting

The UES standards for Cultural Resources (UES§3-7) are derived from the National Historic Preservation Act (NHPA). The Act establishes federal responsibilities and implementing regulations in 36 CFR 800 and in the US Archaeological and Historic Preservation Act (Public Law 93-291). The regulations for promoting cultural preservation that are in the RMI's Historic Preservation Act 1991 (45 Marshall Islands Revised Code, Chapter 2) was considered in developing UES§3-7. (UES§1-5.9)

The Standards for cultural resources are similar, with a few exceptions, to the US statutes and regulations on which they are based. Under the UES, the US Advisory Council on Historic Preservation (ACHP) does not

have a formal role but may be used as a resource by the RMI Historic Preservation Officer (RMIHPO). The RMI ACHP reviews documentation of interaction between USAKA and RMIEPA in certain instances and may be called upon to mediate disagreements between the RMIHPO and the Commander, USAG-KA. Under the Standards, the RMIHPO executes the function of the state historic preservation office. All communication between USAG-KA and the RMIHPO is conducted through RMIEPA. The Standards substitute the RMI National Register of Historic Places and its listing criteria for the corresponding US Register and listing criteria.

A programmatic DEP (current version - Cultural Resources DEP 2006) on protecting cultural resources at USAKA addresses the potential effects of routine operations at USAKA on cultural resources and the procedures for identifying potential cultural resources in areas where they are not known. The programmatic DEP also establishes mitigation procedures for all adverse effects on previously unidentified cultural resources. For proposed activities not covered by the programmatic DEP, a specific DEP that discusses the potential for effects on cultural resources is required. The Navy SSP would complete a Notice of Proposed Activity (NPA) and DEP for the FE-1 flight test that addresses all applicable areas of the UES.

3.3.1.2 Region of Influence (ROI)

Illeginni Islet (Preferred Impact Location)

The ROI includes those areas on Illeginni Islet where FE-1 flight test activities would occur. Surface cover from construction of a helipad, roads, and facilities, and operational disturbances encompass almost the entirety of Illeginni Islet. Vegetative cover is moderate in some areas and represents regrowth since the early 1970s construction occurred. (HPP, 2006)

Limited subsurface testing on the Islet found severe disturbance to the original land surface, especially along the lagoon-facing shoreline; most of which was bulldozed at some time in the past. With the construction of the remote launch site on the east side of the Islet and subsequent use of the Illeginni as a target impact site, any buried traditional or prehistoric remains are likely under significant amounts of modern fill. Archaeological surveys conducted in 1988 (Craib, et al., 1989) failed to identify any sites on Illeginni Island. Surveys and subsurface testing in 1994 (Panamerican Consultants, Inc.) identified midden-associated (refuse heap) charcoal along the lagoon shoreline that is most likely a modern intrusion; this site was not recommended as eligible for inclusion in the RMI NRHP. (HPP, 2006) No indigenous cultural materials or evidence of subsurface deposits has been found.

In September 1996, a survey of Cold War-era properties at USAKA was completed; a Cold War Historic Context study that built on the 1996 survey was completed in 2012. Several buildings and structures at USAKA are eligible for listing on the RMI NRHP under a Missile Defense Cold War context. Seven potentially eligible buildings are located on Illeginni Islet, and three of those are considered to be significant. These are primarily missile launch facilities and associated buildings. The buildings and other facilities are primarily located in the central and eastern portions of the Islet. Most of them are no longer used and have been abandoned in place. (Leslie Mead, KRS, personal communication, 2014)

Offshore Waters – Southwest and Northeast (Alternative Impact Locations)

There are no cultural resources identified at either of the offshore water impact locations.

3.3.2 Biological Resources at Kwajalein Atoll

Biological resources and habitat are defined at in section 3.1.3. Biological resources at and near Kwajalein Atoll are divided into three major categories: (1) terrestrial vegetation, (2) terrestrial wildlife, and (3) marine

wildlife. Threatened, endangered, and other special status species are discussed in their respective categories. For purposes of this assessment, the ROI focused on those areas at Illeginni Islet (Preferred Alternative) or in deep ocean waters near USAKA (Southwest and Northeast Action Alternatives) affected by FE-1 flight test missile component impacts, elevated sound pressure levels, and increased human and/or equipment activity. The following subsections describe biological resources for marine and terrestrial environments within the ROI according to the environmental setting, important habitats, and the species requiring agency consultation or coordination. Table 3-10 lists all special status species requiring consultation under the UES that are potentially present at or near Kwajalein Atoll. All coordination species are listed in Appendix B.

Table 3-10 Special-Status Species Requiring Consultation Known to Occur or Potentially Occurring in ROI at Illeginni and the Offshore Waters of Kwajalein Atoll

Common Name	Scientific Name	ESA Listing Status	Protection Status	LoO in the Kwajalein Atoll Offshore Waters	LoO at or near Illeginni Islet
Cetaceans					
Minke whale	<i>Balaenoptera acutorostrata</i>	-	MMPA	L	P
Sei whale	<i>B. borealis</i>	E	MMPA	P	U
Bryde's whale	<i>B. edeni</i>	-	MMPA	L	P
Blue whale	<i>B. musculus</i>	E	MMPA	P	U
Fin whale	<i>B. physalus</i>	E	MMPA	P	U
Short-beaked common dolphin	<i>Delphinus delphis</i>	-	MMPA	L	P
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	-	MMPA	L	L
Humpback whale	<i>Megaptera novaeangliae</i>	E	MMPA	P	U
Killer whale	<i>Orcinus orca</i>	-	MMPA	L	P
Melon-headed whale	<i>Peponocephala electra</i>	-	MMPA	L	P
Sperm whale	<i>Physeter macrocephalus</i>	E	MMPA	L	L
Pantropical spotted dolphin	<i>Stenella attenuata</i>	-	MMPA	L	P
Striped dolphin	<i>S. coeruleoalba</i>	-	MMPA	L	P
Spinner dolphin	<i>S. longirostris</i>	-	MMPA	L	L
Bottlenose dolphin	<i>Tursiops truncatus</i>	-	MMPA	L	P
Sea Turtles					
Green turtle	<i>Chelonia mydas</i>	E, T	ESA	L	L
Hawksbill turtle	<i>Enetmochelys imbricata</i>	E	ESA	L	P
Fish					
Bigeye thresher shark	<i>Alopias superciliosus</i>	C	UES	P	U
Oceanic whitetip shark	<i>Carcharhinus longimanus</i>	C	UES	P	U
Humphead wrasse	<i>Cheilinus undulatus</i>	-	UES	U	L

Common Name	Scientific Name	ESA Listing Status	Protection Status	LoO in the Kwajalein Atoll Offshore Waters	LoO at or near Illeginni Islet
Reef manta ray	<i>Manta alfredi</i>	C	UES	P	P
Oceanic giant manta ray	<i>M. birostris</i>	C	UES	P	U
Scalloped hammerhead shark	<i>Sphyrna lewini</i>	T	ESA	P	P
Pacific bluefin tuna	<i>Thunnus orientalis</i>	C	UES	P	U
Corals					
	<i>Acanthastrea brevis</i>		UES	U	L
	<i>Acropora aculeus</i>		UES	U	L
	<i>A. aspera</i>		UES	U	L
	<i>A. dendrum</i>		UES	U	L
	<i>A. listeri</i>		UES	U	L
	<i>A. microclados</i>		UES	U	L
	<i>A. polystoma</i>		UES	U	L
	<i>A. speciosa</i>	T	ESA	U	P
	<i>A. tenella</i>	T	ESA	U	P
	<i>A. vauhani</i>		UES	U	P
	<i>Alveopora verilliana</i>		UES	U	L
	<i>Cyphastrea agassizi</i>		UES	U	L
	<i>Heliopora coerulea</i>		UES	U	L
	<i>Leptoseris incrustans</i>		UES	U	P
	<i>Montipora caliculata</i>		UES	U	L
	<i>Pavona cactus</i>		UES	U	P
	<i>P. venosa</i>		UES	U	L
	<i>Turbinaria reniformis</i>		UES	U	L
	<i>T. stellulata</i>		UES	U	L
Mollusks					
Black-lipped pearl oyster	<i>Pinctada margaritifera</i>		UES	U	P
Giant clam	<i>Hippopus hippopus</i>	C	UES	U	L
Top snail	<i>Tectus niloticus</i>		UES	U	L
Giant clam	<i>Tridacna gigas</i>	C	UES	U	L
Giant clam	<i>T. squamosa</i>	C	UES	U	L

Abbreviations: LoO = Likelihood of Occurrence; ESA = Endangered Species Act; C = candidate species for federal ESA listing; C = ESA candidate species; E = federal endangered; T = federal threatened; MMPA = Marine Mammal Protection Act; UES = UES protection (USASMD/ARSTRAT 2016 Section 3-4.5.1); L = Likely; P = Potential.

3.3.2.1 Regulatory Setting

The Compact of Free Association between the RMI and the US (48 US Code [USC], Section [§] 1921) requires all US Government activities at USAG-KA (formerly known as US Army – Kwajalein Atoll [USAKA]) and all DoD and RTS activities in the RMI to conform to specific compliance requirements, coordination procedures, and environmental standards identified in the *Environmental Standards and Procedures for USAKA Activities in the RMI*, also known as the USAKA Environmental Standards (UES). As specified in Section 2-2 of the UES, these standards also apply to all activities occurring in the territorial waters of the RMI. The proposed Navy developmental payload test, which could affect Illeginni Islet, the deep-water region southwest of Illeginni Islet, or the deep ocean waters northeast of Kwajalein Atoll, must comply with the UES (USASMDC/ARSTRAT 2016).

For the purposes of this EA/OEA, special-status species at or near Kwajalein Atoll are those species protected under the standards identified in the UES. Section 3-4 of the UES contains the standards for managing endangered species and wildlife resources. The standards in this section were derived primarily from 50 Code of Federal Regulations (CFR), Sections (§§) 17, 23, 402, 424, and 450-452, which include provisions of the ESA (16 USC, §§ 1531-1544) and other regulations applicable to biological resources. The Marshall Islands Marine Resources Authority manages marine resources in the RMI, which does not participate in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

The UES provides protection for a wide variety of marine mammals, sea turtles, fish, mollusks, coral species, birds, and other terrestrial and marine species, which are listed in Section 3-4 of the UES (USASMDC/ARSTRAT, 2016). This protection applies to all of the following categories of biological resources occurring within the Marshall Islands, including RMI territorial waters:

- Any threatened or endangered species listed under the US ESA
- Any species proposed for designation or candidates for designation to the endangered species list in accordance with the US ESA
- All species designated by the RMI under applicable RMI statutes, such as the RMI Endangered Species Act of 1975, Marine Mammal Protection Act of 1990, Marine Resources (*Trochus*) Act of 1983, and the Marine Resources Authority Act of 1989
- Marine mammals designated under the US Marine Mammal Protection Act of 1972
- Bird species pursuant to the Migratory Bird Conservation Act (MBCA)
- Species protected by the Convention on International Trade in Endangered Species (CITES), or mutually agreed on by USAG-KA, USFWS, NMFS, and the RMI Government as being designated as protected species (USASMDC/ARSTRAT, 2014a).

3.3.2.2 Region of Influence (ROI)

Illeginni Islet (Preferred Impact Location)

Illeginni Islet is 31 acres (12.5 hectares) of land area with several buildings (mostly abandoned), towers, roads, a helipad, and a dredged harbor area. Illeginni Islet also has terrestrial and marine habitats of significant biological importance, as defined in the UES.

Vegetation at Illeginni Islet. Illeginni Islet vegetation is previously disturbed and managed on much of the western end of the island and around buildings/facilities. Native vegetation present on the islet consists of one patch of herbaceous vegetation and three patches of littoral (near shore) forest (Figure 3-6). The forest areas are made up primarily of *Pisonia*, *Intsia*, *Tournefortia*, and *Guettarda* trees. Some littoral shrub land

can also be found mostly on the western end of the islet (USAF, 2010; USFWS, 2011). No vegetation species of special status occur on Illeginni Islet.

Terrestrial Wildlife at Illeginni Islet. A number of protected migratory and resident seabirds and shorebirds have been seen breeding, roosting, or foraging on Illeginni Islet (Appendix B, Table B-4). Biological inventories conducted on the islet by the USFWS and NMFS have identified at least 14 bird species, including the black noddy, pacific golden plover, wandering tattler, and ruddy turnstone (Appendix B, Table B-4). Migratory birds protected under the MBCA within USAKA receive protection under the UES. None of these species, however, are currently listed as protected under the US ESA. Surveys have shown shorebirds to use the littoral forest, littoral shrub, and managed vegetation throughout the islet's interior (Figure 3-6). Pooled water on the paved areas attracts both wintering shorebirds and some seabirds (e.g., terns and plovers). White terns have been observed in trees at the northwest corner and southwest quadrant of the islet. The shoreline embankment and exposed inner reef provides a roosting habitat for great crested terns and black-naped terns. Black-naped tern nests with eggs and/or chicks were recorded on Illeginni in 2012 and 2014 and are known to nest in the vicinity of the impact area (Michael Fry, personal communication, 24 April 2017). Concentrations of seabirds have also been seen in the littoral forest on the southeast side of the islet, which supports the second largest nesting colony of black noddies recorded on the USAKA-leased islets; 339 nests were identified in 2008. In general, the nesting season for seabirds and shorebirds at Illeginni and other USAKA islets begins in October and continues through April. Exceptions include white terns, which may nest throughout the year (USAF, 2010; USFWS, 2011) and black-naped terns, which are known to nest in March and October/November but may nest throughout the year (Michael Fry, personal communication, 24 April 2017). These migratory and resident bird species are considered coordination species under the UES. There are no known consultation bird species present on Illeginni Islet.

Suitable sea turtle haul-out/nesting habitat exists along the shoreline on the northwestern and eastern sides of Illeginni.

Other terrestrial species observed on Illeginni include brown rats, red and black ants, and skinks. These non-native species were accidentally introduced to the islet some years earlier (USAF, 2010; USFWS, 2011a).

In 1996, three sea turtle nesting pits were found on the northwestern tip of Illeginni Islet. No pits were observed during the 1998, 2000, 2002, 2004, 2006, 2008, or 2010 biological inventories of Illeginni; however, the habitat still appeared suitable for resting and nesting. On a few occasions, adult hawksbill and green sea turtles have been seen in the waters offshore. Within Kwajalein Atoll, nesting for both hawksbill and green sea turtles has been observed to occur throughout the year (USAF, 2010; USFWS, 2011a).

Marine Wildlife at Illeginni Islet. The marine environment surrounding Illeginni Islet supports a diverse community of fish, corals, and other invertebrates. In general, coral cover and invertebrate diversity is moderate to high on the lagoon reef slopes and around the eastern seaward reef crest and slopes as well as off the seaward western side. While portions of the western seaward reef area are pavement and cobble with limited diversity and abundance of marine wildlife, much of the area has reef flats and ridges with dense assemblages of corals and other marine organisms.



Figure 3-6 Illeginni Islet Littoral Forest, Potential Sea Turtle Nesting/Haulout Areas, and Notional Payload Impact Zone

There are many invertebrate and vertebrate species found in the vicinity of Illeginni Islet which require coordination and several that require consultation. Coordination species observed on recent biological inventories are listed in Appendix B (species are listed in Table B-1 for fish, Table B-2 for mollusks, and Table B-3 for hard corals). Consultation species are listed in Table 3-10.

Marine Mammals. Marine mammals do not occur in the shallow waters immediately adjacent to Illeginni Islet where debris from payload impact has the potential to enter the marine environment. Some marine mammals (Table 3-10) may occur in deeper waters near Illeginni Islet in areas subject to increased vessel activity and elevated sound pressure levels. On the ocean side of the atoll, cetaceans have occasionally been seen and heard (underwater clicking sounds such as those known to be produced by sperm whales) in the vicinity of Illeginni Islet. There have been documented occurrences of sperm whales in the Illeginni Islet area for several years. In 2000, a pod of approximately 12 endangered sperm whales was seen a few miles southeast of Illeginni. In 2006, two sperm whales, eight short-finned pilot whales, and a large group of spinner dolphins were sighted near the area. In 2007, three marine hydrophones deployed near Illeginni Islet detected sperm whales during March, May, and September. In April 2009, an estimated four sperm whales were sighted a few miles southeast of Illeginni (Nosal, 2011; USAFGSC and USASMDC/ARSTRAT, 2015; USAF, 2010). NOAA Fisheries maintains jurisdiction over whales, dolphins, and porpoises, seals.

Potential threats to cetaceans near Illeginni Islet and hearing ability of these species are the same as for those species in other portions of the ROI (see section 3.2.2.2).

Sea Turtles. Of the five species of sea turtle discussed in Sections 3.2.2, only the green turtle and hawksbill turtle are known to occur in the waters of the RMI. Green turtles are more common, while hawksbills are considered rare or scarce (Maison et al., 2010). Only green and hawksbill turtles are known to occur in the vicinity of Illeginni Islet. During the 2010 marine inventory at Illeginni, 4 adult green turtles were observed at 3 of 4 survey stations (USFWS and NMFS, 2012). During 2012, marine inventories of Harbors on Kwajalein Atoll Islets, green turtles were only observed in one harbor and this was at Illeginni Islet (USFWS and NMFS 2017). Sea turtles are highly migratory and utilize the waters of more than one country in their lifetimes. The USFWS and NOAA Fisheries share federal jurisdiction for sea turtles with the USFWS having lead responsibility on the nesting beaches and NOAA Fisheries, the marine environment.

In addition to the threats all sea turtles species face throughout their ranges (see discussion in section 3.2.2), sea turtle near Kwajalein Atoll have the potential to be effected by local threats. In the RMI, sea turtles are an important part of Marshallese culture; they are featured in many myths, legends, and traditions, where they are revered as sacred animals. Eating turtle meat and eggs on special occasions remains a prominent part of the culture. Presently, despite national and international protection as endangered species, marine turtles remain prestigious and a highly desired source of food in the RMI (Kabua and Edwards, 2010). Turtles have long been a food source in the RMI, though the level of exploitation is unknown. Direct harvest of eggs and nesting adult females from beaches, as well as direct hunting of turtles in foraging areas, continues in many areas. Anecdotal information from RMI residents suggests a decline in the green turtle population, possibly of up to 50% in the last 10 years (McCoy 2004). The harvest of sea turtles in the RMI is regulated by the RMI Marine Resources Act, which sets minimum size limits for greens (86 centimeter [cm; 34-inch (in)] carapace length) and hawksbills (69 cm [27 in] carapace length) and closed seasons from June 1 to August 31 and December 1 to January 31. Egg collecting and take of turtles while they are onshore is prohibited (Kabua and Edwards, 2010). The Marshall Islands Marine Resources Authority manages marine resources in the RMI, which does not participate in CITES.

Sea turtles' long life expectancy and site fidelity may make them vulnerable to chronic exposure to marine contaminants (Woodrom Rudrud et al., 2007). Sea turtles may also be vulnerable to the bioaccumulation of heavy metals in their tissues (Sakai et al., 2000). At this time, the amount of contaminants in the marine environment at USAG-KA has not been measured, and sea turtles in the RMI have not been tested for heavy metal levels in blood or tissues. Several studies evaluating sources and contaminants in marine waters, sediments, and organisms have been completed at USAKA for the USAG-KA Environmental Cleanup program. Specifically, the Kwajalein Harbor (USAKA/RTS, 2013), Kwajalein Landfill (USAG-KA, 2017), and US Army Public Health Center (USAPHC, 2014) Fish Studies have brought to light sources and releases of contaminants that have made their way into the marine environment. While the purpose of each of these studies was related to issues of release and cleanup, results of several of the studies have indicated there are contaminant concentrations of concern in marine waters, sediments, and organisms at some USAKA sites. Following the USAPHC fish study, it was determined that several lagoon "No Fishing" areas would be established to safeguard the Marshallese and US inhabitants of USAKA because contaminant concentrations in lagoon reef fish are at levels where they may adversely affect public health, the marine environment, and protected beneficial uses of surface water (e.g., fishing). The implications to marine organisms, including sea turtles, are that they also could be affected, particularly by ingestion of fish, algae, and other food sources within the waters at Kwajalein Atoll. Damage to coral reefs can reduce foraging habitat for hawksbill turtles, and damage to seagrass beds and declines in seagrass distribution can reduce near shore foraging habitat for green turtles in the RMI (NMFS and USFWS, 2007c; 1991).

Fish. Many species of reef-associated fish are found in the vicinity of Illeginni Islet. A single consultation species, the humphead wrasse (*Cheilinus undulatus*), has been observed on biological inventories at Illeginni Islet. A second species of fish, *Plectropomus laevis*, has been observed near Illeginni Islet, is a SOSBI species under the UES, and is therefore a coordination species (USASMDC/ARSTRAT, 2016). Both species have been observed at multiple locations throughout USAKA (Table 3-11). One other consultation species, the reef manta ray (*Manta alfredi*), has been observed at two sites near Kwajalein Islet in biennial inventories (Table 3-11). Though this species has not been recorded near Illeginni Islet, it has the potential to occur in this area. Scalloped hammerhead sharks are found in nearshore areas including bays and estuaries, over continental shelves, and around coral reefs (Defenders of Wildlife, 2015). While some reports of scalloped hammerhead sharks in the vicinity of Illeginni Islet are known (M. Molina, Pers. Comm., 2014), this species likely has a sparse and sporadic distribution near Illeginni islet.

Table 3-11 Consultation and Coordination Fish Species Frequency of Occurrence at 2010 Biological Inventory Sites at Illeginni Islet and Throughout Kwajalein Atoll

Scientific Name	Common Name	Listing Status*	Frequency at Illeginni Islet (n=4 Sites)	Frequency Throughout Kwajalein Atoll (n=61 Sites)
<i>Cheilinus undulatus</i>	Humphead wrasse	UES, SOSBI	0.25	0.18
<i>Manta alfredi</i>	Reef manta ray	ESA Candidate	--	0.03
<i>Plectropomus laevis</i>	Giant coral trout	UES, SOSBI	0.50	0.10

* Sources: USASMDC/ARSTRAT 2014a, USAFGSC and USASMDC/ARSTRAT 2015

Listing Status; ESA: Endangered Species Act, SOSBI: Species of Significant Biological Importance, UES: UES protection (USASMDC/ARSTRAT 2011a Section 3-4.5.1)

In addition to these coordination and consultation species, there have been many other reef-associated fish observed in the vicinity of Illeginni Islet during biological inventories. These fish include many species of squirrelfishes, pipefish, groupers, hawkfish, jacks, and snappers.

The humphead wrasse is found at low densities (1 to 8 per acre) where it occurs, and is generally observed as solitary male/female pairs or in small groups of two to seven individuals (NMFS, 2009). This fish occurs in coral reef regions of the Indo-Pacific in depths from 3-330 ft (1-100 m; WildEarth Guardians, 2012). Both juveniles and adults utilize reef habitats. While juveniles inhabit denser coral reefs closer to shore, adults live in deeper, more open water at the edges of reefs in channels, channel slopes, and lagoon reef slopes (Donaldson and Sadovy, 2001). While there is limited knowledge of their movements, it is believed that adults are largely sedentary over a patch of reef and during certain times of the year they move short distances to congregate at spawning sites (NMFS, 2009).

Threats to special-status fish include overharvest as well as habitat destruction and degradation (NMFS, 2009). The humphead wrasse is especially vulnerable to overharvest by both legal and illegal fishing activities due to their long lifespan, large size, and unique life history of female to male sex change later in life (NMFS, 2009). Another significant threat to the decline of reef-associated fish species is habitat loss and degradation, specifically destruction and degradation of reef habitats, which is common throughout the Indo-Pacific (NMFS, 2009).

No EFH exists near Illeginni Islet.

Coral. The marine environment surrounding Illeginni supports a community of corals that is typical of reef ecosystems in the tropical insular Pacific. Within this community are species of corals that are protected by

an assortment of regulatory mechanisms (Table 3-10 and Appendix B, Table B-3). There are 14 species of coral requiring consultation that have been found in the vicinity of Illeginni Islet since 2008 (Appendix B, Table B-3) and an additional 5 consultation species that have the potential to occur in the ROI. These species include 2 coral species listed as ESA- threatened and the remaining 17 species requiring consultation are protected under section 3.4.5.1(a)UES (USASMDC/ARSTRAT, 2016). The 17 species were proposed for listing under the ESA but were found not to warrant protection under that act and for which the RMIEPA has decided that they remain as consultation species. All 19 coral species that require consultation are also listed as vulnerable by the International Union for Conservation of Nature (IUCN) and as Species of Significant Biological Importance (SOSBIs) under the UES (USASMDC/ARSTRAT, 2016). During 2010 biological inventories of USAKA, 109 hard coral species were observed in the vicinity of Illeginni Islet. All of these coral species are listed as SOSBIs under the current edition of the UES (USASMDC/ARSTRAT, 2016) and as such are considered coordination species (Table B-3). The frequency of all hard coral species identified during the 2010 survey as well as their frequencies throughout the atoll are listed in Appendix B (Table B-3), including the consultation species. All consultation and coordination species were observed in surveys of at least one other islet of the 11 islets surveyed and 84% of hard coral species were observed on 4 or more islets (Table B-3).

All hard coral species found at Illeginni Islet are typical of shallow-water tropical Indo-Pacific coral reefs. In general, these corals may occur at depths of 0-100 ft (0-30 m), although some species have more specific depth and subhabitat preferences (USAFGSC and USASMDC/ARSTRAT, 2015; Sakashita and Wolf, 2009). Predators of corals include sea stars, snails, and fishes (e.g., crown of thorns sea stars, parrotfish, and butterfly fish; Boulon et al., 2005; Gochfeld, 2004; Gulko, 1998). The crown of thorns sea stars (*Acanthaster planci*) are the primary predators of most ESA-candidate and SOSBI coral species known at Illeginni Islet (Table 3-10 and Appendix B, Table B-3).

Corals prey on zooplankton, which are small organisms that inhabit the ocean. Corals capture prey in tentacles armed with stinging cells that surround the corals' mouths or by employing a mucus-net to catch suspended prey (Brusca and Brusca, 2003). In addition to capturing prey, corals possess a unique method of acquiring essential nutrients through their relationship with zooxanthellae (a type of algae) that benefits both organisms.

Reproductive strategies in corals are not well defined (Fautin, 2002). Most of the shallow-water species requiring consultation in Table 3-10 reproduce by spawning, typically from July to December. Some species brood live young, and some coral species engage in both spawning and brooding (Fautin, 2002; Gascoigne and Lipcius, 2004). Most corals are capable of asexual reproduction by fragmentation. This is most often seen in branching corals that are more likely to break (Lirman, 2000). Reproductive potential (fecundity) is a function of colony age and size, and many threats to corals reduce reproductive potential by degrees, up to halting reproduction for several years (Boulon et al., 2005; Fautin, 2002; Gascoigne and Lipcius, 2004; Lirman, 2000).

Coral larval duration ranges from a few days to months (reviewed by Jones et al., 2009), but short durations of 3-9 days are much more common (Hughes et al. 2000) (Vermeij, et al. 2010). Accordingly, dispersal ranges a few tens of meters to 2000 km, but local short-distance dispersal on a scale of tens of kilometers (miles) occurs much more frequently than long-distance dispersal (Jones et al., 2009; Mumby and Steneck, 2008). Less frequent long-distance dispersal is more commonly associated with spawning corals, and it is these buoyant eggs and planktonic larvae (typically free-swimming planulae) that are more likely to be found in open ocean areas. Among corals of the Great Barrier Reef, about 130 of approximately 400 species spawn at the peak of summer (November and December) (Hughes et al., 2000). It is a reasonable assumption that this

proportion would be spawning species in RMI. Altogether this suggests that gametes and planulae will be found in the open ocean, but this is the smaller fraction of the total pool of gametes, planulae, and larvae.

Coral planulae density in the water directly over the reef is zero except during reproduction when density peaks at 1,600 per 100 m³ (brooding species) to 16,000 per 100 m³ (spawning species) (Hodgson, 1985). On the Great Barrier Reef, similar densities of coral larvae directly over the reef rapidly dispersed by 3 to 5 orders of magnitude in waters 5 km (3.1 mi) distant from the reef (Oliver et al., 1992). Eggs, larvae, and planulae are not homogeneously distributed but sometimes travel in semi-coherent aggregations (slicks) or become concentrated along oceanic fronts (Hughes et al., 2000; Jones et al., 2009).

There are no known species-specific threats for any particular coral species listed in Table 3-10 or Table B-3, although it is conceivable that some diseases are species specific. Some groups of corals are more or less susceptible to predation and general threats. For example, the predatory crown of thorns sea star (*Acanthaster planci*) feeds preferentially, but not exclusively, on *Acropora* and *Pocillopora* species (Gulko, 1998). A type of "white" disease seems to preferentially affect tabular colonies of *Acropora* (Beger et al., 2008). The aquarium industry has various taxa-specific preferences and, as one of the more profitable industries in the RMI, is a potential contributor to loss of preferred populations (Pinca et al., 2002). Factors that can stress or damage coral reefs are coastal development (Risk, 2009), impacts from inland pollution and erosion (Cortes and Risk, 1985), overexploitation and destructive fishing practices (Jackson et al., 2001; Pandolfi et al., 2003), global climate change and acidification (Hughes et al. 2003), disease (Beger et al., 2008; Galloway et al., 2009), predation (Richmond et al., 2002; Sakashita and Wolf, 2009), harvesting by the aquarium trade (Caribbean Fishery Management Council, 1994; Richmond et al., 2002), boat anchors (Burke and Maidens, 2004), invasive species (Bryant et al., 1998; Galloway et al., 2009; Wilkinson, 2002), ship groundings (Sakashita and Wolf, 2009), oil spills (NOAA, 2001), and possibly human-made noise (Vermeij et al., 2010).

All of the general threats to and characteristics of corals listed above are not known or expected to be different among consultation, coordination, or other coral species in the RMI.

Non-coral Benthic Invertebrates. Animals that live on the sea floor are called benthos. Most of these animals lack a backbone and are called invertebrates. Typical benthic invertebrates include sea anemones, sponges, corals, sea stars, sea urchins, worms, bivalves, crabs, and many more. A diverse benthic invertebrate community exists in the shallow waters near Illeginni Islet. Several special-status species have been observed near Illeginni Islet in biennial inventories of the area and are listed in Table 3-10 and Appendix B, Table B-2.

Five species of mollusk requiring consultation have been found at Illeginni, including the top snail (*Trochus niloticus*), the black-lipped pearl oyster (*Pinctada margaritifera*), and three species of giant clam (*Hippopus hippopus*, *Tridacna gigas*, and *Tridacna squamosal*). Two other mollusk species that are listed as SOSBIs and are subsequently coordination species have been observed in the vicinity of Illeginni Islet (Appendix B, Table B-2). *Lambis truncata*, and *Tridacna maxima* are known to occur in shallow water reef habitat throughout Kwajalein Atoll. All consultation and coordination mollusk species are found at multiple islets throughout Kwajalein Atoll (Appendix B, Table B-2) and are found in many shallow-water reef habitats throughout the RMI and the tropical Indo-Pacific.

All members of the family Tridacnidae are native to shallow-water coral reef habitats in the tropical Indo-Pacific. Although some species are occasionally found in the low intertidal zone and can tolerate brief aerial exposure, all members of Tridacnidae are generally found at subtidal depths. Although deep-water mollusks may occur in the ROI, no surveys have been done to determine their presence, abundance, or diversity.

The black-lipped pearl oyster (*Pinctada margaritifera*), a consultation species, is found on reef habitats throughout the tropical Indo-Pacific. It is typically found shallower than 8 m (25 ft) but occurs at least as deep as 15 m (50 ft; Keenan et al., 2006). Although these species are occasionally found in the low intertidal zone and can tolerate brief aerial exposure, they are generally found at subtidal depths. These animals typically spawn bimonthly (Nair, 2004) and pelagic larval duration for this species lasts from 15 to more than 30 days (Thomas et al., 2011).

Spider conchs of the family Strombidae are found on reef habitats throughout the tropical Indo-Pacific. *Lambis* spp. are typically found in waters shallower than 5 m (15 ft). Although some species are occasionally found in the low intertidal zone and can tolerate brief aerial exposure, all members of Strombidae are generally found at subtidal depths. They are oviparous (egg laying) and the free-swimming larvae (veligers) are competent for at least 7 days (Hamel and Mercier, 2006).

Reproduction of mollusks often includes a free-swimming stage (veliger) enabling dispersal over great distances, and genetic similarity across most mollusk species' ranges indicates that long-distance dispersal occurs with regularity. Dispersal on smaller spatial scales of tens of kilometers is much more common (Cowen and Sponaugle, 2009; Mumby and Steneck, 2008).

The densities of mollusk larvae are difficult to predict as there is much variation in life histories both among species and among individuals within a species (Hadfield and Strathmann, 1996). Researchers have found that marine invertebrate species have variation in both timing and duration of breeding seasons with latitude and annual environmental conditions (Hadfield and Strathmann, 1996). Marine invertebrate species may also have variation in the duration of the pelagic larval phase depending on life history characteristics, environmental conditions such as water temperatures, and ultimately, presence of suitable substrate to induce metamorphosis (Hadfield and Strathmann, 1996; Scheltema, 1971). Altogether, this suggests that veligers will be found in the open ocean, but this is the smaller fraction of the total pool of veligers.

All members of the family Tridacnidae and *Pinctada margaritifera* are filter-feeders, preying on plankton, bacteria, and particulate organic matter. Giant clams also host symbiotic zooxanthellae (see Section 2.3.2). Although giant clams are efficient filter feeders, most of their carbohydrate needs are supplied by their photosynthetic symbionts (Klumpp, 1992).

Major threats to mollusk include predation by specialist invertebrates and vertebrates including octopus and triggerfish (family Balistidae) and fishing pressure for food, the aquarium, and curio trades (USAFGSC and USASMDC/ARSTRAT, 2015). This has led to widespread declines of some mollusks near human populations. Fishing pressure has caused many stocks to collapse, and most are greatly reduced from their historical baselines (Munro, 1994; Tardy et al., 2008). However, populations of Tegulidae and other marine mollusks increase rapidly when fishing bans are well enforced (Dumas et al., 2010). General threats include habitat degradation and land-based anthropogenic pollution, which interferes with reproduction (Spade et al., 2010).

Sponges are ubiquitous on the seafloor at all depths, but are most common on hard bottom or reef substrates. The sponges that inhabit coral reefs range from robust species, capable of surviving wave energy and temperature extremes, to specialized species that are delicate and cryptic. The sponges that inhabit coral reefs of the RMI are generally found throughout the tropical Indo-Pacific region. All artificially planted or cultivated sponges (phylum *Porifera*) within the RMI are afforded protection under the RMI Marine Resources Act (USASMDC/ARSTRAT, 2016). All artificially planted or cultivated sponges are protected under the UES (USASMDC/ARSTRAT, 2016); however, no cultivated sponges are present in the study area. No sponges are regulated by the CITES and no sponges are protected under the ESA (USAFGSA and

USASMDC/ARSTRAT, 2015). While there are no consultation or coordination sponges in the ROI, the sponges that inhabit the shallow-water coral reefs of the RMI are generally found throughout the Indo-Pacific, although endemism is possible given that at least 50 other organisms are known to be endemic to the RMI (Beger et al. 2008).

Offshore Waters – Southwest and Northeast (Alternative Impact Locations)

For biological resources in deep ocean waters near USAKA, the ROI includes a deep ocean waters area northeast of Kwajalein Atoll and one southwest, which can be affected by payload impact, elevated noise levels, and increased human and equipment activity (Figure 2-2). The ROI includes portions of the territorial waters and Exclusive Economic Zone of the RMI near Kwajalein Atoll.

Ocean depths in this region of the RMI generally range between 5,000 and 15,748 ft (1,524 and 4800 m) (Hein et al., 1999). Kwajalein Atoll is near the southern edge of the large North Equatorial Current, which generally flows from the east/northeast to the west/southwest; this Current forms the southern side of a clockwise subtropical gyre. There is a wide variety of pelagic and benthic communities in the deep ocean areas near Kwajalein Atoll. A number of threatened, endangered, and other protected cetacean species can occur here, which are listed in Table 3-10 and in Appendix B along with their likelihood for occurrence. Some of these species occur only seasonally for breeding or because of unique migration patterns.

As described in Section 3.2.2, there are many different sources of noise in the marine environment, both natural and anthropogenic. Within the ROI, some of the loudest underwater sounds generated are most likely to originate from storms, ships, and some marine mammals.

Marine Wildlife in Offshore Waters

Marine Mammals. Jurisdiction over marine mammals is maintained by NOAA Fisheries and the RMI.

Cetaceans are the only special-status marine mammals that have been documented in the deep offshore waters near Kwajalein Atoll (Table 3-10). Eleven cetacean species are considered likely to occur in the deep offshore waters portion of the ROI near Kwajalein Atoll and ten other cetaceans are considered to have the potential to occur in this area. Some of these species occur only seasonally for breeding or during particular points in the migration patterns. Migratory paths of these species were considered when determining the likelihood of occurrence though little is known about the migratory patterns and distributions of some cetacean species. Five of these special-status cetacean species are listed under the ESA as endangered. All marine mammals discussed in this section are also protected under the MMPA (16 USC, § 1361 et seq.) and the UES.

Potential threats to cetacean species and hearing abilities of cetaceans in the deep offshore waters near Kwajalein Atoll are the same as the general cetacean threats outlined for the open ocean area (section 3.2.2).

Sea Turtles. Of the five species of sea turtle species found in the ROI, only the green turtle and hawksbill turtle are known to occur in Kwajalein Atoll offshore waters. Green turtles are more common, while hawksbills are considered rare or scarce (Maison et al., 2010). Sea turtles are highly migratory and utilize the waters of more than one country in their lifetimes. The USFWS and NOAA Fisheries share federal jurisdiction for sea turtles with the USFWS having lead responsibility on the nesting beaches and NOAA Fisheries, the marine environment.

Fish. Six species of special-status fish have the potential to occur in the deep offshore waters of Kwajalein Atoll (Table 3-10). While the bigeye thresher shark, oceanic whitetip shark, and Pacific bluefin tuna are

known to occur in the Marshall Islands and have been documented as being caught in local fisheries, little is known about their abundance, distribution, or seasonality in this area. The reef manta ray is not likely to occur in deep offshore waters, however, individuals have been known to migrate further offshore. The oceanic giant manta ray is a more oceanic species and has the potential to occur in these waters. Scalloped hammerhead sharks of the Indo-west Pacific DPS have the potential to occur in the offshore waters of Kwajalein Atoll. The scalloped hammerhead occurs in coastal, warm temperate waters from the surface and intertidal zones to depths of at least 275 m (900 ft). They are highly mobile and partly migratory (Food and Agriculture Organization of the United Nations 2006). Scalloped hammerheads typically remain close to shore during the day and move into deeper waters at night to feed (Bester, 1999). Little is known about the abundance, distribution, or migration patterns of scalloped hammerheads in the ROI.

Coral. Adult shallow-water reef-associated corals (Table 3-10) that require consultation do not occur in the deep-water portions of the ROI because their required shallow habitat is absent. At various times of the year the gametes (eggs and sperm) and larvae of reef-associated invertebrates may occur in deep offshore waters. For corals, this is generally July to December and particularly the week following the August and September full moons. The densities of coral larvae are difficult to predict, but studies of coral larvae during peak spawning report 0.1 to 1 planktonic larvae m^3 in waters 5 km away from the reef, and 1.6 m^3 (brooding species) to 16 m^3 (spawning species) in waters directly over the reef during reproduction (Hodgson, 1985). Larval density in the deep ocean waters near USAG-KA are likely to be near the lower range except during peak spawning when density may approach the upper range. Eggs, larvae, and planulae are not homogeneously distributed but sometimes travel in semi-coherent aggregations (slicks) or become concentrated along oceanic fronts (Hughes et al., 2000; Jones et al., 2009).

Non-coral Benthic Invertebrates. There are five mollusk species that require consultation in the ROI: the commercial top snail, the black-lipped pearl oyster, and three species of giant clam (Table 3-10). The commercial top snail (*Tectus niloticus*) is regulated by Marshall Islands Revised Code 1990, Chapter 3. The black-lipped pearl oyster (*Pinctada margaritifera*) is regulated by Marshall Islands Revised Code 1990, Chapter 1, § 5. The giant spider conch and one additional species of giant clam (Appendix B, Table B-2) are coordination species which are also found in the vicinity of Kwajalein Atoll.

Adult shallow-water reef-associated mollusks that require consultation and coordination do not occur in the deep offshore waters of the ROI because their required shallow habitat is absent. At various times of the year the gametes (eggs and sperm) and larvae of reef-associated invertebrates may occur in the BOA or deep ocean waters. The densities of mollusk larvae are difficult to predict as there is much variation in life histories both among species and among individuals within a species (Hadfield and Strathmann, 1996). Researchers have found that marine invertebrate species have variation in both timing and duration of breeding seasons with latitude and annual environmental conditions (Hadfield and Strathmann, 1996). Marine invertebrate species may also have variation in the duration of the pelagic larval phase depending on life history characteristics, environmental conditions such as water temperatures, and ultimately, presence of suitable substrate to induce metamorphosis (Hadfield and Strathmann, 1996; Scheltema, 1971). However, eggs and larvae are not homogeneously distributed and sometimes travel in semi-coherent aggregations (slicks) or become concentrated along oceanic fronts (Hughes et al., 2000; Jones et al., 2009). Larval density in the deep ocean waters near USAG-KA is likely to be near the lower end of its range except during peak spawning when density may be higher.

3.3.3 Noise

This discussion of noise includes the types or sources of noise and the associated sensitive receptors in the human environment. Natural sources of noise on Kwajalein Atoll include the constant wave action along shorelines and the occasional thunderstorm. The sound of thunder is one of the loudest sounds expected at the Atoll and can register up to 120 dB. Within the Atoll communities, other noise sources include a limited number of motor vehicles, motorized equipment, and an occasional fixed- or rotary-wing aircraft. Daytime noise levels within the local communities are expected to typically range between 55 and 65 dBA. Ambient noise levels at Kwajalein Island are slightly greater because of higher levels of equipment, vehicle, and aircraft operations; there are several aircraft flights per week there, including military and commercial jet aircraft. (USASMDC, 2014)

Flight test vehicles can generate sonic booms during flight. The sound of a sonic boom resembles rolling thunder, and is produced by a shock wave that forms at the nose and at the exhaust plume of a missile when it travels faster than the speed of sound. These shock waves produce an audible sonic boom when they reach the ground.

3.3.3.1 Regulatory Setting

The UES incorporate provisions and policies for noise management and specify conformance with the US Army's Environmental Noise Management Program and noise monitoring provisions as specified in Army Regulation 200-1 (*Environmental Protection and Enhancement*). As an Army installation, USAG-KA also implements the Army's Hearing Conservation Program as described in Department of the Army Pamphlet 40-501 (*Hearing Conservation Program*). Army standards require hearing protection whenever a person is exposed to steady-state noise greater than 85 dBA, or impulse noise greater than 140 dB, regardless of duration. Army regulations also require personal hearing protection when using noise-hazardous machinery or entering hazardous noise areas.

3.3.3.2 Region of Influence (ROI)

Illeginni Islet (Preferred Impact Location)

During terminal flight and impact at RTS, the Navy SSP payload has the potential to affect land areas with sonic booms. The ROI for noise is focused primarily on those RMI atolls and islands closest to a proposed flight path. For the Illeginni Islet land impact scenario, Kwajalein, Likiep, Ailuk, Taka, and Utirik Atolls, as well as Jemo Island, might be affected. Census records from 2011 indicate 401 residents on Likiep Atoll, 339 on Ailuk Atoll, and 435 on Utirik Atoll; and none were reported on Taka Atoll or on Jemo Island. Kwajalein Atoll has the highest population within the ROI with a total population of approximately 11,408, including US personnel and Marshallese residents. (Secretariat of the Pacific Community, 2011)

Offshore Waters – Southwest and Northeast (Alternative Impact Locations)

During terminal flight and impact at RTS, the developmental payload has the potential to affect open ocean areas with sonic booms. Thus, the ROI for noise for a BOA impact is focused primarily on those RMI atolls and islands closest to the proposed flight path. For a BOA impact scenario, Bikar, Taka, and Utirik Atolls might be affected. Census records from 2011 indicate 435 residents on Utirik Atoll and none were reported on Bikar or Taka Atolls or on Jemo Island.

3.3.4 Public Health and Safety

RTS range safety ensures protection to Installation personnel, inhabitants of the Marshall Islands, and ships and aircraft operating in the downrange areas potentially affected by flight tests. Commercial, private, and military air and sea traffic in caution areas designated for specific flight tests or missions, and inhabitants near a flight path, are notified of potentially hazardous operations. A NOTMAR and a NOTAM are transmitted to appropriate authorities to clear traffic from caution areas and to inform the public of impending missions. The warning messages describe the time, the area affected, and safe alternate routes. The GRMI also is informed in advance of rocket launches and reentry payload missions.

3.3.4.1 Regulatory Setting

Specific procedures based on regulations, directives, and flight safety plans are required for all missions at RTS involving aircraft, missile launches, and reentry vehicles. All program operations must first receive approval from the Safety Office at RTS. This is accomplished through presentation of the proposed program to the Safety Office. All safety analyses, SOPs, and other safety documentation applicable to operations affecting the RTS must be provided, along with an overview of mission objectives, support requirements, and schedule. The flight safety plans evaluate risks to inhabitants and property near the flight path, calculate trajectory and debris areas, and specify range clearance and notification procedures. Criteria used at RTS to determine debris hazard risks are in accordance with RCC Standard 321-10, *Common Risk Criteria Standards for National Test Ranges* (Range Commanders Council, 2010).

3.3.4.2 Region of Influence (ROI)

Illeginni Islet (Preferred Impact Location)

The areas of Illeginni Islet where FE-1 flight test activities would occur are the ROI for a land impact scenario. Illeginni is and has been the target impact location for several missile programs, including the MMIII ICBM flights. As part of USAKA, the Islet is not open to the public. A limited number of FE-1 flight test personnel would access the Islet before the flight test to place equipment and after the test to recover the equipment and restore the impact site. There would be no personnel on-island during the impact; project personnel would be located offshore on ships or at other islands at the time of impact.

Offshore Waters – Southwest and Northeast (Alternative Impact Locations)

The deep offshore waters to the southwest or northeast of Kwajalein Atoll are the ROI for a FE-1 flight test water impact. These have been previously identified as potential impact locations for several missile programs. Radar and/or visual sweeps of hazard areas are accomplished immediately prior to operations to assist in the clearance of non-mission ships and aircraft. For terminal flight tests, when a point of impact in the Mid-Atoll Corridor Impact Area at RTS (Figure 2-2) is required, additional precautions are taken to protect personnel and the general public, including evacuating nonessential personnel. The FE-1 flight test would not have a Mid-Atoll Corridor impact.

3.3.5 Hazardous Materials and Wastes

Hazardous materials are defined by the UES referencing the US DOT definition: a substance or material that is capable of posing an unreasonable risk to health, safety, or property when transported in commerce and has been so designated. Hazardous waste is defined as any solid waste not specifically excluded which meets specified concentrations of chemical constituents or has certain toxicity, ignitability, corrosivity, or reactivity characteristics.

3.3.5.1 Regulatory Setting

The UES for material and waste management (UES §3-6) are derived from a composite of US statutes and regulations addressing the use and management of hazardous material and solid waste and the RMIEPA regulations. (UES §1-5.8)

The UES for hazardous materials and wastes differ from US standards in that the UES classify all materials as either general-use, hazardous, petroleum products, or prohibited. The objective of the Standards for material and waste management is to identify, classify, and manage in an environmentally responsible way all materials imported or introduced for use at USAKA/RTS. Hazardous materials are subject to requirements for security, storage, and inspection at USAKA. Hazardous wastes must be shipped off the island. Also prohibited are all new uses of PCBs, introduction of new PCBs, and introduction of PCB articles or PCB items.

The USAG-KA base contractor manages hazardous materials and wastes through a Hazardous Materials Management Plan (HMMP, UES §3-6.4.2), which is incorporated into the Kwajalein Environmental Emergency Plan [KEEP] (UES §3-6.4.1). The import, use, handling, and disposal procedures, records, and reporting outlined in the KEEP apply to all tenant activities at USAKA and the RMI as well as to the Garrison.

3.3.5.2 Region of Influence (ROI)

Illeginni Islet (Preferred Impact Location)

Per the UES requirements, activity-specific Hazardous Materials Procedures are submitted by the project or mission proponents to the Commander, USAG-KA for approval within 15 days of receipt of any hazardous material or before use, whichever comes first. Hazardous materials to be used by organizations on the RTS test range and its facilities are under the direct control of the user organization, which is responsible for ensuring that these materials are stored and used in accordance with UES requirements. The use of all hazardous materials is subject to ongoing inspection by USAG-KA environmental compliance and safety offices to ensure the safe use of all materials. The majority of these materials are stored in satellite supply facilities, are distributed through the base supply system, and are consumed in operational processes.

Pollution prevention, recycling, and waste minimization activities are performed at USAKA in accordance with the UES and established contractor procedures are in place and managed through USAG-KA.

USAG-KA has a contingency plan (the KEEP; UES§3-6.4.1) for responding to releases of oil, hazardous material, pollutants, and contaminants to the environment similar to the spill prevention, control, and countermeasure (SPCC) plan required in the US. The UES also include a process for evaluating and, when called for, remediating sites contaminated from releases. The process is similar to US CERCLA requirements with full participation by the public and UES Appropriate Agencies.

USAG-KA has removed all remaining hazardous materials and wastes (e.g., asbestos, polychlorinated biphenyls in old light ballasts, and cans of paint) from buildings and facilities on Illeginni (USAF, 2004). Range personnel, generally using the unexploded ordnance (UXO) burn pit on the far west side of the islet, also ensure that any unexploded ordnance or material is consumed with each burn operation. Due to the intermittent nature of flight testing and consequent occupancy of at Illeginni Islet, only small quantities of hazardous wastes are generated and managed on occasion at Illeginni Islet.

Hazardous waste, whether generated by Installation activities or RTS users, is collected at individual work sites in waste containers. Containers are labeled in accordance with the waste which they contain and are dated the day that the first waste is collected in the container.

Containers are kept at the point of generation until full or until a specified time limit is reached. Once full, containers are collected from the generation point within 72 hours and are prepared for transport to the Hazardous Waste Storage Facility (Building 1521) on Kwajalein. Each of the accumulation sites is designed to handle hazardous waste and provide the ability to contain any accidental spills of material, including spills of full containers, until appropriate cleanup can be completed.

Hazardous handling and disposal activities are closely monitored by the USAG-KA Environmental Office in accordance with Standard Practice Instruction 1534 (Management of Materials, Wastes, and Petroleum Products). Waste treatment or disposal is not allowed at the Installation under the UES.

At Illeginni Islet, as a result of previous reentry vehicle tests, residual concentrations of beryllium (Be) and depleted uranium (DU) remain in the soil near the helipad on the west side of the Islet. In 2005, LLNL analyzed over 100 soil samples collected around the helipad to determine concentrations of Be and DU in the soil (Robison et al., 2006). Soil samples were collected again following subsequent flight tests and results were reported in 2010 and 2013 (Robison et al., 2010 and 2013). Table 3-12 summarizes the concentration results from the 2013 sampling event.

Several studies evaluating sources and contaminants in marine waters, sediments, and organisms have been completed at USAKA for the USAG-KA Environmental Cleanup program. Specifically, the Kwajalein Harbor (2013), Kwajalein Landfill (2017), and US Army Public Health Center Fish Studies (2016) have brought to light sources and releases of contaminants that have made their way into the marine environment. While the purpose of each of these studies was related to issues of release and cleanup, results of several of the studies have determined there are contaminant concentrations of concern in marine waters, sediments and organisms at some USAKA sites. Following the USAPHC fish study, it was determined that several lagoon “No Fishing” areas would be established to safeguard the Marshallese and US inhabitants of USAKA because contaminant concentrations in lagoon reef fish are at levels where they may adversely affect public health, the marine environment, and protected beneficial uses of surface water (e.g., fishing). The implications to marine organisms, including sea turtles, are that they also could be affected, particularly by ingestion of fish, algae, and other food sources within the waters at Kwajalein Atoll.”

Table 3-12 Concentrations of Beryllium and Uranium in Soil at Illeginni Islet

Concentration	Beryllium (µg/g)	Uranium (µg/g)
Low	0.07	3.3
High	6.7	149.7
Mean	2.1	22
Standard Deviation	2.3	35
Standard Error	0.58	8.8

Source: Robison et al., 2013
µg/g = Micrograms per gram

The observed soil concentrations of Be and uranium (U) (as a surrogate for DU) on Illeginni Islet are within compliance with USEPA Region 9 Preliminary Remediation Goals as outlined in the UES. The USEPA and UES guidance for Be in residential soils is 160 micrograms per gram (µg/g). For U as a surrogate for DU, the

USEPA guidance of 230 µg/g and UES guidance of 47 µg/g (based on soluble uranium salts, not relevant to insoluble DU) for residential soils are used for comparison and compliance.

Offshore Waters – Southwest and Northeast (Alternative Impact Locations)

As for a land impact, the UES, KEEP, and HMMP specify procedures relative to hazardous materials and waste. Activity-specific Hazardous Materials Procedures would be submitted by the project or mission proponents to the Commander, USAG-KA for approval within 15 days of receipt of any hazardous material or before use, whichever comes first. Hazardous materials would be under the direct control of the user organization to ensure these materials are stored and used in accordance with UES requirements. Identified materials would be expected to be consumed in operational processes associated with the FE-1 flight test.

NASA conducted a thorough study of the seawater quality effects of missile components deposited in ocean waters (1998). NASA concluded that the release of hazardous materials from missiles into seawater would not be significant. The materials will be rapidly diluted and, except in the immediate vicinity of the debris, will not be found at concentrations that produce adverse effects. The payload materials are relatively insoluble and the depth of the Pacific Ocean at either of the proposed BOA impact sites is thousands of feet; where light does not penetrate; levels of oxygen that might interact with materials at the surface are too low for that to occur; and water temperature differences from the upper water layers hamper any mixing between them. Any area on the ocean bottom affected by the slow dissolution of the payload debris will be relatively small, due to the size of the payload debris pieces as compared relative to the volume of surrounding seawater. Therefore, water quality effects from the payload are expected to be minimal. As potential for toxic concentrations is expected to be small and the effects would be very localized, the potential for cumulative impacts is expected to be nil. There are no plans to monitor deep water impacts in the BOA benthic zones of 8,000 ft depth or greater, where no mixing with upper layers of water occurs.

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4 Environmental Consequences

This chapter presents an analysis of the potential direct and indirect effects of each alternative on the affected environment. The following discussion elaborates on the nature of the characteristics that might relate to resources. “Significantly,” as used in NEPA, requires considerations of both context and intensity. Context means that the significance of an action must be analyzed in several contexts such as society as a whole (e.g., human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of a proposed action. For instance, in the case of a site-specific action, significance would usually depend on the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant (40 CFR part 1508.27). Intensity refers to the severity or extent of the potential environmental impact, which can be thought of in terms of the potential amount of the likely change. In general, the more sensitive the context, the less intense a potential impact needs to be in order to be considered significant. Likewise, the less sensitive the context, the more intense a potential impact would be expected to be significant.

4.1 Kauai Test Facility, Pacific Missile Range Facility

4.1.1 Air Quality

Effects on air quality are based on estimated direct and indirect emissions associated with the action alternatives. The ROI for assessing air quality impacts is the air basin surrounding PMRF.

Estimated emissions from a proposed federal action are typically compared with the relevant national and state standards to assess the potential for increases in pollutant concentrations.

Air Quality Potential Impacts:

- **No Action: No Change**
- **Proposed Action: Minor, short-term Impacts; No Significant Impact**

4.1.1.1 Kauai Test Facility, Pacific Missile Range Facility - No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to baseline air quality. Therefore, no impacts to air quality or air resources would occur with implementation of the No Action Alternative.

4.1.1.2 Kauai Test Facility, Pacific Missile Range Facility - Proposed Action

The Proposed Action would launch a developmental payload on a STARS booster missile with impact of the payload on Illeginni Islet at RTS, USAKA. Launches of the STARS have been analyzed in various environmental documents (USASDC, 1992; US Navy, 2008) and have been determined to not have a significant impact on air quality.

The Proposed Action would include one launch of a STARS booster with the developmental payload from KTF. The STARS booster has been previously launched at SNL/KTF, and it is anticipated that the launch of the FE-1 flight test at the same site would have a similar air quality impact as described for the No Action Alternative. The Proposed Action would be similar to previous ballistic missile tests from SNL/KTF, and the potential impacts on air quality would be similar to that described for previous STARS missile launches.

Table 4-1 lists major exhaust components from STARS missiles launched from PMRF. In the stratosphere (6.2 to 31 mi [10 to 50 km] above the Earth’s surface), missile launch emissions could potentially affect

global warming (the greenhouse gas effect) and contribute to depletion of the stratospheric ozone layer. Of the chemical species that form during launches, the most environmentally significant are hydrochloric acid, aluminum oxide, nitrogen, and carbon dioxide.

Table 4-1 Estimated Emissions from a STARS Missile Launch¹ at SNL/KTF

<i>Emission</i>	<i>Aluminum Oxide²</i>	<i>Carbon Monoxide</i>	<i>Carbon Dioxide³</i>	<i>Hydrogen</i>	<i>Water</i>	<i>Hydrochloric Acid²</i>	<i>Nitrogen Oxides²</i>	<i>Lead</i>	<i>Others</i>
Tons per launch	5.628	4.185	0.431	0.318	0.959	1.943	1.855	0.000	0.027

¹ Exhaust products are total for all three stages

² Ozone-depleting Substances

³ Greenhouse Gas

General Conformity

Existing aircraft exercises and support would continue from the PMRF airfield under the No Action Alternative. Approximately 69% of Navy aircraft using the airfield are C-26 "Metroliner" aircraft and the UH-3H "S-61" helicopter. The estimated annual mobile source emission levels, including aerospace ground support activities and engine testing, are:

- 12.9 tons per year (TPY) for carbon monoxide
- 3.6 TPY for volatile organic compounds (VOC)
- 13.8 TPY for nitrogen dioxides
- 1.3 TPY for sulfur dioxide
- 0.8 TPY for particulate matter with an aerodynamic diameter less than or equal to 10 microns (PM₁₀)

These emissions are calculated using an air emissions screening computer program developed by the Air Force to calculate air emissions for realignment of aircraft, personnel, and for facility construction (USAF, 2005). Aircraft operating data are derived from 2004 operations at the airfield (US Department of the Navy, Engineering Field Activity Chesapeake, 2006). These emissions are not further evaluated because they are not restricted by the current Title V permit held by PMRF, and because the General Conformity Rule applicability analysis, though a useful tool, is not required for Navy actions in Hawai'i.

Greenhouse Gases

In the stratosphere (6.2 to 31 mi above the Earth's surface), missile launch emissions could potentially affect global warming (the greenhouse gas effect) and contribute to depletion of the stratospheric ozone layer. The worst case estimated total carbon dioxide emissions from launches into the troposphere for the Proposed Action would be less than 10 TPY (Table 4-1 for emissions per launch). However, because the STARS is relatively small and the launch is a short-term, discrete event, the time between launches of the Proposed Action and other launches scheduled from SNL/KTF would allow the dispersion of greenhouse gases and ozone depleting substances. Therefore, implementation of the FE-1 flight test would not result in significant impacts to air quality.

4.1.2 Water Resources at Kauai Test Facility, Pacific Missile Range Facility

Effects on water quality are based on estimated direct and indirect impacts associated with the action alternatives. The ROI for assessing water resources impacts is the area surrounding PMRF.

Water Resources Potential Impacts:

- **No Action: No change**
- **Proposed Action: Minor, short-term impact; No Significant Impacts**

4.1.2.1 Water Resources at Kauai Test Facility, Pacific Missile Range Facility - No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to baseline water resources. Therefore, no significant impacts to water resources would occur with implementation of the No Action Alternative.

4.1.2.2 Water Resources at Kauai Test Facility, Pacific Missile Range Facility - Proposed Action

The Proposed Action is a single launch of a developmental payload on a STARS missile with impact at RTS, USAKA. Launches of the STARS have been analyzed in various environmental documents and have been determined to not have a significant impact on air quality.

Analysis of STARS launch-related impacts is covered in the STARS EIS (US Army Strategic Defense Command, 1992). The EIS evaluated the potential impacts of launch emissions, spills of toxic materials, and early flight termination. The analysis concluded that hydrogen chloride emissions would not significantly affect the chemical composition of surface or groundwater; that there would be no significant increase in aluminum oxide in surface waters due to launches; that sampling of surface waters in the vicinity of the launch site showed that hydrogen chloride, potentially deposited during past launches, has not affected surface water quality on PMRF or adjacent areas; and that contamination from spills of toxic materials would be highly unlikely.

Subsequent sampling and analysis, prior to and following a 26 February 1993 STARS target launch, showed little or no evidence that the launch produced any adverse impact on water, soil, or vegetation (USASSDC, 1993a). Based on the Calendar Year 2005 Annual Site Environmental Report for Tonopah Test Range and Kauai Test Facility (Sandia National Laboratories, 2006), there were no reportable releases at the SNL/KTF under EPCRA or CERCLA in 2005. In addition, there were no compliance issues with respect to any state or federal water pollution regulations in 2005. As reported in the Annual Site Environmental Report, a National Pollutant Discharge Elimination System (NPDES) permit is not required due to the lack of significant storm water runoff discharging into "Waters of the US," as defined in 40 CFR 122.

The results of soil sampling conducted in 1999, 2002, and 2007 are presented in the KTF Report (Sandia National Laboratories, 2008). The results show that most reported values are below the USEPA residential screening levels. Iron and thallium exceed the residential screening level however; they are below the industrial screening level. Arsenic exceeds the USEPA industrial screening level however; the State of Hawai'i has identified action levels based on bioavailable arsenic. As presented in the Hawai'i Department of Health Technical Report (Hawai'i Department of Health, 2006) background concentrations of arsenic in soil in Hawai'i may range up to 20 milligrams per kilogram (mg/kg) [20 parts per million (ppm)] or higher (up to 50 mg/kg (50 ppm) in some cases). In addition, much of the arsenic in pesticide-contaminated soil appears to be tightly bound to soil particles and not available for uptake in the human body. This portion of the arsenic is essentially nontoxic. These two factors led to a need for

further guidance, particularly with respect to the use of bioaccessible arsenic data in human health risk assessments and in the development of risk-based, soil action levels.

The highest level found in the KTF report was 56 mg/kg (56 ppm). This would fall into the Hawai'i Department of Health Category 2 Soils (C-2): Bioaccessible Arsenic >19 mg/kg and <95 mg/kg. Long-term exposure to Category 2 (C-2) soils is not considered to pose a significant risk to workers provided that lawns and landscaping are maintained to minimize exposure and control fugitive dust.

Impacts on water resources have not been identified from these constituents at the levels found on PMRF. Sampling for perchlorate was conducted at PMRF in October and November 2006, and the results indicated perchlorate levels were within guidelines. Based on this previous analysis and sampling, the Proposed Action activities do not adversely affect water resources. Therefore, implementation of the Proposed Action would not result in significant impacts to water resources.

The launches of the STARS have been analyzed in various environmental documents (USASDC, 1992; US Navy, 2008) and have been determined to not have a significant impact on water resources.

Therefore, implementation of the Proposed Action would not result in significant impacts to water resources.

4.1.3 Biological Resources at SNL/KTF

Potential impacts of construction, building modification, and missile launches on terrestrial biological resources within the PMRF ROI have been addressed in detail in the HSTT EIS/OEIS (US Navy, 2013), t EIS/OEIS (US Navy, 2008), Strategic Target System EIS (USASDC, 1992), the Restrictive Easement EIS (USASDC, 1993b), the PMRF Enhanced Capability EIS (US Navy, 1998), and the THAAD Pacific Flight Tests EA, (USASDC, 1992; USASDC, 1993a; US Navy, 1998; USASDC, 2002). Based on these prior analyses, and the effects of current and past missile launch activities, the potential impacts of all alternatives of the Proposed Action on terrestrial biological resources would be expected to be minimal.

Biological Resource Potential Impacts:

- **No Action: No Change**
- **Proposed Action: Short-term Impact; No Significant Impacts**

4.1.3.1 Biological Resources at SNL/KTF - No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to biological resources. Therefore, no significant impacts to biological resources would occur with implementation of the No Action Alternative.

4.1.3.2 Biological Resources at SNL/KTF - Proposed Action

The study area for the analysis of effects to biological resources associated with the Proposed Action includes SNL/KTF for the greatest launch effects. Surrounding terrestrial and marine areas of PMRF may also be affected by hazardous chemicals, increased sound pressure levels, and increased human and vessel activity. In this section the potential for the Proposed Action to adversely impact the biological resources described in section 3.1.3 is analyzed.

Launches of the new booster configurations as part of the Proposed Action testing would be similar to launches of the STARS previously analyzed in the Strategic Target System EIS and the PMRF Enhanced Capability EIS (USASDC, 1992; US Navy, 1998). No new facilities would be required. The launch azimuth and flight termination system would be the same as that of the previously analyzed STARS boosters.

Existing radars and the ground hazard area would also be the same. As a result, impacts on biological resources would be similar to those previously analyzed and are expected to be minimal. Impacts on threatened and endangered species at PMRF are not expected to be different than for any other terrestrial wildlife species. Additionally, installation personnel would continue to manage habitats according to the Installation Natural Resources Management Plan (INRMP), which is designed to protect and benefit threatened and endangered species.

Vegetation at SNL/KTF

No ground clearing or construction is expected for the Proposed Action. The Launch would take place at a previously disturbed, previously used, and previously analyzed location. Vegetation near the launch pad could be impacted by the heat generated at launch, however, vegetation is typically cleared from areas adjacent to the launch site and duration of high temperature is extremely short (a few seconds). Plants also have the potential to be impacted by hydrogen chloride or aluminum oxide emissions at launch. However, analyses of the STARS system (USASDC, 1992) concluded that there is no evidence of any long-term adverse impact on vegetation from heat or chemical emission in two decades of launches on PMRF. Compliance with relevant Navy policies and procedures during these increased training events should continue to minimize the effects on vegetation, as well as limit the potential for introduction of invasive plant species. Equipment imported to the launch site at SNL/KTF from the mainland or other islands would be inspected prior to loading and upon arrival to reduce the risk of introduction or spread of invasive species.

No long term adverse impacts on vegetation are expected. No threatened or endangered plants have been observed on PMRF and critical habitat for the ohai and lau'ehu would not be affected by the action.

Terrestrial Wildlife at SNL/KTF

No ground clearing or construction is expected for the Proposed Action. Wildlife species such as birds may be impacted by elevated sound pressure levels from launch as well as hazardous chemicals, increased human activity, artificial lighting, and direct contact from debris. The launch site at KTF is in an area that has routine human activity, equipment operation, and launch activity.

Elevated Sound Pressure Levels. Impacts on wildlife species can vary from temporary behavioral effects to physical injury or even death. As analyzed for previous STARS launches at PMRF (US Navy, 2008), noise from launches and launch related activity may startle nearby wildlife, causing flushing behavior in birds, but this startle reaction would be of short duration. The brief noise peaks produced by missiles are comparable to levels produced by thunder at close range (120 decibels [dB] to 140 dB peak; US Navy, 2008). Disturbance to wildlife from launches would be brief and is not expected to have any long-term impacts. Increased human and equipment activity, such as vehicles, helicopters, and landing craft, may cause birds and other mobile wildlife to temporarily leave the area. It is expected that these individuals would return to the area and to normal activity after the sound producing activities have ended. Monitoring of birds in areas similarly exposed to launch noise during the breeding season indicates that adults respond to launch noise by flying away from nests, but returning within 2 to 4 minutes (US Navy, 2008). Terrestrial species at PMRF are already habituated to high levels of noise associated with ongoing activities at this facility.

Hazardous Chemical Emissions. Results of monitoring conducted following a STARS launch from SNL/KTF at PMRF indicated little effect on wildlife due to the low-level, short-term hydrogen chloride air (exhaust) emissions (US Navy, 2008). The program included surveys of representative birds and

mammals for both prelaunch and post-launch conditions. Birds flying through an exhaust plume may be exposed to concentrations of hydrogen chloride that could irritate eye and respiratory membranes, however, most birds would not come into contact with the exhaust plume, because of their flight away from the initial launch noise (US Navy, 2008). Deposition of aluminum oxide from missile exhaust onto skin, fur, or feathers of animals would not cause injury because it is inert and not absorbed into the skin (US Navy, 2008). Because aluminum oxide and hydrogen chloride do not bioaccumulate, no indirect effects on the food chain are anticipated from these exhaust emissions (US Navy, 1998; USASMDC, 2008).

In the unlikely event of an on-pad fire or early flight failure over land of this solid propellant missile, most or all of the fuel would likely burn up before being extinguished. Any remaining fuel would be collected and disposed of as hazardous waste. Soil contamination which could result from such an incident is expected to be localized, along with any impacts on vegetation or wildlife.

Artificial Lighting. Pre-launch activities at KTF include final vehicle and experiment assembly, preflight checks, and demonstration of system performance. None of these activities will take place at night and lights will not be turned on at night for any FE-1 activities during the period of concern for Newell's shearwaters. If program activities are required to occur at night (outside the Newell's shearwater period of concern), the US Navy will coordinate these activities through PMRF to comply with the Dark Skies policy and avoid disorienting Newell's shearwaters with artificial lights. The USFWS has concurred with this determination (Appendix A).

Direct Contact from Debris. No impacts on wildlife due to direct contact from debris are expected during normal flight operations. The probability for a launch mishap is very low. However, an early flight termination or mishap would cause missile debris to impact at PMRF or along the flight corridor. In most cases, an errant missile would be moving at such a high-speed that resulting missile debris would strike the water further downrange (US Navy, 2008). If monk seals or sea turtles were observed in the launch safety zone, the launch would be delayed until the animals leave.

Marine Species at KTF

Marine wildlife species listed in Table 3-2, which include marine mammals and sea turtles, have the potential to be impacted by elevated sound pressure levels, hazardous chemicals, direct contact from debris, and disturbance from increase human or equipment operation. The offshore waters of PMRF is an area that has routine human activity, equipment operation, and launch activity.

Elevated Sound Pressure Levels. Impacts of elevated sound pressure levels on marine wildlife species can vary from temporary behavioral effects to physical injury or even death. As analyzed for previous STARS launches at PMRF (US Navy, 2008), noise from launches and launch related activity may startle nearby wildlife, but this startle reaction would be of short duration. The brief noise peaks produced by missiles are comparable to levels produced by thunder at close range (120 dB to 140 dB peak; US Navy, 2008). The offshore waters where marine wildlife reside would be subject to much lower sound pressure levels as sound pressures attenuate with distance from the launch site. Disturbance to wildlife from launches would be brief and is not expected to have any long-term impacts. Increased human and equipment activity, such as vehicles, helicopters, and landing craft, may cause mobile marine wildlife to temporarily leave the area. It is expected that these individuals would return to the area and to normal activity after the sound producing activities have ended. Standard operating procedures at PMRF incorporate procedures to avoid wildlife that are foraging or resting such as sea turtles, Hawaiian monk seals, or

cetaceans. Marine species at PMRF are likely already habituated to high levels of noise associated with ongoing activities at this facility.

Hazardous Chemical Emissions. Within offshore waters, the potential ingestion of contaminants by fish and other marine species would be remote because of atmospheric dispersion of the emission cloud, the diluting effects of the ocean water, and the relatively small area of the Essential Fish Habitat (EFH) that would be affected (US Navy, 2008). Results of monitoring conducted following a STARS launch from KTF at PMRF indicated little effect on wildlife due to the low-level, short-term hydrogen chloride air (exhaust) emissions (US Navy, 2008). The program included surveys of representative birds and mammals for both prelaunch and post-launch conditions. Deposition of aluminum oxide from missile exhaust onto skin, fur, or feathers of animals would not cause injury because it is inert and not absorbed into the skin (US Navy, 2008). Because aluminum oxide and hydrogen chloride do not bioaccumulate, no indirect effects on the food chain are anticipated from these exhaust emissions (US Navy, 1998; USASMDC, 2004).

In the unlikely event of an early flight failure over offshore waters, scattered pieces of burning propellant could enter coastal water and potentially affect wildlife or EFH closer to shore. Concentrations of toxic materials would be highest in this shallow water and have a greater chance of being ingested by feeding animals (US Navy, 2008). However, the potential for a launch mishap is very low, and in most cases the errant missile would be moving at a rapid rate such that pieces of propellant and other toxic debris would strike the water further downrange. The debris would also be small and widely scattered, which would reduce the possibility of ingestion.

Direct Contact from Debris. No impacts on marine wildlife due to direct contact from debris are expected during normal flight operations. According to analysis contained in the PMRF Enhanced Capability EIS (US Navy, 1998), debris from shore-based missile launch programs is not expected to produce any measurable impacts on offshore benthic (sea floor) resources (US Navy, 2008). The potential impact on EFH from launch activities would mainly be from boosters and missile debris to waters off the coast (US Navy, 2008) in the BOA.

The probability for a launch mishap is very low. However, an early flight termination or mishap would cause missile debris to impact along the flight corridor, potentially in offshore waters (US Navy, 2008). If humpback whales, monk seals, or sea turtles were observed in the offshore launch safety zone, the launch would be delayed (US Navy, 1998). Some fish near the surface could be injured or killed by larger pieces of debris. It is unlikely that the smaller pieces of sinking debris would have sufficient velocity to harm individual marine mammals or fish.

4.1.4 Airspace at SNL/KTF

The analysis of airspace management and use involves consideration of many factors including the types, locations, and frequency of aerial operations, the presence or absence of already designated (controlled) airspace, and the amount of air traffic using or transiting through a given area.

4.1.4.1 Airspace at SNL/KTF - No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to airspace. Therefore, no significant impacts to airspace would occur with

Airspace Potential Impacts:

- **No Action: No Change**
- **Proposed Action: No Significant Impact**

implementation of the No Action Alternative.

4.1.4.2 Airspace at SNL/KTF - Proposed Action (All Alternatives)

The Navy SSP **FE-1** flight test would be similar to previous ballistic missile tests, and the potential impacts on controlled and uncontrolled airspace, special use airspace, en route airways and jet routes, and airports and airfields would be similar to that described for missile launches in previous environmental documentation (USASDC, 1992; US Navy, 2008) for PMRF and SNL/KTF.

The advanced planning and coordination with the FAA regarding: scheduling of special use airspace, and coordination of the proposed FE-1 flight test relative to en route airways and jet routes, would result in minimal impacts on airspace.

Therefore, implementation of the Proposed Action (All Alternatives) would not result in significant impacts to airspace.

4.1.5 Noise at SNL/KTF

Analysis of potential noise impacts includes estimating likely noise levels from the Proposed Action and determining potential effects to sensitive receptor sites.

Noise Potential Impacts:

- **No Action: No Change**
- **Proposed Action: No Significant Impact**

4.1.5.1 Noise at SNL/KTF - No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to baseline noise levels. Therefore, no significant impacts due to the noise environment would occur with implementation of the No Action Alternative.

4.1.5.2 Noise at SNL/KTF - Proposed Action

The study area for the analysis of effects to noise resources associated with the Proposed Action includes KTF and PMRF.

The Proposed Action would include the launch of a STARS booster with the developmental payload from SNL/KTF. The STARS booster has been previously launched at SNL/KTF (USASDC, 1992; US Navy, 2008), and noise levels would be the same as previous launches. Launching of the Proposed Action would produce similar noise levels to previous STARS launches at SNL/KTF.

Therefore, because five previous STARS analyses concluded with a FONSI, implementation of the FE-1 flight test also would not result in significant impacts to the noise environment.

4.1.6 Public Health and Safety at SNL/KTF

The safety and environmental health analysis contained in the respective sections addresses issues related to the health and well-being of military personnel and civilians living on or in the vicinity of SNL/KTF and PMRF. Additionally, this section addresses the environmental health and safety risks to children.

Public Health and Safety Potential Impacts:

- **No Action: No Change**
- **Proposed Action: No Significant Impact**

4.1.6.1 Public Health and Safety at SNL/KTF - No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to public health and safety. Therefore, no significant impacts would occur with implementation of the No Action Alternative.

4.1.6.2 Public Health and Safety at SNL/KTF - Proposed Action (All Alternatives)

The study area for the analysis of effects to noise resources associated with the Proposed Action includes SNL/KTF and PMRF.

The FE-1 flight test would include the launch of a STARS booster with the payload from SNL/KTF. The STARS booster has been previously launched at SNL/KTF. The testing of the developmental payload at the same site would have a similar potential health and safety impact as described for the No Action Alternative. The proposed solid propellants would be similar to past launches and would follow the same health and safety procedures developed under existing plans.

Because the NEPA analyses (USASDC, 1992; US Navy, 2008) of the past STARS booster launches concluded with a FONSI and the conditions at SNL/KTF have not changed, implementation of the Proposed Action would not result in significant impacts to public health and safety.

4.1.7 Hazardous Materials and Wastes at SNL/KTF

The hazardous materials and wastes analysis contained in the respective sections addresses issues related to the use and management of hazardous materials and wastes as well as the presence and management of specific cleanup sites at KTF.

Hazardous Material and Waste Potential Impacts:

- **No Action: No Change**
- **Proposed Action: No Significant Impact**

4.1.7.1 Hazardous Materials and Wastes at SNL/KTF - No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change associated with hazardous materials and wastes. Therefore, no significant impacts would occur with implementation of the No Action Alternative.

4.1.7.2 Hazardous Materials and Wastes at SNL/KTF - Proposed Action (All Alternatives)

The study area for the analysis of effects to hazardous materials and wastes associated with the Proposed Action includes SNL/KTF and PMRF.

The flight test would include the STARS booster with the developmental payload launched from KTF. The STARS booster has been previously launched at SNL/KTF, and hazardous materials and wastes would be the same for these launches. The launch of the Proposed Action would be anticipated to use similar hazardous materials and produce similar hazardous waste. This launch is included in the overall number of missile launches proposed in the HRC EIS/OEIS. Hazardous material usage and waste generation would continue to be managed by PMRF under appropriate State and Federal requirements. Because the NEPA analyses (USASDC, 1992; US Navy, 2008), of the past STARS booster launches concluded with a FONSI and the conditions at SNL/KTF have not changed, implementation of the Proposed Action would not result in significant impacts with hazardous materials and wastes.

In accordance with EO 13045, *Protection of Children from Environmental Health and Safety Risks*, the Navy has determined that, since the majority of the FE-1 flight test would be conducted on DoD property and out in the open ocean, the FE-1 flight test has no environmental health and safety risks that may disproportionately affect children.

4.2 Over-Ocean Flight Corridor

4.2.1 Air Quality, Global Atmosphere, and Climate Change in the Over-Ocean Flight Corridor

Effects on air quality are based on estimated direct and indirect emissions associated with the action alternatives. The ROI for the over-ocean flight corridor is the global upper atmosphere over the Pacific BOA along the flight path from outside the launch area at SNL/KTF to outside the impact area at RTS. During flight, the emissions within the over-ocean flight corridor from the FE-1 flight test have the potential to affect air quality in the global upper atmosphere.

Estimated emissions from a proposed federal action are typically compared with the relevant national and state standards to assess the potential for increases in pollutant concentrations.

Air Quality Potential Impacts:

- **No Action: No Change**
- **Proposed Action: No Significant Impact**

4.2.1.1 Air Quality, Global Atmosphere, and Climate Change in the Over-Ocean Flight Corridor - No Action Alternative

Under the No Action Alternative, the FE-1 flight test would not occur and there would be no change to baseline air quality. Therefore, no significant impacts to air quality or air resources would occur with implementation of the No Action Alternative.

4.2.1.2 Air Quality, Greenhouse Gases, and Climate Change in the Over-Ocean Flight Corridor - Proposed Action (All Alternatives)

Air Quality

For all alternatives, the FE-1 vehicle would launch from SNL/KTF and travel along a pre-determined flight corridor over the Pacific BOA before payload descent for impact at RTS.

The FE-1 vehicle would launch from SNL/KTF to RTS with rocket emissions occurring in the over-ocean flight corridor as propellant is burned until exhausted from the rocket motor boosters. The active flight time over the ROI would be measured in minutes. Exhaust emissions would contain both chlorine compounds and free chlorine, produced primarily as hydrogen chloride (HCl) at the nozzle.

Approximately 5.6 tons of Al_2O_3 and 1.9 tons of NO_x (Table 3-7) are released over a period of minutes. The aluminum oxide is emitted as solid particles and can activate chlorine in the atmosphere. Chlorine and HCl would have a tropospheric lifetime long enough to eventually mix with the stratosphere. Both Al_2O_3 and NO_x are of concern with respect to stratospheric ozone depletion. NO_x contributes to catalytic gas phase ozone depletion and the exact magnitude of ozone depletion that can result from a buildup of Al_2O_3 over time has not yet been determined quantitatively. However, following the FE-1 flight test, the majority of Al_2O_3 would be removed from the stratosphere through dry deposition and precipitation.

The production of NO_x species from solid rocket motors is dominated by high-temperature "afterburning" reactions in the exhaust plume. As the temperature of the exhaust decreases with increasing altitude, less NO_x is formed. On a global scale, the quantity of NO_x emissions from a single STARS vehicle would represent a very small fraction of NO_x species generated. Additionally, diffusion and winds would disperse the NO_x species. No significant effect on ozone levels from NO_x is expected (US Department of the Air Force, 2010).

Emissions of HCl and Al_2O_3 from a single launches of a STARS booster (Table 3-7) would be substantially less than those that were released by a single Space Shuttle launch, and on a global scale the level of emissions would not be statistically significant. Because the emissions of HCl, Al_2O_3 , and NO_x from a launch of a STARS booster would be relatively small compared to emissions released on a global scale, the large air volume over which these emissions are spread, and the rapid dispersion of the emissions by stratospheric winds, a single launch of a STARS booster should not have a significant impact on stratospheric ozone. Therefore, impacts from single launch of a STARS vehicle for the FE-1 flight test would not be expected to have a significant impact on the upper atmosphere.

STARS rocket motor emissions from the FE-1 flight test would not have a significant impact on stratospheric ozone depletion. Ozone-depleting gas emissions from the single flight test would represent such a minute increase that even incremental effects on the global atmosphere are not likely.

Impacts of the FE-1 flight test launch on global warming, climate change, and ozone depletion in the atmosphere have also been considered as part of cumulative impacts in Section 4.18.

Greenhouse Gases and Climate Change within Over-Ocean Flight Corridor

CO_2 is the only GHG identified in the Kyoto Protocol or the Hawai'i rule that would be emitted during the FE-1 flight test. Because of the solid propellant used, the launch would release only 0.4 ton of CO_2 . This does not include a small number of support ocean vessels, aircraft, and other equipment that would be used along the flight path, at RTS, and around USAKA to support the terminal phase preparations and operations, which would be limited and temporary. The availability of GHG emission factors for vessels and some aircraft is limited. Therefore, GHG emissions from those sources were not quantified in this analysis. The amount of emissions that would be released, however, is assumed to be negligible based on the small number of vessels and aircraft utilized and the short period of time associated with conducting the FE-1 flight test activities. This limited amount of emissions would not likely contribute to global warming or climate change to any discernible extent.

Therefore, implementation of the FE-1 flight test would not result in significant impacts to greenhouse gases and climate change in the over-ocean flight corridor.

4.2.2 Biological Resources in the Over-Ocean Flight Corridor

Potential impacts of the Action on biological resources in the over-ocean flight corridor are evaluated in this section. The over-ocean flight corridor is in the Pacific BOA between Kauai, Hawai'i and Kwajalein Atoll.

Biological Resource Potential Impacts:

- **No Action: No Change**
- **Proposed Action: No Significant Impact**

4.2.2.1 Biological Resources in the Over-Ocean Flight Corridor - No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to biological resources. Therefore, no significant impacts to biological resources would occur with implementation of the No Action Alternative.

4.2.2.2 Biological Resources in the Over-Ocean Flight Corridor - Proposed Action

The Proposed Action is evaluated for the potential impacts on marine biological resources in the BOA of the ROI. Potential impacts of the Action in this area include elevated sound pressure levels, direct

contact from missile debris, exposure to hazardous chemicals, and increased human and vessel activity. The potential for the Proposed Action to adversely impact biological resources including those special-status species described in section 3.2.2 (Table 3-8) is evaluated in this section. In depth analyses of effects on consultation species have been completed in the FE-1 BA (US Navy and USASMDC, 2017) and have been reviewed by NMFS in a Biological Opinion (NMFS, 2017b; Appendix F). Impacts on threatened and endangered species are not expected to be different than those on non-listed species.

Within the over-ocean flight corridor, the FE-1 flight test flight is not expected to have a discernible or measurable impact on benthic or planktonic organisms because of their abundance, their wide distribution, and the protective influence of the mass of the ocean around them. The potential exists, however, for impacts to larger vertebrates in the open ocean area, particularly those that must come to the surface to breathe (e.g., marine mammals and sea turtles). Potential stressors to such species could occur from exposure to elevated noise (sonic booms), direct contact from falling booster stages and other vehicle components, and exposure to propellants or other contaminants released into the water.

Because of the potential for ESA-listed and other protected marine species to be affected in the open ocean area, the US Navy initiated consultations with NMFS (Pacific Islands Regional Office) in Honolulu, Hawai'i.

4.2.2.2.1 Exposure to Elevated Sound Levels

The Proposed Action has the potential to result in elevated sound pressure levels both in-air and underwater in the BOA. The primary elements of the Proposed Action that would result in elevated sound pressure levels in the BOA are: 1) sonic booms and 2) splashdown of vehicle components.

Sound creates vibrations that travel through air or water. Sound vibrations are characterized by their frequency (generally expressed in Hertz [Hz]) and amplitude or loudness which is quantified here using the logarithmic dB. In water, sound pressure levels (SPL) are typically referenced to a baseline of 1 μ Pa whereas in-air pressures are typically referenced to 20 μ Pa. In-air pressure measurements are converted to in-water estimates. Unless noted, all in-water sound pressure levels in the following analyses all dB levels presented below assume dB re 1 μ Pa. For many organisms it can be useful to distinguish between peak exposure levels (dBpeak) and total exposure over time (sound exposure level [SEL]). For some organisms, effects are compared to thresholds based on the root mean square (RMS) sound pressure level which is the quadratic mean sound pressure over the duration of the sound.

Sonic Booms The launch vehicle would fly at speeds sufficient to generate sonic booms from close to launch at PMRF and extending to impact at or near Kwajalein Atoll. Sonic booms create elevated pressure levels both in-air and underwater. The sonic boom generated by the FE-1 test flight has been estimated and is detailed in the FE-1 BA (US Navy and USASMDC, 2017). Numerous assumptions were made for sonic boom calculations and all assumptions were made to err on the side of conservatism, yielding calculated values larger than what will likely occur during the test flight. Table 4-2 shows peak sonic boom sound pressure levels at various stages during the trajectory.

The sonic boom will propagate up-range from the launch site and extend downrange along the entire flight path. The FE-1 sonic boom overpressures in the water at the ocean surface were estimated to be near their maximum level (~145 dB) near the launch site and would only be at this level for a short downrange distance and extending out from the flight path less than 28 km (15 nm). The maximum SPL of the sonic boom over the BOA is 135 dB and the average 130 dB footprint extends out from the flight path no more than 55km (30 nm). The duration of these overpressures is expected to average 270

milliseconds (ms) where SPLs are less than 140 dB, and the overpressure (sound levels) would dissipate with increasing distance and ocean depth.

Table 4-2 Estimated Sonic Boom Peak Sound Pressure Levels in Water for FE-1 Trajectory

<i>Reference</i>	<i>Intensity (dB re 1 μPa)</i>	<i>Location in ROI</i>
Boost (Maximum)	145	SNL/KTF
Flight (Maximum)	135	BOA
Flight (Average)	130	BOA
Terminal (Maximum)	175	Kwajalein Atoll

Source: Kahle and Bhandari, 2016

For the entire FE-1 flight path, affected areas for sonic boom were calculated at various acoustic intensities (dB re 1 μ Pa (FE-1 BA, US Navy and USASMDC, 2017). Approximately 1 km² (0.4 mi²) of ocean surface would be exposed to SPLs up to 170 dB, 54 km² (21 mi²) to SPLs up to 160 dB, and 338 km² (131 mi²) to SPLs up to 150 dB. Assuming an “N-Wave” sonic boom, a wide range for frequencies at various pressure levels are expected (see FE-1 BA, US Navy and USASMDC, 2017). As stated above, the model assumptions for estimating sonic boom overpressures likely lead to conservatively high estimates of sonic boom pressures and, therefore, conservatively high estimates of affect area.

Splashdown of Spent Rocket Motors and other Vehicle Components. Elevated sound pressure levels would occur in the ocean as spent rocket motors impact the ocean’s surface. Three spent rocket motor drop zones for these components are identified in the BOA of the ROI between 130 and 2,778 km (70 and 1,500 nm) from the launch pad (Figure 2-4). The nose fairing covering the payload is expected to be ejected and to fall into the third stage spent motor drop zone approximately 270 nm from the third stage impact.

Estimates of splashdown forces and associated sound pressure levels for FE-1 spent motors and the nose fairing have been estimated based on the size, shape, weight, trajectory, and impact velocity of the components, are discussed in detail in the FE-1 BA (US Navy and USASMDC, 2017), and are summarized in Table 4-3. Calculations for these estimates were made with numerous assumptions because there are no data available. All assumptions were made to err on the side of conservatism, yielding values larger than what would actually occur. All estimates are presented as in-water (at the surface) SPLs in dB re 1 μ Pa. The frequency of stage impacts is estimated to range from 100 Hz to 4 kHz (detailed in the FE-1 BA).

The effects of elevated sound levels due to splashdown of spent vehicle components is only expected to occur in the BOA of the action area. While there are no calculated estimates of duration for elevated SPLs associated with vehicle component splashdown, these elevated sound pressure levels are not expected to last more than a few seconds. Using the spherical spreading model for deep ocean waters, the range to threshold and affect area were calculated for the biologically relevant thresholds for special status species in the FE-1 BA (US Navy and USASMDC, 2017).

Effect Thresholds for Wildlife Species

Noise from sonic booms, splashdown of vehicle components could impact the behavior and hearing sensitivity in cetaceans, sea turtles, and fish in the ROI. Loud sounds might cause these organisms to quickly react, altering their normal behavior either briefly or more long term or may even cause physical injury. The extent of the effect depends of the frequency and intensity of the sound as well as on the

Table 4-3 Estimated Stage Impact Contact Areas and Peak Sound Pressure Levels for FE-1 Vehicle Components

<i>Stage</i>	<i>Contact Area m² (ft²)</i>	<i>Peak Sound Pressure Level (dB re 1 μPa)</i>
Stage 1 Spent Motor	27.73 (81.12)	218
Stage 2 Spent Motor	10.17 (33.38)	205
Stage 3 Spent Motor	5.94 (19.5)	201
Nose Fairing	16.81 (55.14)	196

Source: FE-1 BA (US Navy and USASMDC, 2017)

Table 4-4 Marine Mammal Species Groups for Assessing the Effects of Elevated Sound Pressure Levels

<i>Group</i>	<i>Common Name</i>	<i>Scientific Name</i>
Low-frequency Cetaceans	Minke whale	<i>Balaenoptera acutorostrata</i>
	Sei whale	<i>B. borealis</i>
	Bryde's whale	<i>B. edeni</i>
	Blue whale	<i>B. musculus</i>
	Fin whale	<i>B. physalus</i>
	Humpback whale	<i>Megaptera novaeangliae</i>
Mid-frequency Cetaceans	Short-beaked common dolphin	<i>Delphinus delphis</i>
	Pygmy killer whale	<i>Feresa attenuata</i>
	Short-finned pilot whale	<i>Globicephala macrorhynchus</i>
	Risso's dolphin	<i>Grampus griseus</i>
	Longman's beaked whale	<i>Indopacetus pacificus</i>
	Fraser's dolphin	<i>Lagenodelphis hosei</i>
	Pacific white-sided dolphin	<i>Lagenorhynchus obliquidens</i>
	Blainville's beaked whale	<i>Mesoplodon densirostris</i>
	Killer whale	<i>Orcinus orca</i>
	Melon-headed whale	<i>Peponocephala electra</i>
	Sperm whale	<i>Physeter macrocephalus</i>
	False killer whale	<i>Pseudorca crassidens</i>
	Pantropical spotted dolphin	<i>Stenella attenuata</i>
	Striped dolphin	<i>S. coeruleoalba</i>
	Spinner dolphin	<i>S. longirostris</i>
	Rough-toothed dolphin	<i>Steno bredanensis</i>
	Bottlenose dolphin	<i>Tursiops truncatus</i>
	Cuvier's beaked whale	<i>Ziphius cavirostris</i>
High-frequency Cetaceans	Pygmy sperm whale	<i>Kogia breviceps</i>
	Dwarf sperm whale	<i>K. sima</i>
Phocids	Hawaiian monk seal	<i>Neomonachus schauinslandi</i>

Source: NOAA 2016

hearing ability of the organism. In general, a SPL that is sufficient to cause physical injury to auditory receptors is a sound that exceeds an organism's permanent threshold shift (PTS) level. Depending on the species, higher SPLs may induce other physical injury or, in extreme cases, even death. The extent of physical injury depends on the SPL as well as the anatomy of each species. A temporary threshold shift

(TTS) is when an organism is exposed to sound pressures below the threshold of physical injury but may result in temporary hearing alteration. Another common effect of elevated sound pressure levels is behavioral modification. Most observations of behavioral responses to anthropogenic sounds have been limited to short-term behavioral responses, which include disturbance to feeding, resting, or social interactions. Such responses as sudden diving, change in swim speed, and change in respiration rate can have an effect on foraging and can decrease the foraging efficiency of various species. A disruption in foraging, or a reaction that forces an animal to expend energy diving or fleeing, may also affect the animal's energy budget (energy income against expenditure), with the outcome of less energy available for important biological functions. Responses can also include changes in the type or timing of an animal's vocalizations and masking of sounds produced from the impacted individual or from other individuals of the same species in the area such that those near the sound source would not hear those calls. Marine mammals have been observed to decrease their vocalizations in response to noise (Aguilar de Soto 2006; IWC 2007), which can have further implications on breeding, feeding, and social interacting.

Interpreting the effects of noise on marine mammals, sea turtles, and fish depends on various parameters, including the sound exposure level and duration, the sound frequency, and the animals hearing ability. As discussed above, SPLs can be expressed in several ways including: (1) peak pressure levels expressed in either psi, or dB re 1 μ Pa, (2) the average or root-mean-square (RMS) level over the duration of the sound, also expressed in dB re 1 μ Pa, and (3) sound exposure level (SEL) where the sound pressure is squared and integrated over the duration of the signal and summed for multiple events to result in a cumulative SEL (SEL_{cum}). Because the expected underwater noise levels from sonic booms and component splashdown represent single pulses that are relatively low in acoustic strength and very short in duration (on the order of several seconds, peak pressure levels were used for analysis purposes when available.

Cetaceans. For assessing TTS and PTS effects on cetaceans in the Action Area, this analysis used the revised acoustic threshold criteria from NMFS "Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing" (NOAA, 2016). The current thresholds depend on the hearing ability of marine mammals where cetaceans are separated into low-frequency, mid-frequency, and high-frequency groups (Table 4-4). The revised thresholds (Table 4-5) use both peak sound pressure levels (SPL_{peak}) and accumulated sound exposure levels (SEL_{cum}; NOAA, 2016). Since the revised acoustic threshold criteria used by NMFS (NOAA, 2016) include only thresholds for PTS and TTS and no criteria for behavioral effects, we use the "Criteria and Thresholds for US Navy Acoustic and Explosive Effect Analysis" (Finneran and Jenkins, 2012). The current US Navy standard for analysis for single explosive events is not to use a behavioral disturbance threshold for marine mammals as any behavioral disturbance from this type of event is likely to be limited to a short-lived startle reaction (Finneran and Jenkins, 2012).

Phocids. For phocids, the current thresholds used by NMFS to evaluate the onset of PTS and TTS are ≥ 212 dB and ≥ 218 dB, respectively (NOAA, 2016; Table 5-3). As with other marine mammals, the US Navy does not use any unique behavioral disturbance thresholds for exposure to single explosive events because any behavioral disturbance is likely to be limited to a short-lived startle reaction.

Birds. Hearing range and sensitivity has been determined from many land birds; however, seabird hearing remains largely unknown (US Navy, 2015a). Studies of terrestrial and marine bird hearing have shown greatest hearing sensitivity for these species between 1 and 4 kHz with minimum detectable frequency around 20 Hz and maximum hearing limit of 15 kHz (US Navy, 2015a). While most seabirds

Table 4-5 Acoustic Thresholds for PTS, TTS, and Behavioral Disruption from Single Exposure to Impulsive In-Water Sounds in Marine Mammals (Peak SPL Thresholds in dB re 1 μ Pa)

<i>Group</i>	<i>PTS threshold (dB SPL_{peak})</i>	<i>TTS Threshold (dB SPL_{peak})</i>	<i>Behavioral Disruption¹</i>
Low-frequency Cetaceans	219	213	NA
Mid-frequency Cetaceans	230	224	NA
High-frequency Cetaceans	202	196	NA
Phocids	218	212	NA

¹ For single explosive events, behavioral disturbance is likely to be limited to a short-lived startle reaction; therefore, the US Navy does not use any unique behavioral disturbance thresholds for marine mammals exposed to single explosive-like events.

found in the ROI feed by diving, skimming, or grasping prey at the water's surface or within 1-2 m (3-6 ft) of the surface, there is little published literature on the hearing abilities of seabirds underwater (US Navy, 2015a). A bird's response to noise depends on many factors including life-history characteristics of the species, frequency and amplitude of the noise source, distance from the noise source, presence of visual stimuli, and previous exposure to similar sounds (US Navy, 2015a).

If a seabird were exposed to elevated sound pressure levels, it could suffer auditory fatigue (hearing sensitivity over a portion of hearing range) or behavioral disruption (US Navy, 2015a). As with marine organisms, auditory threshold shifts may be either permanent (PTS) or temporary (TTS). Unlike most other species, birds have the ability to regenerate hair cells in the inner ear which allows them to recover from auditory injury better than other species, usually within several weeks (US Navy, 2015a). Some very intense sounds may result in permanent hearing damage in birds. Few studies have examined hearing loss in seabirds; however, the Navy's current standard of analysis uses a PTS threshold of 110 A-weighted decibels (dBA) re 20 μ Pa for continuous sounds and 140 dB re 20 μ Pa for blast noise (US Navy, 2015a).

Behavioral response to elevated sound pressure levels in birds include behaviors such as alert behavior, startle response, avoidance behavior, and increased vocalizations (US Navy, 2015a). In some cases, where noises induce behavioral response repeatedly over time, effects to birds may include chronic stress which may compromise the overall health and reproductive success (US Navy, 2015a). The reported behavioral and physiological response of birds to elevated sounds as in the Proposed Action can fall within the range of normal adaptive responses to stressors such as predation which birds experience on a daily basis (US Navy, 2015a). There is also some evidence that certain birds may become habituated to noises after frequent exposure and cease to respond behaviorally (US Navy, 2015a). While birds may experience behavioral and physiological responses to sounds, for short duration and unrepeatable sounds, birds may return to normal almost immediately after exposure and no long term effects are expected. Conservative estimates of sound effects on birds have been presented by the California Department of Transportation (Dooling and Popper, 2007). These estimates based on dBA (A-weighted for human hearing) do not provide accurate estimates of the noise level in the frequency range where birds hear and communicate; however, they can provide an overestimate of effects and therefore very conservative (if unrealistic) thresholds of effect (Dooling and Popper, 2007). A 93 dBA threshold for physiological or behavioral disruption from continuous noise sources has been suggested as a very conservative estimate of effects in birds (Dooling and Popper, 2007). While no data supported thresholds are known for impulsive sounds, the threshold for continuous noise can be used as a very conservative threshold of effects.

Sea Turtles. For sea turtles, we use the criteria and acoustic threshold standards which have been used by the US Navy for explosive sources (Finneran and Jenkins, 2012). These criteria and acoustic thresholds for sea turtles are similar to those proposed for marine mammals and all sea turtles are placed into a single functional hearing group (Finneran and Jenkins, 2012). Sea turtles have a functional hearing range of approximately 100 Hz to 1 kHz with an upper frequency limit of 2 kHz (Finneran and Jenkins, 2012). Physiological effects of elevated sound pressure levels from explosive sources can include not only auditory effects (PTS and TTS) but also mortality and direct (non-auditory) tissue damage known as primary blast injury (Finneran and Jenkins, 2012). In sea turtles, the lungs and auditory system are considered the most likely site of primary blast injury; however the US Navy applies a conservative approach of using the GI tract injury threshold for marine mammals for sea turtles also (Finneran and Jenkins, 2012). Therefore, the threshold for mortality and primary (non-auditory) blast injury for sea turtles is an (unweighted) SPL of 237 dB re 1 μ Pa (Finneran and Jenkins 2012). Since no data exist to better estimate the auditory effects of explosive sound sources, the US Navy applies the thresholds for TTS and PTS of low-frequency cetaceans to sea turtles as well (Finneran and Jenkins 2012). Therefore, the TTS threshold for sea turtles is a peak SPL of 224 dB re 1 μ Pa and the PTS threshold is a peak SPL of 230 dB re 1 μ Pa (Finneran and Jenkins, 2012). As with marine mammals, the behavioral effects of a single explosive event on sea turtles are likely to be limited to a short lived-startle reactions. Even though this is a single event, the US Navy's sea turtle behavioral disturbance threshold after exposure to multiple, successive underwater impulses might be used for a conservative estimate of behavioral effects on sea turtles: SEL (weighted) of 160 dB re 1 μ Pa²s (Finneran and Jenkins, 2012). This threshold is based on studies that indicate that behavioral disturbance may occur with SPLs of 175 to 179 dB re 1 μ Pa (which correspond to SELs of 163.6 to 160.4 dB re 1 μ Pa²s (Finneran and Jenkins, 2012).

Fish. While little is known about the specific hearing capabilities of the most species, most fish are able to detect a wide range of sounds from below 50 Hz up to 500-1500 Hz (Popper and Hastings 2009). While fish would likely be able to detect sounds like a sonic boom, their response to this sound disturbance is unclear. Potential responses to sound disturbance in fish include temporary behavioral changes, stress, hearing loss (temporary or permanent), tissue damage (such as damage to the swim bladder), or mortality (Popper and Hastings 2009).

The effects of elevated sound levels on fish are evaluated using the current conventional threshold levels by the US Navy for assessing the effects of explosives on fish based on NMFS 2015a and Popper et al. 2014. The mortality/mortal injury threshold, peak SPL of 229 dB re 1 μ Pa, is based on a literature review by Popper et al. (2014). It is important to note that this mortality threshold is based on the distance from the sound source that would be expected to result in only 1% fish mortality. The Northwest Training and Testing Biological Opinion (NMFS, 2015a) does not provide a set threshold for sub-lethal injury effects on fish. The onset of physical injury (non-lethal) is modeled based on the representative weight of the fish species (and age class, if data are available; NMFS, 2015a). Since the authors did not provide these calculations for PTS and other references are not available, we use the TTS threshold as an extremely conservative estimate of the extent of both temporary and permanent non-lethal damage. The threshold criteria for eliciting TTS in fish is 186 dB SEL_{cum} (NMFS, 2015a). The threshold for TTS in fish without a swim bladder and for fish with a swim bladder that is not involved in hearing is likely higher than this value (US Navy, 2015b); however, we use 186 dB SEL_{cum} as a conservative threshold for all fish species. While there are little known data supporting a general threshold for behavioral disturbance in fish and the effects from a single impulsive event are likely to be very fleeting, 150 dBRMS has been used in past analyses and is used here.

Corals and Mollusks. Corals and mollusks can perceive sounds (Fritzsche et al. 2007; Mooney et al. 2010; Vermeij et al. 2010), but much less than other invertebrates more specialized to produce and sense sounds (e.g., crabs and shrimp) (Patek and Caldwell 2005; Waikiki Aquarium and University of Hawai'i-Manoa 2009). Thresholds for damage to auditory sensors are unknown for corals and mollusks. Exposure to intense sound can cause behavioral reactions in some animals, which may include cessation of resting, feeding, social interactions, predator avoidance, and physiological changes to respiration or metabolism. Repeated exposures may cause behavioral acclimation, and chronic exposure to elevated sound levels is likely to impact individuals or populations for other taxa (Vermeij et al. 2010). Acute and temporary acoustic exposures such as those associated with FE-1 flight test impacts are likely to have only temporary consequences, if any, for some of the more specialized invertebrates. These impacts could include temporary disruption of feeding or predator avoidance behaviors (Mooney et al. 2010), but such consequences are likely to be irrelevant for corals and mollusks.

Estimation of Elevated Sound Level Impacts

Elevated sound pressure levels from sonic booms are not expected to impact marine wildlife in the BOA as maximum SPLs for sonic booms in the BOA (145 dB re 1 μ Pa) do not exceed the PTS, TTS, or behavioral thresholds for cetaceans, pinnipeds, phocids, sea turtles, or fish.

The probability of animals being impacted by elevated sound levels from splashdown of vehicle components in the BOA was calculated for special-status cetacean, phocid, and sea turtle species in the Navy SSP FE-1 BA (US Navy and USASMDC, 2017). Elevated SPLs resulting from vehicle component splashdown exceed PTS for only 3 marine mammal species (pygmy sperm whale, dwarf sperm whale, and Hawaiian monk seal) and exceed TTS for only those 3 species and 6 other cetacean species (minke whale, sei whale, Bryde's whale, blue whale, fin whale, and humpback whale). Based on densities of these marine mammals in the action area, the chance of exposures to SPLs exceeding PTS was between 1 in 1.07×10^6 and 2.62×10^6 . The chance of exposure to SPLs exceeding TTS was between 1 in 261,327 and 1 in 2.0×10^9 . Based on these exceedingly low probabilities, elevated SPLs from FE-1 vehicle component splashdown is not expected to impact marine mammals in the BOA.

For sea turtles, elevated SPLs resulting from vehicle component splashdown exceed only the behavioral disturbance threshold for these animals and do not exceed the TTS or PTS thresholds. Based on the best available density data for sea turtles, FE-1 BA analyses resulted in estimates for the chances of sea turtle exposure to SPLs exceeding the threshold for behavioral disturbance is 1 in 109. As with marine mammals, the model used for analysis assumed that the turtles did not move or exhibit avoidance behaviors to the approaching components. The estimates for the chances of elevated sound levels affecting individual sea turtles are likely overestimated in these analyses; however, these estimates do provide a conservative estimate of effects. Based on these analyses, elevated SPLs from FE-1 vehicle component splashdown is not expected to adversely impact sea turtles in the BOA.

While specific analyses were not conducted for fish due to lack of density data, elevated sound pressure levels are not likely to significantly impact fish in the BOA. Sound pressures have the potential to exceed the TTS threshold for fish up to 40 m (131 ft) from motor splashdowns and to exceed the behavioral disruption threshold out to 2.5 km (1.4 nm). While PTS threshold levels were not calculated, the TTS threshold was used as a very conservative estimate of physical injury potential. Some fish may be in these areas; however, these SPLs are not likely to adversely impact fish due to the very short in duration (less than 1 second) of the sound pressures and the low abundance and patchy distribution of fish in the BOA. Although loud sounds may cause fish species to quickly react, briefly altering their normal

behavior, fish are expected to resume their normal activity within minutes and these sounds would not impact individuals long-term. Elevated SPLs are not expected to adversely impact EFH in the action area.

At certain times of the year the gametes and larvae of some reef-associated fish, coral, and mollusk species may occur as zooplankton within the boundaries of the stage-three drop zones. It is extremely unlikely that these shallow-water reef-associated larvae would occur in the BOA because they are so far up current from sources of larvae. Elevated sound levels are not expected to impact individual larval fish, corals, or mollusks.

For birds, sonic boom SPLs in the BOA do not exceed the PTS threshold. Birds may be exposed to SPLs high enough to elicit behavioral response from sonic booms in the BOA for brief periods (average duration of 270 ms). Sonic boom pressure may exceed 94 dB in-air at the water's surface over an area of 392,581 km² (151,576 mi²). This is an estimate for the entire flight path (from launch at SNL/KTF to impact at Kwajalein Atoll) and due to assumptions made during sonic boom modeling, this is likely a conservative estimate which overestimates the affect area. In the BOA, seabirds are likely to have very low densities and patchy distributions. Some seabirds may be exposed to sonic boom SPLs great enough to elicit behavioral response; however, any response is likely to be very short in duration and limited to behaviors such as startle response. Bird behavior is expected to return to normal after a few minutes.

Elevated SPLs from vehicle component splashdown may exceed the PTS threshold for birds over a total area of 0.54 km² (0.21 mi²) and the behavioral response threshold over 26,861 km² (10,371 mi²). Reliable density data for seabirds in the BOA is not available; however surveys of seabirds in deep ocean areas suggest that seabird density is low and patchy as bird's density and distribution is likely determined by the distribution and abundance of their food supply. Consequently, elevated SPLs in the BOA are not likely to impact seabirds by physical injury. Some seabirds may be impacted by elevated SPLs causing temporary behavioral disruption; however, any behavioral disruption is expected to be limited to minor behavioral modification and bird behavior is expected to return to normal within minutes of exposure.

4.2.2.2.2 Direct Contact

The Proposed Action would result in spent rocket motors and nose fairings splashing down into the BOA. These falling components will directly impact marine habitats and have the potential to directly contact consultation organisms. The force of impact for these vehicle components contacting the ocean surface may result in shock waves radiating out from the point of impact. Shock-wave pressures are discussed in section 4.2.2.2.1 above. The first stage motor is 4.62 m (182 in) long with a diameter of 1.37 m (54 in) with an additional interstage section that is 87.12 cm (34.3 in) long with a diameter of 1.37 m (54 in). The second stage motor is 2.26 m (89 in) long with a diameter of 1.37 m (54 in) and the third stage motor is 1.32 m (52 in) long with a diameter of 1.37 m (54 in). Direct contact areas for these individual components are listed in Table 4-3 and total approximately 61 m² (189 ft²).

If a spent rocket motor or other FE-1 component were to strike a cetacean, sea turtle, or fish near the water surface, the animal would most likely be killed or injured. Based on the above discussed affect areas, and the best available species density information, chances of direct contact to cetaceans and sea turtles in the BOA were calculated in the FE-1 BA (US Navy and USASMDC, 2017). Calculations were based on methodology in the Mariana Islands Training and Testing Activities Final EIS (Appendix G in US Navy 2015a) and the Hawai'i-Southern California Training and Testing EIS (Appendix G in US Navy 2013). Very little information regarding fish densities is available for deep ocean waters; therefore direct contact probability was not calculated for fish species. These analyses assumed that all animals would be at or near the surface 100% of the time and that the animals are stationary. While these assumptions

did not account for animals that spend the majority of time underwater or for any animal movement or potential avoidance to proposed activities, these assumptions should have resulted in a conservative estimate of direct contact effect on species.

Based on analyses for marine mammals in the FE-1 BA (US Navy and USASMDC, 2017), the estimated number of animal exposures to direct contact from falling FE-1 components in the BOA is between 1 in 117,000 and 1 in 14,700,000 depending on individual species (Table 4-3). While we have included all possible species in these analyses, it is also important to note that many of these species are extremely unlikely to occur in the BOA or in the deep ocean waters of the Action Area (Table 3-8). Even when totaled across species, the estimated number of marine mammal exposures is only 1 in 20,200. The model does not account for animal movement or avoidance behaviors. Since cetaceans are highly mobile, they may be able to detect and avoid approaching vehicle components to some extent. The exposure estimates were modeled based on conservative assumptions and likely results in an overestimation of probability of effect. For all cetacean species, the chances of animals being physically injured from direct contact from splashdown of vehicle components is considered discountable based on these analyses.

Based on the best available density data for sea turtles, the estimated number of animal exposure to direct contact from falling FE-1 vehicle components in the BOA is 1 in 748,000. As with cetaceans, it is important to note some of the drawbacks of this model that may lead to overestimation of effect. The model is based on the best available density data. Since many density studies of turtles are conducted in nearshore areas, density estimates in deep ocean areas are largely unknown. The model also assumes that the turtles do not move or exhibit avoidance behaviors to the approaching components. Based on these analyses, FE-1 components are not expected to adversely impact sea turtles in the BOA.

Due to density data deficiencies, the number of direct contact exposures for fish was not able to be estimated. The abundance of these organisms in the BOA is expected to be low and their distributions patchy. These are also highly mobile organisms which may be able to detect and avoid falling vehicle components. For these reasons, direct contact from spent rocket motors or other FE-1 vehicle components is not likely to impact fish or EFH in the BOA.

Direct contact from splashdown of rocket components may impact individual larval fish, corals, and mollusks but the effects are considered insignificant. The Proposed Action may injure or kill a small but undeterminable number of fish, coral, and mollusk larvae. However, the impact on larval fish, coral, and mollusks are expected to be extremely small in relation to their total numbers, their distribution, and their life history.

While seabird density data are not available to allow reliable calculation of direct contact effects, the low density and patchy distribution of seabirds make it unlikely that birds would be impacted by direct contact from FE-1 component splashdown in the BOA.

4.2.2.2.3 Exposure to Hazardous Chemicals

The Proposed Action has the potential to introduce hazardous chemicals into the ROI. Splash-down of launch vehicle components has the potential to introduce propellants, hydraulic fluids, battery acids, explosives, and heavy metals into the marine environment of the BOA.

Any substances of which the launch vehicle is constructed or that are contained on the launch vehicle and are not consumed during FE-1 flight or spent motor jettison will fall into the BOA when first, second-, and third-stage launch vehicle motors and nose fairing are released (Tables 2-1 and 2-2). The

launch vehicle includes rocket motors, solid rocket propellant, magnesium-thorium in the booster interstage, asbestos in the second stage, battery electrolytes (lithium-ion and silver-zinc), radio frequency transmitters, and small electro-explosive devices. Though the batteries carried onboard the rocket motors would be discharged by the time they splash down in the ocean, they would still contain small quantities of electrolyte material. These materials, along with residual amounts of propellant, asbestos, and heavy metals contained in the first- and third-stage motors or nose fairing, may contaminate seawater. The release of such contaminants could harm a cetacean or sea turtle that comes in contact with, or ingests, toxic levels of these solutions.

In an evaluation of the effects of rocket systems that are deposited in seawater, the National Aeronautics and Space Administration concluded that the release of hazardous materials carried onboard launch vehicles would not significantly impact marine life. Materials would be rapidly diluted in the seawater and, except for the immediate vicinity of the debris, would not be found at concentrations that produce adverse effects (US Navy 1998).

Overall, larger and heavier vehicle components will sink fairly quickly to the ocean floor. Ocean floor depths in the BOA are so deep that consultation organisms will likely not be in contact with these materials. Any chemicals that do leak into the water column will be quickly diluted by ocean currents and the very large volume of ocean water.

Hazardous chemical release in the BOA is not expected to impact marine biological resources including EFH and seabirds due to the relatively small area affected by the dissolution of chemicals and the minimal amount of residual chemicals the spent boosters contain, components sinking to the ocean bottom where depths reach thousands of feet, the quick dilution and dispersion of any chemicals introduced to the water column, and the low density and patchy distribution of marine mammals, sea turtles, fish, and larval fish, corals and mollusks in the BOA.

4.2.2.2.4 Disturbance from Increased Human Activity and Vessels

The Proposed Action has the potential to increase ocean-going vessel traffic in the ROI. Pre-test activities would include vessel traffic to and from the BOA for onboard sensor placement. Three vessels with sensors are expected to enter the BOA where they would remain through the completion of the test. Since vessel traffic is common in this area and the increase in human activity and vessel traffic in the BOA is expected to be minimal, these activities are not expected to impact marine resources including threatened and endangered species or EFH.

4.3 USAKA, Kwajalein Atoll, Republic of the Marshall Islands

4.3.1 Cultural Resources at Illeginni Islet

Analysis of potential impacts to cultural resources considers both direct and indirect impacts. Direct impacts may be the result of physically altering, damaging, or destroying all or part of a resource, altering characteristics of the surrounding environment that contribute to the importance of the resource, introducing visual, atmospheric, or audible elements that are out of character for the period the resource represents (thereby altering the setting), or neglecting the resource to the extent that it deteriorates or is destroyed.

Cultural Resources Potential Impacts:

- **No Action: No Change**
- **Preferred Impact Location: No Significant Impact**
- **Alternative Impact Locations: No Impacts**

4.3.1.1 Cultural Resources at Illeginni Islet - No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to cultural resources. There would be no site preparation or placement of radars or data collection equipment at Illeginni Islet or Gagan Islet. Therefore, no impacts to cultural resources would occur with implementation of the No Action Alternative.

4.3.1.2 Cultural Resources at Illeginni Islet - Proposed Action (All Impact Location Alternatives)

The ROI is the areas on Illeginni Islet where FE-1 flight test activities would occur; there are no identified cultural resources within the deep ocean locations. The preferred site for the developmental payload impact is on the west side of Illeginni Islet. Existing surface cover and site disturbance from construction of a helipad, roads, and facilities, and operations including previous missile flight tests with land impacts encompass almost the entirety of Illeginni Islet. Buildings and other facilities on Illeginni are primarily in the central and eastern portions of the islet.

Illeginni Islet (Preferred Impact Location)

For a land impact, the FE-1 flight test is proposed to occur on the west end of Illeginni Islet. Archaeological surveys have not found indigenous cultural materials or evidence of subsurface deposits on the Islet. The Cold War-era properties potentially eligible for listing on the RMI NRHP are located in the central and eastern portions of the Islet. Because a land impact would not occur in proximity to known or potential cultural resources on Illeginni Islet, implementation of the Proposed Action would not result in significant impacts to cultural resources. Personnel involved in the FE-1 flight test operational activities would be briefed on and would follow UES requirements in handling or avoiding any cultural resources uncovered during operational or monitoring activities.

Offshore Waters – Southwest and Northeast (Alternative Impact Locations)

There are no cultural resources associated with either the southwest or northeast BOA location, and, therefore, no impacts to cultural resources.

There would be no significant impact to cultural resources from the FE-1 flight test at any of the three proposed impact zones.

4.3.2 Biological Resources at Kwajalein Atoll

Potential impacts of the FE-1 flight test on biological resources at the terminal end of the flight at or near Kwajalein Atoll are evaluated in this section. The payload flight would terminate either at Illeginni Islet (preferred impact location) or at one of two deep-water offshore sites (alternative impact locations; southwest or northeast deep water impact zones) near Kwajalein Atoll.

Biological Resources Potential Impacts:

- **No Action: No Change**
- **Preferred Impact Location: No Significant Impact**
- **Alternative Impact Locations: No Significant Impacts**

4.3.2.1 Biological Resources at Kwajalein Atoll - No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to biological resources. Therefore, no impacts would occur to biological resources with implementation of the No Action Alternative.

4.3.2.2 Biological Resources at Kwajalein Atoll (Preferred Impact Location)

The Proposed Action is evaluated for the potential impacts on marine biological resources at Illeginni Islet. Potential impacts of the Action in this area include elevated sound pressure levels, direct contact from payload impact debris, exposure to hazardous chemicals, and increased human and vessel activity. The potential for the Proposed Action to adversely impact biological resources including those special-status species described in section 3.3.2 (Table 3-10 and Appendix B) is evaluated in this section. In depth analyses of effects on consultation species have been completed in the FE-1 BA (US Navy and USASMDC, 2017) and has been reviewed by NMFS in a Biological Opinion (NMFS, 2017b; Appendix F). Impacts on threatened and endangered species are not expected to be different than those on non-listed species.

4.3.2.2.1 Exposure to Elevated Sound Levels

The Proposed Action has the potential to result in elevated sound pressure levels both in-air and underwater. The primary elements of the Proposed Action that would result in elevated sound pressure levels in this area are sonic booms and impact of the developmental payload.

Discussion of potential effects of elevated sound pressure levels on wildlife species as well as on effect thresholds for these species is presented in section 4.2.2.2.1 above.

Sonic Booms

The developmental payload would fly at high-speeds sufficient to generate sonic booms from third stage separation in the BOA and extending to impact at or near Kwajalein Atoll. Sonic booms create elevated pressure levels both in-air and underwater. At the terminal end of the flight path, the sonic boom generated by the approaching payload is estimated to peak at less than 180 dB near (Table 4-2). At the point of impact, the sonic boom footprint would narrow to about 46 km (25 nm) at this peak pressure. For payload impact at Illeginni Islet, elevated SPLs due to the sonic boom would be present in the air over land and would also be present in the surrounding waters. The duration for sonic boom overpressures produced by the payload are expected to average 75 ms where SPLs are greater than 140 dB and 270 ms where SPLs are less than 140 dB.

As detailed in the FE-1 BA (US Navy and USASMDC, 2017; approximately 1 km² (0.4 mi²) of ocean surface would be exposed to SPLs up to 170 dB, 54 km² (21 mi²) to SPLs up to 160 dB, and 338 km² (131 mi²) to SPLs up to 150 dB. As discussed in section 4.2.2.2.1, model assumptions for estimating sonic boom overpressures likely lead to conservatively high estimates of sonic boom pressures and, therefore, conservative estimates of affected area.

Impact of the Developmental Payload

Impact of the developmental payload at the terminal end of the flight would result in elevated in-air and/or underwater sound levels. Estimates for pressure from impact of vehicles using a similar amount of high explosives as those in the payload resulted in sound pressure levels in-air of 140 dB re 20 µPa at 18 m (59 ft). These levels were used as a bounding case for the current Proposed Action in the FE-1 BA (US Navy and USASMDC, 2017). Using the spherical spreading model, the SL is estimated to be 165 dB in-air and an estimated 191 dB in-water. For payload impact at Illeginni Islet, in-air pressure levels would remain above 140 dB up to 18 m (59 ft) from the impact site and above 93 dB up to 3,981 m (13,061 ft) away. The impact may result in some in-water elevated sound pressure levels in the shallow waters surrounding Illeginni. Using the cylindrical spreading model for shallower waters and an in-water SL of

191 dB, sound pressure levels may be above 160 dB out to 117 m (384 ft) and above 150 dB out to 541 m (1,775 ft).

Estimation of Elevated Sound Level Impacts

Terrestrial Wildlife. A payload impact on Illeginni has the potential to impact nesting, roosting, and foraging bird species. If birds were exposed to elevated sound pressures above PTS threshold levels, physical injury or even death could result. Birds are able to recover from hearing damage better than many other species, and most physical injury would likely be temporary; however, very loud sounds may cause permanent damage. Elevated SPLs from sonic booms would exceed PTS threshold for birds near payload impact where sound pressure levels would be above 140 dB re 20 μ PA over only about 0.2 km² (0.08 mi²), an area that is smaller than the potential impact area on Illeginni Islet where birds are unlikely to occur. It is likely that birds would be exposed to SPLs lower than the PTS threshold but high enough to cause behavioral disturbance. While birds might be temporarily startled by these sounds, any behavioral or physiological response is likely to be very brief as the duration of the elevated SPLs from sonic booms are on the order of 270 ms. No adverse impacts to birds on or near Illeginni Islet are expected due to elevated SPLs due to sonic booms.

Elevated sound pressure levels from payload impact would only exceed the PTS threshold for birds out to 18 m (59 ft) the point of impact. The impact area is composed primarily of previously disturbed habitat and mitigation measures to deter bird from nesting and roosting in the impact area would be employed such as visual deterrents (e.g., scarecrows, Mylar flags, helium-filled balloons, or strobe lights). Therefore, birds are not expected to be in this disturbed portion of the Islet that is the impact zone. Birds are expected to be roosting, foraging, or nesting (depending on the season) in the area surrounding the impact zone that may be subject to SPL exceeding bird's behavioral disturbance threshold. While birds are likely to be exposed to SPLs high enough to elicit behavioral response, any response to this short duration sound is likely to be limited to temporary startle responses. Bird behavior is expected to return to normal within minutes of impact and no lasting behavioral or physiological responses are expected. Birds may be more sensitive to elevated sound pressure level disturbance at certain nesting cycle stages (US Navy, 2015a). There is evidence that elevated noise levels may be more likely to cause nest abandonment during the incubation stage than during brooding of chicks (US Navy, 2015a). In general, the nesting season for seabirds and shorebirds at Illeginni and other USAKA islets begins in October and continues through April. In 2011, a USFWS and US Geological Survey team (Foster and Work, 2011) evaluated the AHW impact at the helipad on Illeginni Islet with pre- and post-test site visits. Post-test visits revealed that black-naped terns were actively feeding chicks at nests approximately 65 and 100 m (213 and 328 ft) of the impact site (Foster and Work, 2011). White terns were also observed roosting about 140 m (459 ft) from the impact site (Foster and Work, 2011). Even during nesting season, short-duration elevated SPLs from FE-1 activities are not expected to cause birds to abandon nests. Elevated SPLs from payload impact are not expected to adversely impact seabirds at and near Illeginni Islet.

Marine Wildlife. If organisms were exposed to elevated sound pressure levels above thresholds for PTS, physical injury or even death could result. If this were to occur, the animals would be subject to "harm" (as defined by the ESA and MMPA) or Level A Harassment. Exposure to SPLs above thresholds for TTS or behavioral thresholds have the potential to temporarily alter hearing abilities or temporarily alter behavior in consultation organisms but would not result in lasting effects or injury. If a consultation organism was impacted by temporary hearing shift or temporary behavioral modification, this could be considered Level B Harassment (as defined under the ESA and MMPA). The chances that these events

would occur as a result of the proposed action were analyzed in the FE-1 BA (US Navy and USASMDC, 2017). Methods for these analyses and acoustic threshold levels for organisms are discussed in Section 4.2.2.2.1 above.

The maximum SPLs for sonic booms at the terminal end of payload flight do not exceed the PTS or TTS thresholds for cetaceans, sea turtles, or fish. There is a potential for behavioral disruption in sea turtles near the payload impact point: however, only 54 km² (20.9 mi²) would be subject to SPLs of 160 dB sonic boom overpressures. For fish, sonic boom SPLs would not exceed the TTS threshold and would exceed behavioral disruption threshold over an area of 338 km² (130.5 mi²) near the payload impact point. An estimated maximum of 21 green turtles and 7 hawksbill turtles may be exposed to SPLs high enough to elicit behavioral response. No lasting effects from any realized behavioral disruption are expected for any of the consultation organisms. Animals may have a startle response from this short duration sound but animals are expected to return to their normal behavior within minutes of exposure. For these reasons, elevated sonic boom SPLs are not expected to adversely impact wildlife near Illeginni Islet.

At Illeginni Islet, payload impact pressure levels would not exceed PTS or TTS thresholds for marine mammals or sea turtles in the waters surrounding Illeginni. The SPLs from payload impact may expose green and hawksbill turtles to SPLs above the behavioral disruption threshold. Based on analyses in the FE-1 BA (US Navy and USASMDC, 2017) the chance of an individual green turtle being in the area with payload impact SPLs high enough to induce behavioral disturbance is 1 in 61. The chance of a hawksbill turtle being subject to SPLs loud enough to induce behavioral disturbance is 1 in 176. As with cetaceans, it is important to note some of the drawbacks of this model that may lead to overestimation of effect. The model is based on the best available density data for turtles in shallow Pacific waters. The model assumes that the turtles do not move or exhibit avoidance behaviors to the approaching components. The estimates for the chances of elevated sound levels affecting individual sea turtles are likely overestimated in these analyses; however, these estimates do provide a conservative estimate of effects. Elevated SPLs from payload impact are not expected to adversely impact marine mammals or sea turtles near Illeginni Islet.

There are no known reliable density estimates for consultation fish species in the shallow waters near Kwajalein Atoll. These fish species likely have very low densities in these areas with patchy distributions. Near Illeginni, the maximum radial distance at which fish might be subject to injury is only 2.2 m (7.2 ft) from payload impact and 541 m (1,775 ft) for behavioral disturbance. Adult fish are not expected to be within 2.2 m (7.2 ft) of payload impact on Illeginni and as stated above, any behavioral disturbance in fish would likely be limited to a brief startle response and behaviors would likely quickly return to normal. Elevated SPLs from payload impact are not expected to adversely impact fish near Illeginni Islet.

Although densities of larval fish, coral, and mollusks have the potential to be higher in the shallow waters surrounding Illeginni Islet, elevated sound pressure levels in the area are not likely to impact larval fish, corals and mollusks. Fish, corals, and mollusks are expected to respond behaviorally to acute sounds, if at all. Any modification of behavior is likely to be temporary and behavior would return to normal after a brief interval. Larval fish, corals, and mollusks, while present in shallow waters near Illeginni Islet are episodic in their presence with peak abundance during spawning season between July and December.

4.3.2.2.2 Direct Contact

The Proposed Action would result in impact of the payload on land. Falling debris would directly impact terrestrial habitats and has the potential to directly contact marine habitats. The force of impact for the

payload contacting land may result in ejecta and/or shock waves radiating out from the point of impact. While direct estimates for shock-wave strength and cratering are not available for the FE-1 flight test, cratering and shock waves are expected to be less than those of MMIII re-entry vehicles (RVs). Therefore, MMIII estimates of cratering and shock waves (USAFGSC and USASMDC/ARSTRAT 2015) are used as a maximum bounding case for the Proposed Action. Shock-wave pressures are discussed in section 4.3.2.2.1 Exposure to Elevated Sound Levels.

Analysis was performed using the kinetic energy of previous Minuteman III impacts which is greater than that anticipated for the FE-1 impact. As described in the Biological Assessment, the kinetic energy of impact of the FE-1 stages is on the order of 4×10^9 Joules, or 0.96 ton of trinitrotoluene. For a terrestrial impact on Illeginni Islet, the payload would likely form a crater including ejecta spreading out from the crater. The designated impact zone is an area approximately 290 m (950 ft) by 137 m (450 ft) on the northwest end of the Islet, as limited by available land mass. The footprint of a payload impact on land would be roughly elliptical but its size would depend on the precise speed of the payload and its altitude. Since speed, altitude, and size information are not available for a payload impact, we use estimates of re-entry vehicle (RV) cratering from MMIII test flights as a bounding case for potential impacts of the Proposed Action. For MMIII RVs, the ejecta field from crater formation at impact was expected to cover a semicircular area (approximately 120 degrees) extending 60-91 m (200-300 ft) from the impact and the density of ejecta was expected to decrease with distance from the point of impact (USAFGSC and USASMDC/ARSTRAT 2015). Craters from MMIII RVs have been documented to be 6-9 m (20-30 ft) in diameter and 2-3 m (7-10 ft) deep.

The payload is planned to impact on Illeginni Islet within the designated impact zone (Figure 2-6). A shoreline impact has the potential to affect sea turtle nesting habitat. It is possible that a payload impact on the shoreline at Illeginni would affect the near shore marine environment through ejecta from a crater and/or falling fragments.

Estimation of Direct Contact Impacts

Terrestrial Vegetation. Terrestrial vegetation in the payload impact zone at Illeginni is vegetation of previously disturbed habitat and is predominantly managed vegetation. Therefore, no adverse impacts to terrestrial vegetation are expected.

Terrestrial Wildlife.

Birds on Illeginni Islet. Direct contact from the payload or debris/ejecta radiating out from the point of impact has the potential impact birds by injuring or killing birds, or by nest destruction. Fifteen bird species are known to occur on Illeginni Islet. Birds such black noddies, Pacific golden plovers, white terns, sanderlings, and tattlers are known to use the forested area east of the Illeginni impact zone (Foster and Work, 2011; USFWS and NMFS, 2012) and black noddies are known to nest in this area. Several species are also known to use the forested area west of the impact zone. White terns, tattlers, plovers, black-naped terns, and great-crested terns are known to utilize the grassy areas near the helipad but it is unknown if any of these species use the area for nesting (Foster and Work, 2011; USFWS and NMFS, 2012). Black-naped tern nests with eggs and/or chicks were recorded on Illeginni in 2012 and 2014 and are known to nest in the vicinity of the impact area (Michael Fry, personal communication, 24 April 2017). Up to 4 black-naped tern nests have been observed by USFWS on Illeginni at one time and nests normally have one or two viable eggs/chicks (USFWS communication, 27 April 2017). It is likely that pre-flight human activity and equipment operation would disturb any birds using the impact area and may cause nest abandonment if any birds are nesting in the area (discussion in "Disturbance from

Human Activity and Equipment Operation” section below). The impact area is composed primarily of previously disturbed habitat and mitigation measures to deter bird from nesting and roosting in the impact area would be employed such as visual deterrents (e.g., scarecrows, Mylar flags, helium-filled balloons, or strobe lights). Birds are not expected to be in this disturbed portion of the Islet that is the impact zone; however, there is a chance that birds may still be roosting, foraging, or nesting in the area the time of payload impact. Direct contact from payload debris or ejecta may adversely impact birds in the impact zone. The USFWS estimated that a maximum of 12 black naped terns might be adversely affected by a daytime payload impact and a maximum of 16 birds could be injured or killed in the event of a nighttime payload impact (USFWS communication, 27 April 2017). The impact area would be monitored for black-naped tern nesting activity during pre-launch activities. If nests are found, eggs and chicks would be protected with the construction of wooden “A-frame” structures as per USFWS guidance to shade eggs or chicks in the event that adults are flushed from nests and to warn project personnel of the presence of this protected resource (USFWS communication, 27 April 2017). Birds roosting or nesting in the adjacent littoral forest and shrub habitats are not expected to be adversely affected by payload impact.

Sea Turtles and Sea Turtle Nests on Illeginni Islet. Only green sea turtles and hawksbill turtles have been observed near Kwajalein Atoll islets. These two species are known to nest or haul out on some Kwajalein Atoll Islets. If a sea turtle or sea turtle nest were struck by debris or ejecta from payload impact, a sea turtle could be killed or injured or sea turtle eggs could be damaged or destroyed. Turtles may also be subject to behavioral disruption significant enough to preclude females from haul-out and nesting.

In the Marshall Islands, sea turtle nesting generally occurs between May and November and peaks from June to September. Based on available information, NMFS and USFWS (2015) estimated 300 nesting green turtle females in the RMI out of a total of 6,500 nesting females in the Central West Pacific DPS (4.6% of known breeding population). In a 2008 survey of USAG-KA, suitable nesting habitat (relatively open sandy beaches and seaward margins of herbaceous strand above tidal influence) for sea turtles was identified, and these areas were thoroughly surveyed on foot for nesting pits and tracks. Green sea turtles have been observed hauling out and nesting at the northeastern portion of Kwajalein Islet, including the lagoon side at Emon Beach and the sand berm on the ocean side, approximately east of Emon Beach. However, no sea turtles were observed during the 2008 survey. The most significant green turtle nesting assemblage in RMI is in Bikar Atoll, in the northeastern corner of RMI. In May 2009, a hawksbill nested on the lagoon side of Omelek Islet near the harbor area (Malone 2009). The eggs hatched in early July and were inventoried. Thirteen unhatched eggs and 101 hatched eggs were counted. Three sea turtle nests (species unidentified) were found at Kwajalein Islet in September and October 2010, on a beach on the east-facing shore across the street from the high school (Eder 2011). The three nests were excavated after the eggs hatched, and the numbers of hatched and unhatched eggs were estimated as less than 300 eggs.

Successful sea turtle nesting on Eniwetak was confirmed by video recordings of turtle hatchlings entering the ocean at the islet in May 2011 (Aljure 2016). Successful nesting was also observed on Kwajalein Islet in January 2015 when hatchlings were found and returned to the beach or ocean (Aljure 2016). Observations of potential turtle haul-outs within Kwajalein Atoll include, a lagoon-side observation at Legan in May 2013, one at Eniwetak in March 2014, two haul-outs on the ocean-side of Kwajalein Islet in 2014, and two at Eniwetak in December 2014 (Aljure 2016).

Known green and hawksbill sea turtle activity in the vicinity of Illeginni Islet is limited to the following individual sightings:

- An adult green turtle was seen in nearshore waters on the ocean side of Illeginni in 1996 (USFWS and NMFS 2002);
- A hawksbill was observed near shore in the lagoon north of Illeginni in 2002 (USFWS and NMFS 2004);
- An adult hawksbill was observed during a 2004 marine survey of an area extending over the lagoon-facing reef northwest of the harbor to a point across from the northwestern corner of the islet. The survey occurred at depths from 5 to 10 m (16 to 33 ft; USFWS and NMFS 2006). This high-relief habitat supports a complex community of coral, a foraging area for hawksbills;
- An adult turtle of unknown species was documented in the 2006 inventory;
- Four green sea turtles were observed near Illeginni in the 2010 inventory;
- In 2012, 1 green sea turtle was observed off a lagoon patch reef adjacent to Illeginni Islet;
- An adult green sea turtle was observed during the 2014 inventory in a dense area of seagrass (*Halophila minor*) in Illeginni Harbor; and
- Sea turtle nest pits (unidentified species) were last found on Illeginni Islet in 1996, on the northern tip of the islet. No nesting was observed in surveys taken in 1998, 2000, 2002, 2004, 2006, or 2008, although suitable sea turtle nesting habitat was observed (USFWS 2011). Suitable nesting habitat appears northwest and east of the helipad on the lagoon side of Illeginni (USFWS and NMFS 2002).

The reported observations listed above were made during single-day surveys that were part of biennial resource inventories. These surveys were very limited in scope and effort, lasting for only a few hours and usually done by three people. The low number of sightings near Illeginni Islet may be attributed to the low level of effort expended to observe sea turtles there. While avoidance of a shoreline payload impact would be attempted, there is a chance that this would occur or that debris or ejecta from an impact further inland would affect sea turtle nesting habitat near the shoreline as debris and ejecta may extend out 100 m from the point of impact. While Illeginni Islet has shoreline habitat suitable for sea turtle nesting, no sea turtle nests or nesting activity have been observed on Illeginni in over 20 years. The last evidence of sea turtle nesting activity on Illeginni Islet consisted of observations of nest pits in 1996, 21 years ago. Therefore, the US Navy and USASMDC have concluded that the probability of sea turtle nesting in the area is so low as to be discountable and that FE-1 activities may but are not likely to adversely affect nesting sea turtles (US Navy and USASMDC, 2017). The USFWS has concurred with this determination (Appendix A).

Mitigation measures would be employed to decrease the chances of there being effects on sea turtles or sea turtle nests. For at least 8 weeks preceding the FE-1 flight test launch, Illeginni Islet would be surveyed bi-weekly by qualified personnel for sea turtles, sea turtle nesting activity, and sea turtle nests and any observation would be reported to the appropriate test personnel and the USAG-KA Environmental Engineer. If possible, personnel would also inspect the area within two days of the launch. Pre-test personnel at Illeginni Islet and in vessels traveling to and from Illeginni Islet would look for and report to the appropriate test personnel and the USAG-KA Environmental Engineer any

observations of sea turtles, evidence of sea turtle haul out or nesting, or of sea turtle nests at or near Illeginni Islet. If personnel observe endangered, threatened, or other species requiring consultation moving into the area, work would be delayed until such species leave the area or were out of harm's way. Should any missile components or debris impact areas of sensitive biological resources (i.e., sea turtle nesting habitat or coral reef), a USFWS or NMFS biologist would be allowed to provide guidance and/or assistance in recovery operations to minimize impacts on such resources.

Marine Wildlife

Larval Fish, Corals, and Mollusks. Direct contact or shock waves from splashdown of rocket components may impact individual larval fish, corals or mollusks that may be present as components of drifting plankton. However, the density and distribution of larval organisms is likely to be so variable in space and time that accurate estimates of potential incidental take of larval consultation species would have to include a margin of error of several orders of magnitude.

Studies of coral larvae density during the peak spawning period indicate 1 to 0.1 planktonic larvae m^3 in per 35.31 ft^3 in waters 5 km (2.7 nm) away from the reef (Hodgson 1985). Larval densities are generally higher nearer to the reef and decrease as distance increases. These larval densities depend on conditions including ocean currents and seasonality. Based on analyses in the FE-1 BA (US Navy and USASMDC, 2017), it is possible that a very low number of fish, coral, or mollusk larvae would be within the affected volume of surface water. Therefore, payload impact may adversely impact a very small, but indeterminable, number of larval fish, corals or mollusks.

In general, the consequences of taking individual larvae are considered to be substantially less severe than the consequences of taking individual adults because the baseline mortality rate of larvae is several orders of magnitude higher than for adults; therefore, the odds of individual larvae surviving to reproductive age are substantially lower than the odds of an adult surviving to reproduce again (Gascoigne and Lipcius 2004). Population effects to consultation species are discountable for this reason; because the affected area is trivially small relative to the distribution of these invertebrates; and because the number of larvae potentially affected is likely to be trivially small relative to their population sizes and the effects are considered discountable.

Non-larval Fish, Corals, and Mollusks near Illeginni Islet. Many non-larval reef associated fish, coral, and mollusk species have the potential to occur near Illeginni Islet (Appendix B) including 19 consultation coral species, 3 consultation fish species, and 5 consultation mollusk species. These forms include the relevant coral and mollusk species and adults and juveniles of the relevant fish species. Although coral reefs are not planned or expected to be targeted, a land payload impact on the shoreline of Illeginni could result in ejecta/debris fall, shock waves, and post-test cleanup operations, which may adversely impact at least some of the consultation fish, coral and mollusk species on the adjacent reef. Attempts would be made to avoid payload impact near these sensitive shoreline areas; however, here we present results of FE-1 BA (US Navy and USASMDC, 2017) analyses of this worst case scenario to elucidate the maximum effects of the Proposed Action.

The anticipated worst-case scenario of a payload land impact at Illeginni islet is considered to be a shoreline strike, which would result in debris fall and shock wave effects within an affected area that would extend outward from the point of strike (Figure 4-1). Based on this worst-case scenario, the US Navy and USASMDC (FE-1 BA, US Navy and USASMDC, 2017) estimated a maximum of 100 juvenile and 8 adult humphead wrasses may be found in habitats in both the debris fall and shock wave affect areas. The maximum number of consultation coral colonies that may be present was estimated to be 9,097

colonies and the maximum number of individual consultation mollusks was estimated to be 468. Not every consultation species individual or colony within an affected area of habitat would be equally vulnerable to the effects of debris fall and shock wave impacts (NMFS-PIRO 2014a and 2014b). These effects should be assumed to affect only a proportion of the associated coral colonies, mollusks, and fish that may be present.

Planned land strikes would not be targeted close to the shoreline, and impacts to near shore consultation species would be avoided. As can be seen in Figure 4-1, the entire potential affected reef area is very small in comparison to the total comparable reef area surrounding and connected to Illeginni. Moreover, this area is considered extremely small compared to sum of comparable reef areas under US control per the current military use agreement with the RMI, and miniscule in comparison with comparable reef areas within the entire Atoll. If the reef, reef flat, or shallow waters were inadvertently impacted, an inspection would be performed within 24 hours to assess any damage and determine mitigation measures.

Of the 15 consultation coral species that have the potential to be impacted as adults, all were observed at multiple islets and 80% were observed at more than five islets. Most of the species appeared to be geographically widespread with observed occurrences of four species, *Acropora microclados*, *Heliopora coerulea*, *Pavona venosa*, and *Montipora caliculata*, exceedingly common. The humphead wrasse is common in distribution within USAG-KA. A total of 103 sites were surveyed for protected fish since 2008. *Cheilinus undulatus* has been seen at 10 of the 11 islets.

Since at least some adult consultation corals, mollusks, and fish may be affected by direct contact, the US Navy and USASMDC have concluded that these activities may adversely affect these species (US Navy and USASMDC, 2017) and initiated consultation with NMFS. In their Final Biological Opinion (NMFS, 2017b; Appendix F), NMFS concluded that a total of up to 9,929 colonies of consultation corals, 117 top shell snails, and 12 giant clams could be affected by direct contact, ejecta, and/or shock waves from a FE-1 payload impact near the Illeginni shoreline. The NMFS also concluded that the potential loss of these adult coral and mollusk species is not expected to eliminate them from Illeginni or to appreciably reduce the likelihood of their survival and recovery (NMFS, 2017b; Appendix F).

Cetaceans. Cetaceans would not be affected by direct contact from payload components in the vicinity of Illeginni Islet. All affects from direct contact with payload fragments or ejecta are expected to occur within 91 m (300 ft) of a payload impact. Cetaceans do not occur in these shallow waters.

4.3.2.2.3 Vessel Strike

The Proposed Action has the potential to increase ocean-going vessel traffic in the ROI. Prior to the test flight, radars and test equipment would be placed on Illeginni Islet and would be transported aboard ocean-going vessels. Sensor rafts would also be deployed near the impact site from a LCU vessel. The rafts are self-stationing; therefore, none of the rafts would require an anchoring system. Post-test recovery efforts would also result in increased vessel traffic to the payload impact site. In the event of a payload impact at Illeginni Islet, vessels would be used to transport heavy equipment (such as backhoe or grader) and personnel for manual cleanup of debris, backfilling or any craters, and instrument recovery. BMP would be implemented to ensure disturbed sediment does not wash in nearby waters. Deployed sensor rafts would also be recovered by a LCU vessel. Debris would only be recovered in waters up to approximately 30.5 m (100 ft) deep. Pre- and Post-test, vessel traffic is expected to last approximately 10 weeks total and involve about 8 vessel round-trips.



Figure 4-1 Representative Maximum Direct Contact Affect Areas for a Shoreline Payload Impact at Illeginni Islet, Kwajalein Atoll

Estimation of Vessel Strike Impacts

Terrestrial Wildlife. Seabirds that forage in waters offshore of Illeginni Islet may be exposed to vessels transiting to and from Illeginni Islet. Direct collisions of birds with Navy vessels are unlikely and not expected. Birds are more likely to be visually and behaviorally disturbed by vessels causing birds to either avoid vessels or in some cases to follow vessels. No adverse impacts to birds are expected from vessels transiting to and from Illeginni Islet.

Marine Wildlife. Marine wildlife has the potential to be impacted by vessel strike primarily by being at the surface when a vessel travels through an area or by a deploying raft. Organisms at the surface are at risk of being struck by the vessel or their propellers. Organisms that are not found at the sea surface have the potential of being struck when a vessel drops anchor or if a vessel runs aground. Cetaceans, sea turtles, fish, corals, and mollusks present in the vicinity of Illeginni Islet are not expected to be impacted by vessel strike, as a small number of vessel trips would be required to support pre-flight and post-flight cleanup activities, and there would be only one flight test conducted.

While cetaceans and sea turtles breathe air, must surface to breathe, and are known to bask at the ocean surface, these are highly mobile animals capable of avoiding vessels and they may already be used to some vessel traffic in the ROI. Fish species do not need to surface to breathe are not known to frequent the ocean surface, and are highly mobile animals capable of avoiding vessels. Corals and mollusks have the potential to be struck by a dropped anchor or a vessel contacting reef habitats, although this is unlikely, vessel operators would be made aware of sensitive reef habitats in order to avoid these areas. Additionally mitigation measures would be employed to avoid vessel strikes, including vessel operators and other project personnel watching for and avoiding cetaceans and sea turtles by adjusting their speed or waiting until animals have moved away from the area before deploying rafts. Any marine

mammal or sea turtle sightings during surveys, overflights, or ship travel would be reported to the USAG-KA Environmental Engineer, the RTS Range Directorate, and the Flight Test Operations Director for consideration in approving the launch.

4.3.2.2.4 Exposure to Hazardous Chemicals

Land impact of the payload would have the potential to introduce propellants, battery acids, explosives, and heavy metals into the terrestrial environment of Illeginni Islet. Pre-test preparatory and post-test cleanup activities may involve heavy equipment and ocean-going vessels, which have the potential to introduce fuels, hydraulic fluids, and battery acids to terrestrial habitats as well as marine habitats. A small number of small radars are considered expendable and may be destroyed during testing. While the debris from these radars is expected to be recovered, battery acids and heavy metals may be introduced into the terrestrial environment and may potentially leech into the marine environment.

Following the impact of the payload, fragmentation of the payload would disperse any of the residual onboard hazardous materials (Table 2-2), such as battery acids, residual explosives, and heavy metals, around the impact point. Onboard the payload there would be up to four lithium ion batteries each weighing between 1.36 and 22.68 kg (3 and 50 lbs) and two radio frequency transmitters. The batteries carried onboard the payload would be discharged by the time the vehicle impacts on land at Illeginni Islet; however a small quantity of electrolyte material (on the order of a couple ounces) may still enter the terrestrial environment. The payload also carries up to 454 kg (1,000 lbs) of tungsten alloy which would enter the terrestrial and possible marine environments upon payload impact. The payload structure itself contains heavy metals including aluminum, titanium, steel, magnesium, tungsten, and other alloys.

With the payload impact on Illeginni, debris including hazardous materials would fall on Illeginni and possibly into nearshore habitats. Debris and ejecta from a land impact would be expected to fall within 100 m (328 ft) of the impact point. Post-flight cleanup of the impact area would include recovery/cleanup of all visible debris including during crater backfill. BMP would be implemented to ensure disturbed sediment does not wash into nearby waters. Searches for debris would be attempted out to water depths of 15 to 30.5 m (50 to 100 ft) if debris enters the marine environment. Considering the small quantities of hazardous materials contained in the batteries, the planned land impact, and the dilution and mixing capabilities of the ocean and lagoon waters, the battery materials released during payload impact should be of little consequence to any cetaceans, fish or sea turtles in the area. Any visible battery fragments in the lagoon, in other shallow waters, or on Illeginni would be removed during recovery and cleanup. While every attempt would be made to clean up all visible metal and other fragments, it is likely that some fragments would be too small to be recovered or may be buried by the force of impact. Therefore, it should be considered that a small but unknowable amount of these heavy metals or other substances may remain in the terrestrial or marine environments at Illeginni Islet.

Since up to 454 kg (1,000 lbs) of tungsten alloy would be contained on the payload and be introduced into the terrestrial (and possibly marine) environments upon payload impact, it is possible that a small but unknowable amount of tungsten alloy would remain at Illeginni Islet. While the effects of tungsten alloys in ecosystems is largely unknown, recent studies have concluded that under certain environmental conditions tungsten may dissolve and some forms of tungsten (depending on soil conditions) can move through soil (Dermatas et al., 2004). A 2008 study (Bednar et al.) of geochemical parameters influencing tungsten mobility in soils found that dissolved tungsten reached equilibrium after approximately 48 hours and mobility decreased by approximately one-half within a 4 month period. In the presence of alloying elements such as iron, nickel, and cobalt, tungsten was sorbed to clay

soils and mobility was decreased; however, this sorption also depends on soil conditions such as pH and mineral and organic composition (Dermatas et al., 2004). Soils on Illeginni are primarily well-drained and composed of calcareous sand that is poor in organic materials with a few carbonate fragments. Some studies suggest that introduction of tungsten into soil increases soil pH and may impact soil microbial communities (Dermatas et al., 2004; Strigul et al., 2005). There is also some evidence that soluble tungsten may decrease biomass production, and that plants and worms may take up tungsten ions from the soil (Strigul et al., 2005).

The US Navy and USASMDC performed a bench study and computer modeling (LLNL, 2017; Appendix D) to quantify material-specific tungsten alloy dissolution rates in groundwater and seawater and predict the degree of tungsten sorption to the carbonate material of Marshall Islands coralline soils. The bench study dissolution rates were applied to the computer model to determine the residual quantities of tungsten alloy over time. The model results are compared to USEPA guidance (June 2017) for human health-based risks associated with exposure, and conclusions drawn based on the USEPA guidance. Based on a calculated amount of tungsten material from the FE-1 flight test remaining in the soil following cleanup at Illeginni Islet, the bench study and model results indicate levels of tungsten in Illeginni Islet soil and groundwater would be below the USEPA Residential RSLs (LLNL, 2017) for soil and drinking water (although this area is not designated as potable water) from the end of the flight test to 25 years out, the period for which the model was run. Therefore, significant environmental effects from tungsten in soils would not be expected. US Navy SSP would perform pre- and post-flight test sampling at Illeginni Islet to verify model results.

Regarding the long term risk from entering the marine ecosystem, the bench study and model results (LLNL, 2017) indicate very slow dissolution and passivation (i.e., natural chemical encapsulation) of tungsten from FE-1 may occur in sea water. The dissolution rate of the tungsten alloy in seawater peaked within an initial two week leaching period during the study. The average dissolution rate over three months was 2.8 milligrams per square meter per hour ($\text{mg}/\text{m}^2/\text{hr}$); the highest rate measured over the 13 week study was $7.4 \text{ mg}/\text{m}^2/\text{hr}$, occurring in the second week, which agreed with the model. The lowest rate was $0.0 \text{ mg}/\text{m}^2/\text{hr}$ occurring in the first week, followed by $0.4 \text{ mg}/\text{m}^2/\text{hr}$ for the 11th and 13th weeks. At a rate of $0.4 \text{ mg}/\text{m}^2/\text{hr}$, if that rate were fairly constant, it would take approximately 280 years for the maximum 454 kg (1,000 lbs) mass to dissolve in ocean waters. Because the preferred impact location is Illeginni Islet, none or only a small quantity of the payload would occur within the nearshore environment and no significant effects would be expected.

Up to four small units powered by car batteries are considered expendable and would be destroyed by the impact. While the debris from these radars is expected to be recovered, acids and heavy metals may be introduced into the terrestrial environment. Only trace amounts of hazardous chemicals are expected to remain in terrestrial areas. If any hazardous chemicals enter the marine environment they are expected to be diluted and dispersed quickly by currents and wave action.

Prior to use or transport, vessel and heavy equipment operators would inspect and clean equipment for fluid and fuel leaks. Post-flight cleanup activities may include the use of heavy equipment such as a backhoe or grader on Illeginni. This equipment has the potential to introduce fuels, hydraulic fluids, and battery acids into terrestrial habitats. Equipment operation would not involve any intentional discharges of fuel, toxic wastes, or plastics and other solid wastes that could harm terrestrial or marine life. Any accidental spills from support equipment operations would be contained and cleaned up. All waste materials would be transported to Kwajalein Islet for proper disposal. Hazardous materials would be handled in adherence to the hazardous materials and waste management systems of USAG-KA.

Hazardous material releases would comply with the emergency procedures set out in the KEEP and the UES. Following cleanup and repair operations at Illeginni, soil samples would be collected at various locations around the impact area and tested for pertinent contaminants.

Estimation of Exposure to Hazardous Chemicals Impacts

Terrestrial Vegetation. Terrestrial vegetation in the payload impact zone at Illeginni is vegetation of previously disturbed habitat and is predominantly managed vegetation. Exposure to hazardous chemicals may affect terrestrial vegetation; however since these areas are predominantly disturbed areas there is not expected adverse impact on native vegetation.

Terrestrial Wildlife. Hazardous chemicals may but are not likely to adversely impact nesting sea turtles, sea turtle nests, and/or sea turtle nesting habitat. As discussed in section 4.3.2.2.2, debris and ejecta from payload impact has the potential to impact sea turtle nesting habitat. This debris and ejecta has the potential to include hazardous chemicals including heavy metals. If these chemicals were introduced into sea turtle nesting habitat, they have the potential to dissuade females from nesting, harm sea turtle eggs, or affect the health of sea turtle hatchlings. While post-test cleanup would be conducted, there is a chance that fragments or residual chemicals may remain in sea turtle nesting habitat. While Illeginni Islet has shoreline habitat suitable for sea turtle nesting, no sea turtle nests or nesting activity have been observed on Illeginni in over 20 years. The last evidence of sea turtle nesting activity on Illeginni Islet consisted of observations of nest pits in 1996, 21 years ago. Therefore, the US Navy and USASMDC have concluded that the probability of sea turtle nesting in the area is so low as to be discountable and that FE-1 activities may but are not likely to adversely affect nesting sea turtles (US Navy and USASMDC, 2017). The USFWS has concurred with this determination (Appendix A).

Hazardous chemicals are not expected to impact birds at Illeginni Islet.

Marine Wildlife. Cetaceans and scalloped hammerhead sharks would not be impacted by hazardous chemicals from payload components in the vicinity of Illeginni Islet. All effects from hazardous chemicals are expected to occur within 91 m (300 ft) of a payload impact or on Illeginni Islet. Cetaceans do not occur in these shallow waters and scalloped hammerhead sharks are not known to occur within 91 m (300 ft) of the Illeginni shoreline.

Chemicals dispersed at Illeginni Islet are not expected to impact fish, corals, or mollusks because most payload fragments and chemicals should be contained within terrestrial environments, all visible debris in terrestrial and shallow water (up to water depths of 15 to 30.5 m) would be recovered, and any soluble chemicals introduced into the marine environment are expected to be quickly dispersed and diluted by ocean currents and wave action.

4.3.2.2.5 Disturbance from Human Activities and Equipment Operation

Both pre-flight preparations and post-flight cleanup activities would result in elevated levels of human activity in terrestrial and marine environments. Elevated levels of human and equipment activity are expected for approximately 10 weeks. Personnel and equipment would be used for preparation of the impact site including placement of radars in both terrestrial and ocean areas. Post-flight cleanup would involve recovery of all debris possible and would include personnel and equipment in both terrestrial and ocean areas. Radars would be retrieved from marine and terrestrial locations and impact craters (if present) would be filled. Approximately 8 round-trips of ocean-going vessels would be used to transport personnel and equipment to Illeginni. It is anticipated that as many as two dozen persons would be active on Illeginni Islet during pre- and post-test activities. These activities would include use of heavy

equipment such as a backhoe or grader. In the event of an impact on the Illeginni shoreline, post-flight operations would be conducted similarly to terrestrial operations, when tide conditions and water depth on the adjacent near shore reef permit. A backhoe would be used to excavate the crater, excavated material would be screened for debris, and the crater would usually be backfilled with coral that had been ejected around the wall of the crater. BMP would be implemented to ensure disturbed sediment does not wash into nearby waters. Use of heavy equipment, if necessary, would be coordinated with USFWS/NMFS in order to minimize impacts to sensitive resources.

Estimation of Disturbance from Human Activities and Equipment Operation Impacts

Terrestrial Vegetation. Terrestrial vegetation in the payload impact zone at Illeginni is vegetation of previously disturbed habitat and is predominantly managed vegetation. Exposure to disturbance from human activities and equipment operation may impact terrestrial vegetation; however since these areas are predominantly disturbed areas, there is not expected adverse impact on native vegetation.

Terrestrial Wildlife. Disturbance from human activities and equipment operation has the potential to impact birds, especially nesting seabirds on Illeginni islet. Fifteen bird species are known to occur on Illeginni Islet. Birds such black noddies, Pacific golden plovers, white terns, sanderlings, and tattlers are known to use the forested area east of the Illeginni impact zone (Foster and Work, 2011; USFWS and NMFS, 2012) and black noddies are known to nest in this area. Several species are also known to use the forested area west of the impact zone. White terns, tattlers, plovers, black-naped terns, and great-crested terns are known to utilize the grassy areas near the helipad but it is unknown if any of these species use the area for nesting (Foster and Work, 2011; USFWS and NMFS, 2012). The impact area is composed primarily of previously disturbed habitat and mitigation measures to deter bird from nesting and roosting in the impact area would be employed such as visual deterrents (e.g., scarecrows, Mylar flags, helium-filled balloons, or strobe lights). Visual and physical deterrents such as Mylar flags or tarp coverings would also be attached to heavy equipment when not in use to deter birds from roosting on equipment. While birds are not expected to be in this disturbed portion of the Islet that is the impact zone, pre-flight human activity and equipment operation would disturb any birds using the impact area and may cause nest abandonment if any birds are nesting in the area. Birds roosting, nesting, or foraging adjacent to the impact area may also be disturbed by activities in the impact zone or by transit of personnel and equipment across the Islet to and from the impact zone. The impact area would be monitored for black-naped tern nesting activity during pre-launch activities. If black-naped tern or other seabird nests are found, eggs and chicks would be protected with the construction of wooden "A-frame" structures as per USFWS guidance (USFWS communication, 27 April 2017) to shade eggs or chicks in the event that adults are flushed from nests and to warn project personnel of the presence of this protected resource.

Noise from and presence of helicopters also has the potential to disturb birds at Illeginni Islet. Helicopters may elicit short-term behavioral or physiological responses such as alert response, startle response, or temporary increase in heart rate in birds (US Navy, 2015a). Helicopters typically operate at low altitudes and slow speeds which increase the duration of noise exposures and some studies have suggested that birds respond more to noise from helicopters than from fixed-wing aircraft (US Navy, 2015a). Helicopter flights may disturb roosting, foraging, and nesting birds near the helipad and surrounding habitats. Studies of many bird species have found that many birds may respond by flushing from their nests in response to helicopter landings; however there is also some evidence that birds may become habituated to these types of activities and that birds may return to their nests within 15

minutes after the disturbance ceases (US Navy, 2015a). For the above reasons, disturbance from human activity and equipment operation may impact birds at Illeginni Islet.

Disturbance from human activities and equipment operation may but is not likely to adversely impact nesting sea turtles, sea turtle nests, and/or sea turtle nesting habitat. While personnel would be instructed to avoid suitable sea turtle haul out or nesting habitat, pre-test activities still have the potential to disturb sea turtles that have hauled out or are nesting and to possibly cause a nesting attempt to be aborted. As discussed in section 4.3.2.2.2, debris and ejecta from payload impact has the potential to impact sea turtle nesting habitat. While a shoreline impact may be avoided, debris and ejecta has the potential to extend out 100 m (328 ft) from payload impact, which may affect sea turtle nesting habitat. Post-flight cleanup operations include recovery/cleanup of visible payload debris and backfilling of any payload-created crater. BMP would be implemented to ensure disturbed sediment does not wash into nearby waters. During post-flight operations, heavy equipment may be used to recover land-based debris (including hazardous materials), backfill craters, and restore potential sea turtle nesting habitat. It is possible that during these operations, heavy equipment may severely damage or destroy turtle eggs and may physically change the habitat, making it unsuitable for future successful nesting. While Illeginni Islet has shoreline habitat suitable for sea turtle nesting, no sea turtle nests or nesting activity have been observed on Illeginni in over 20 years. The last evidence of sea turtle nesting activity on Illeginni Islet consisted of observations of nest pits in 1996, 21 years ago. Therefore, the US Navy and USASMDC have concluded that the probability of sea turtle nesting in the area is so low as to be discountable and that FE-1 activities may but are not likely to adversely affect nesting sea turtles (US Navy and USASMDC, 2017). The USFWS has concurred with this determination (Appendix A).

Marine Wildlife. Acoustic effects associated with post-test operations would be consistent with any other land or sea activity that uses mechanized equipment and the greatest intensity would be centered on the payload impact location. Potential consequences of these acoustic effects include noise avoidance and temporary disruption of feeding or predator avoidance behaviors in sea turtles, some motile invertebrates and small fish (Mooney et al. 2010). Because these acoustic effects are substantially less intense than sonic boom overpressures, the area of potential effect would be substantially smaller (See section 4.3.2.2.1), restricted to relatively poor reef habitats near the shoreline due to the nature of the operations, and is not expected to impact marine wildlife.

Physical contact by humans (e.g., handling, walking on, and kicking with fins) is likely to injure corals and likely to disturb reef-associated fish and mollusks if payload debris extends into the marine environment. Contact by equipment is also likely to injure or kill corals and mollusks and may injure or kill reef-associated fish. An organism's potential to recover from injury is a function of intrinsic and extrinsic factors. The extent of this potential impact would be restricted to the vicinity of the payload land impact site and the access corridor between this site and the adjacent reef.

If divers are required to search for payload debris on the adjacent reef flat, they would be briefed prior to operations about coral fragility and provided guidance on how to carefully retrieve the very small pieces of payload debris that they would be looking for. Although diver recovery operations might cause minor coral colony breakage, it is unlikely that any entire colonies would be killed. Although top snails may be moved out of the way, it is unlikely that a top snail would be killed due to the strong and protective nature of the snail's thick shell. Sea turtles and humphead wrasses, which are normally patchy in distribution and usually present as solitary individuals or in very low numbers, might be present. However, due to their natural wariness, they are expected to shy well away from the divers and not be killed or injured.

All land-based post-flight activities have the potential to increase turbidity, especially for filter-feeding invertebrates such as the species of corals and mollusks. Potential consequences include decreased feeding efficiency and increased effort expended to clear sediments (Cortes and Risk 1985; Rogers 1990). However, increased turbidity associated with the operations would be temporary and turbidity would likely return to background levels within a few hours of the activity's conclusion.

Marine organisms such as cetaceans, sea turtles, sharks, and manta rays may be disturbed by vessel traffic for delivering personnel and equipment, dive operations for debris recovery, and by deployment of radar rafts. These highly mobile animals may exhibit avoidance behavior by leaving the disturbed area. However, animals are expected to return to normal distributions and behaviors soon after the disturbance has ceased; therefore, impacts are expected to be insignificant.

In shallow waters near Illeginni, corals, mollusks, and reef-associated fish have the potential to be disturbed by shallow water debris recovery and/or backfill operations. Humphead wrasses are highly mobile animals and may exhibit avoidance behavior, temporarily leaving the site of increased human activity. There is no reason to expect that these fish would not return to these areas once the disturbance has ended. Mollusks are immobile and cannot flee from human activity but they may respond to disturbance by closing their shells which would decrease their foraging activity. It is expected that mollusks would resume normal behaviors shortly after cessation of the disturbance activity. Corals may be affected by disturbance from debris recovery and/or backfill operations. However, personnel would be advised to avoid or use extreme caution if debris is located near corals and reef habitats to avoid damage to these consultation organisms. Divers would be briefed prior to operations about coral fragility and provided guidance on how to avoid or minimize unavoidable contact with fragile marine resources as they carefully retrieve the very small pieces of RV debris that they would be looking for. In the event that payload debris or ejecta impacts reef habitats, there is a chance that recovery operations might cause minor coral colony breakage and therefore a small but unknown number of coral colonies may be affected. This is not expected to be greater than or outside of the estimates of effect for direct contact analyzed in section 4.3.2.2.2.

4.3.2.3 Biological Resources in Offshore Waters – Southwest and Northeast of Kwajalein Atoll (Alternative Impact Locations)

Two alternative actions within the Proposed Action include impact of the payload in deep offshore waters near Kwajalein Atoll. The alternative impact locations are evaluated for the potential impacts on marine biological resources in these deep offshore waters near Kwajalein Atoll. Potential impacts of the Action in this area include elevated sound pressure levels, direct contact from payload impact debris, exposure to hazardous chemicals, and increased human and vessel activity. The potential for the Proposed Action to adversely impact biological resources including those special-status species described in section 3.3.2 (Table 3-10 and Appendix B) is evaluated in this section. Impacts on threatened and endangered species are not expected to be different than those on non-listed species.

4.3.2.3.1 Exposure to Elevated Sound Levels

The Proposed Action has the potential to result in elevated sound pressure levels both in-air and underwater. The primary elements of the Proposed Action that would result in elevated sound pressure levels in this area are sonic booms and impact of the developmental payload.

Discussion of potential effects of elevated sound pressure levels on wildlife species as well as on acoustic thresholds for these species is presented in section 4.2.2.2.1.

Sonic Booms. The developmental payload would fly at high-speeds sufficient to generate sonic booms from stage 3 separation in the BOA and extending to impact near Kwajalein Atoll. Sonic booms create elevated pressure levels both in-air and underwater. At the terminal end of the flight path, the sonic boom generated by the approaching payload is estimated to peak at less than 180 dB near impact (Figure 4-1). At the point of impact, the sonic boom footprint would narrow to about 46 km (25 nm) at this peak pressure. For payload impact in deep ocean waters near Kwajalein Atoll, elevated SPLs due to the sonic boom would be present in the air over land and would also be present in the surrounding waters. The duration for sonic boom overpressures produced by the payload are expected to average 75 ms where SPLs are greater than 140 dB and 270 ms where SPLs are less than 140 dB.

As detailed in the FE-1 BA (US Navy and USASMD, 2017; approximately 1 km² (0.4 mi²) of ocean surface would be exposed to SPLs up to 170 dB, 54 km² (21 mi²) to SPLs up to 160 dB, and 338 km² (131 mi²) to SPLs up to 150 dB. As discussed in section 4.2.2.2.1, model assumptions for estimating sonic boom overpressures likely lead to conservatively high estimates of sonic boom pressures and, therefore, conservative estimates of affect area.

Splashdown of Vehicle Components Elevated sound pressure levels would occur in the ocean as the payload impacts near the ocean's surface. Estimates for pressure from impact of vehicles using a similar amount of high explosives as those in the payload resulted in sound pressure levels in-air of 140 dB at 18 m (59 ft). These levels would be used as a bounding case for the current Proposed Action. Using the spherical spreading model, the SL is estimated to be 165 dB in-air and an estimated 191 dB in-water. For impact in deep ocean areas near Kwajalein Atoll, an in-water SPL of 191 dB would attenuate to 160 dB at 35.5 m (116.5 ft) and to 150 dB at 112 m (367 ft).

Estimation of Elevated Sound Level Impacts

Terrestrial Wildlife. No terrestrial habitat exists in the deep offshore water payload impact zones; however seabirds may forage in these areas and be exposed to elevated SPLs from sonic booms and payload impact. As discussed in for the Preferred Alternative at Illeginni, if birds were exposed to elevated sound pressures above PTS threshold levels, physical injury or even death could result. Birds are able to recover from hearing damage better than many other species, and most physical injury would likely be temporary; however, very loud sounds may cause permanent damage. Elevated SPLs from sonic booms would exceed PTS threshold for birds near payload impact where sound pressure levels would be above 140 dB re 20 µPA over only about 0.2 km² (0.08 mi²). While density of foraging seabirds in these areas is unknown, it is likely densities would be very low. It is possible that birds would be exposed to SPLs lower than the PTS threshold but high enough to cause behavioral disturbance. While birds might be temporarily startled by these sounds, any behavioral or physiological response is likely to be very brief as the duration of the elevated SPLs from sonic booms are on the order of 270 ms. If any behavioral disturbance was realized it would likely be in the form of alert behaviors, minor behavioral changes, or flight response (US Navy, 2015a). No adverse impacts to birds on or near Illeginni Islet are expected due to elevated SPLs due to sonic booms.

Elevated sound pressure levels from payload impact would only exceed the PTS threshold for birds out to 18 m (59 ft) from the point of impact. Due to the likely low density and patchy distribution of seabirds foraging in these areas, birds are not expected to be in this area or be exposed to SPLs loud enough to cause physical damage. While birds may be exposed to SPLs high enough to elicit behavioral response, any response to this short duration sound is likely to be limited to temporary startle responses as described above. Bird behavior is expected to return to normal within minutes of impact and no lasting behavioral

or physiological responses are expected. Elevated SPLs from payload impact are not expected to adversely impact seabirds in the deep offshore impact zones.

Marine Wildlife. If organisms were exposed to elevated sound pressure levels above thresholds for PTS, physical injury or even death could result. If this were to occur, the animals would be subject to “harm” (as defined by the ESA and MMPA) or Level A Harassment. Exposure to SPLs above thresholds for TTS or behavioral thresholds have the potential to temporarily alter hearing abilities or temporarily alter behavior in consultation organisms but would not result in lasting effects or injury. If a consultation organism was impacted by temporary hearing shift or temporary behavioral modification, this could be considered “harassment” or Level B Harassment (as defined under the ESA and MMPA). The chances that these events would occur as a result of the Preferred Alternative were analyzed in the FE-1 BA (US Navy and USASMDC, 2017). The same method was used to analyze impacts for the alternatives of payload impact in deep ocean waters. Methods for these analyses and acoustic threshold levels for organisms are discussed in Section 4.2.2.2.1 above.

The maximum SPLs for sonic booms at the terminal end of payload flight do not exceed the PTS or TTS thresholds for any cetacean, sea turtle, or fish. There is a potential for behavioral disruption in sea turtles near the payload impact point: however, only 54 km² (20.9 mi²) would be subject to SPLs of 160 dB sonic boom overpressures. For fish, sonic boom SPLs would not exceed the TTS threshold and would exceed behavioral disruption threshold over an area of 338 km² (130.5 mi²) near the payload impact point. Without specific data on sea turtle density in these deep ocean waters, density was estimated to be similar to sea turtle guild density in the BOA. Based on the highest BOA density, the estimated chance of a sea turtle being exposed to SPLs high enough to exceed the behavioral response threshold is 1 in 4.3. If a sea turtle were exposed to SPLs high enough to exceed the behavioral disturbance threshold, no lasting effects from any realized behavioral disruption are expected for any of the consultation organisms. Animals may have a startle response from this short duration sound but animals are expected to return to their normal behavior within minutes of exposure. For these reasons, elevated sonic boom SPLs are not expected to adversely impact wildlife in the deep ocean waters near Kwajalein Atoll.

In deep ocean water areas, payload impact pressure levels would not exceed PTS or TTS thresholds for marine mammals or sea turtles. The SPLs from payload impact may expose green and hawksbill turtles to SPLs above the behavioral disruption threshold. Based on analyses in the FE-1 BA (US Navy and USASMDC, 2017) the chance of an individual sea turtle being in the area with payload impact SPLs high enough to induce behavioral disturbance is 1 in 5,435. The chance of a hawksbill turtle being subject to SPLs loud enough to induce behavioral disturbance is 1 in 176. Though turtle density data in these deep ocean areas near Kwajalein Atoll are unavailable, the model is based on the best available density data for turtles in other deep water areas of the Pacific. The model assumes that the turtles do not move or exhibit avoidance behaviors to the approaching components. The estimates for the chances of elevated sound levels affecting individual sea turtles are likely overestimated in these analyses; however, these estimates do provide a conservative estimate of effects. Elevated SPLs from payload impact are not expected to adversely impact marine mammals or sea turtles near Illeginni Islet.

There are no known reliable density estimates for consultation fish species in the deep ocean waters near Kwajalein Atoll. These fish species likely have very low densities in these areas with patchy distributions. For these alternatives, the maximum radial distance at which fish might be subject to injury is only 2.2 m (7.2 ft) from payload impact and 541 m (1,775 ft) for behavioral disturbance. Adult fish are not likely to be within 2.2 m (7.2 ft) of payload impact on Illeginni and as stated above, any

behavioral disturbance in fish would likely be limited to a brief startle response and behaviors would likely quickly return to normal. Elevated SPLs from payload impact are not expected to adversely impact fish in deep ocean waters near Kwajalein Atoll.

Densities of larval fish, coral, and mollusks are expected to be low in the deep ocean waters near Kwajalein Atoll. Therefore, elevated sound pressure levels in the area are not likely to impact larval fish, corals and mollusks.

4.3.2.3.2 Direct Contact

The Alternative Action would result in impact of the payload in one of two deep offshore water locations near Kwajalein Atoll. The payload debris could directly impact aquatic habitats and have the potential to directly contact marine organisms. The location southwest of Kwajalein Atoll would be approximately 244 m (800 ft) by 488 m (1600 ft) with a surface area of 0.1191 km² (0.0459 mi²). The location northeast of Kwajalein Atoll would be approximately 366 m (1200 ft) by 732 m (2400 ft) with a surface area of 0.2679 km² (0.1033 mi²). While the footprint of a payload impact would likely be roughly elliptical, its size would depend on the precise speed of the payload and its altitude. Since speed, altitude, and size information are not available for a payload impact, it is difficult to get an estimate of the area which has the potential for falling debris. For these analyses we use a maximum distance estimated for debris/ejecta for an on-land impact (100 m [328 ft] from impact) for the area exposed to debris in impact zones in deep offshore waters.

Estimation of Direct Contact Impacts

Terrestrial Wildlife. While terrestrial habitat does not occur in the deep offshore impact zones, seabirds may forage in these areas. No reliable density information for seabirds foraging offshore near Kwajalein Atoll is available; however densities are expected to be very low and distributions patchy. Because foraging sea bird densities are likely very low, direct contact from payload debris is not expected to impact birds in the offshore impact zones.

Marine Wildlife. If payload components were to strike a cetacean, sea turtle, or fish near the water surface, the animal would most likely be injured or killed. Reliable density information for cetaceans in the deep ocean waters near Kwajalein Atoll is unavailable. The best available density information is from the Navy's Marine Mammal Density Database which has modeled cetacean density in deep ocean waters between Hawai'i and Kwajalein Atoll (maximum estimates from the BOA, see Navy SSP FE-1 BA [US Navy and USASMDC, 2017] for details). Based on the above discussed affect areas, and the best available species density information, chances of direct contact to cetaceans and sea turtles in the deep offshore waters of Kwajalein Atoll were calculated based on the radial impact scenario in the FE-1 BA (US Navy and USASMDC, 2017). Based on these analyses, the chance of direct contact exposures for cetaceans in the deep waters near Kwajalein Atoll is between 1 in 1,495 and 1 in 191,748 depending on individual species densities. If totaled across species, total number of cetacean exposures has been estimated to be 0.0036 (chances 1 in 278). Assumptions of these analyses are discussed in section 4.2.2.2.2. It is important to note that these estimates are likely overestimates as calculations were based on the maximum possible affect area and assume the entire area would be subject to direct strike rather than subject to payload fragment impact. Based on these calculations, marine mammals are not expected to be impacted by direct contact from payload impact.

The chance of an individual sea turtle being in the area subject to possible direct contact from payload impact has been estimated as 1 in 7,315. These estimates are likely overestimates as calculations were based on the maximum possible affect area and assume the entire area would be subject to direct strike

rather than subject to payload fragment impact. Based on these estimates, sea turtles are not likely to be impacted by direct contact from payload impact in deep ocean waters near Kwajalein Atoll. While little data is available for fish densities in the deep offshore waters near Kwajalein Atoll, fish species are not expected to be impacted by direct contact from payload impact.

Direct contact or shock waves from splashdown of payload components may adversely impact individual larval fish, corals or mollusks that may be present as components of drifting plankton. However, estimates of potential impact on larvae would have to include a margin of error of several orders of magnitude. Even if applicable density data existed, the distribution of larval organisms is likely to be so variable in space and time that accurate estimates of potential incidental take of larval consultation species would have to be based on samples taken at the precise time and location of splashdown of either missile parts or RVs. It is possible that a very low number of fish, coral, or mollusk larvae would be within the affected volume of surface water but this is a very small and indeterminable number. In general, the consequences of taking individual larvae are considered to be substantially less severe than the consequences of taking individual adults because the baseline mortality rate of larvae is several orders of magnitude higher than for adults; therefore, the odds of individual larvae surviving to reproductive age are substantially lower than the odds of an adult surviving to reproduce again (Gascoigne and Lipcius 2004). No adverse effects due to direct contact are expected for adult fish, coral, or mollusks in the deep offshore waters near Kwajalein Atoll.

Three times over at least the week prior to the test as as close to launch as safely practicable, overflights of Illeginni would conducted to survey for marine mammals and sea turtles. At least 30 days prior to launch and as close to launch as safely practicable, the beach area would be inspected for active sea turtle nests. Sightings would be reported to the USAG-KA Environmental Engineer, the RTS Range Directorate, and the Flight Test Operations Director for consideration in approving the launch. When feasible, within 1 day after the flight test, the islet and near-shore waters would be surveyed for injured wildlife, damaged coral, or damage to sensitive habitat. Results of the survey would be provided to the USAG-KA Environmental Engineer to forward to the NFMS, USFWS, and the RMIEPA.

4.3.2.3.3 Vessel Strike

The Proposed Alternative Action has the potential to increase ocean-going vessel traffic in the ROI. Pre-test activities would include vessel traffic to and from one of the two deep-water offshore payload impact sites. Prior to the test flight, sensor rafts would be deployed near the impact site from a LCU vessel. The large raft would have running lights and station-keeping ability; visual deterrents (e.g., scarecrows, Mylar flags) would be employed on the raft to discourage birds from resting on the raft. Post-test recovery efforts would also result in increased vessel traffic to the payload impact site for recovery of deployed sensor rafts. Vessel traffic would be elevated in the deep water impact areas for up to 4 weeks.

Estimation of Vessel Strike Impacts

Terrestrial Wildlife. Seabirds that forage in deep waters offshore of Kwajalein Atoll may be exposed to vessels transiting to and from the offshore payload impact zones. Direct collisions of birds with Navy vessels are unlikely and not expected. Birds are more likely to be visually and behaviorally disturbed by vessels causing birds to either avoid vessels or in some cases to follow vessels. No adverse impacts to birds are expected from vessels transiting to and from offshore impact zones.

Marine Wildlife. Marine organisms have the potential to be affected by vessel strike primarily by being at the surface when a vessel travels through an area. Organisms at the surface are at risk of being struck

by the vessels or their propellers. Organisms that are not found at the sea surface have the potential of being struck when a vessel drops anchor or if a vessel runs aground.

Cetaceans, sea turtles, fish, corals, and mollusks present in the deep ocean waters near Kwajalein Atoll and/or in the vicinity of Illeginni Islet are not expected to be adversely impacted by vessel strike for the following reasons: 1) A small number of vessel trips would be required to support pre-flight and post-flight cleanup activities and there would be only one flight. 2) While cetaceans and sea turtles breathe air, must surface to breathe, and are known to bask at the ocean surface, these are highly mobile animals capable of avoiding vessels and they may already be used to some vessel traffic in the ROI. 3) Fish species do not need to surface to breathe are not known to frequent the ocean surface, and are highly mobile animals capable of avoiding vessels. 4) Corals and mollusks have the potential to be struck by a dropped anchor or a vessel contacting reef habitats, although this is unlikely, vessel operators would be made aware of sensitive reef habitats in order to avoid these areas. 5) Vessel operators would watch for and avoid cetaceans and sea turtles by adjusting their course and speed.

4.3.2.3.4 Exposure to Hazardous Chemicals

Following the impact of the payload, fragmentation of the payload would disperse any of the residual onboard hazardous materials (Table 2-2), such as battery acids, residual explosives, and heavy metals, around the impact point. Onboard the payload there would be up to four lithium ion batteries each weighing between 1.36 and 22.68 kg (3 and 50 lbs) and two radio frequency transmitters. The batteries carried onboard the payload would be discharged by the time the vehicle impacts; however a small quantity of electrolyte material (on the order of a couple ounces) may still enter the marine environment. The payload also carries up to 454 kg (1,000 lbs) of tungsten alloy which would enter the marine environments upon payload impact. The payload structure itself contains heavy metals including aluminum, titanium, steel, magnesium, tungsten, and other alloys.

Debris would be expected to fall within 100 m (328 ft) of the impact point. Post-flight cleanup of the impact area would include recovery/cleanup off all visible floating debris. Considering the small quantities of hazardous materials contained in the batteries, the planned land impact, and the dilution and mixing capabilities of the ocean and lagoon waters, the battery materials released during payload impact should be of little consequence to any cetaceans, fish or sea turtles in the area.

Since up to 454 kg (1,000 lbs) of tungsten alloy would be contained on the payload, that amount of tungsten alloy would be introduced into the marine environments upon payload impact. The effects of tungsten alloys in ecosystems are largely unknown. Generally, dispersion of the tungsten alloy is not expected due to its relatively insoluble nature, the depth at which it would come to rest, which would result in low temperatures, low oxygen content, and no sunlight to facilitate chemical interaction. There also is lack of mixing in the deep sea water column; the deep Pacific experiences no deep convection of cooled salty surface water because the surface layer is too fresh and buoyant to sink. The bench study and model results (LLNL, 2017) indicate very slow dissolution and passivation (i.e., natural chemical encapsulation) of tungsten from FE-1 may occur in sea water such that. tungsten concentrations would have little or no impacts on marine organisms.

Post-flight cleanup activities may include the use of vessels for radar placement and retrieval and has the potential to introduce fuels and oils into the marine habitats. Equipment operation would not involve any intentional discharges of fuel, toxic wastes, or plastics and other solid wastes that could harm terrestrial or marine life. Any accidental spills from support equipment operations would be

contained and cleaned up. All waste materials would be transported to Kwajalein Islet for proper disposal. Hazardous materials would be handled in adherence to the hazardous materials and waste management systems of USAG-KA. Hazardous material releases would comply with the emergency procedures set out in the KEEP and the UES. Following cleanup and repair operations at Illeginni, soil samples would be collected at various locations around the impact area and tested for pertinent contaminants.

Estimation of Exposure to Hazardous Chemical Impacts

Terrestrial Wildlife. While terrestrial habitat does not occur in the deep water offshore payload impact zones, foraging seabirds may occur in these areas. Foraging seabirds are not expected to be exposed to hazardous chemicals and not impacts from hazardous chemicals on foraging seabirds are expected.

Marine Wildlife. Release of hazardous chemicals into the deep offshore waters near Kwajalein Atoll is not expected to adversely impact cetaceans, sea turtles, fish, corals, mollusk, or larval fish, corals, and mollusks. The area which would be affected by dissolution of chemicals would be relatively small because of the size of the payload components and the amount of residual materials they would contain. Components would likely sink to the ocean floor and since these are deep waters, cetaceans, sea turtles, and fish are not likely to contact them. Any chemicals introduced into the water column would be quickly diluted and dispersed and the low densities and patchy distributions of marine mammals, sea turtles, and larval fish, corals, and mollusks in the area make contact with hazardous chemicals unlikely.

4.3.2.3.5 Disturbance from Human Activities and Equipment Operation

Both pre-flight preparations and post-flight cleanup activities would result in elevated levels of human activity in marine environments. Elevated levels of human activity are expected for a period of up to four weeks. Personnel and equipment would be used for preparation of the impact site including placement of radars in ocean areas. Post-flight cleanup would involve recovery of all debris possible and radars and would include personnel and vessels in ocean areas.

Acoustic effects associated with post-test operations would be consistent with any other sea activity that uses mechanized equipment and the greatest intensity would be centered on the payload impact location. Potential consequences of these acoustic effects include noise avoidance and temporary disruption of feeding or predator avoidance behaviors in sea turtles, some motile invertebrates and small fish (Mooney et al. 2010). Because these acoustic effects are substantially less intense than sonic boom overpressures, the area of potential effect would be substantially smaller (See section 4.3.2.3.1).

Estimation of Disturbance from Human Activities and Equipment Operation Impacts

Terrestrial Wildlife. No terrestrial habitat exists in the offshore payload impact zones; however, foraging seabirds may occur in these areas. While disturbance from human activities and equipment operation has the potential to impact birds, the density of foraging sea birds in this area is likely very low. It is unlikely that human activity and equipment operation would disturb, or subsequently impact, any birds in these offshore payload impact zones.

Marine Wildlife. Marine organisms such as cetaceans, sea turtles, and fish may be disturbed by vessel traffic for delivering personnel and equipment, dive operations for debris recovery, and by deployment of radar rafts. These highly mobile animals may exhibit avoidance behavior by leaving the disturbed

area. However, animals are expected to return to normal distributions and behaviors soon after the disturbance has ceased and affects are expected to be insignificant.

Disturbance from human activity and equipment operation is not expected to adversely impact cetaceans, sea turtles, fish, invertebrates or larval fish, coral, or mollusks in the deep ocean waters near Kwajalein Atoll. The duration of disturbance is expected to be short and these widely dispersed, highly mobile species are able to avoid areas of disturbance by leaving the area. It is expected that these species would return to normal behaviors and distributions after cessation of human activities or equipment operation.

4.3.3 Noise within the Kwajalein Atoll

Analysis of potential noise impacts includes estimating likely noise levels from the Proposed Action and determining potential effects to sensitive receptor sites.

4.3.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to noise levels in the ROIs. Therefore, no significant impacts would occur from noise with implementation of the No Action Alternative.

4.3.3.2 Proposed Action

The ROIs for noise from the FE-1 flight test are Illeginni Islet for a land impact or one of the BOA locations southwest of Illeginni Islet or east of Gagan for a water impact.

Illeginni Islet (Preferred Impact Location)

Terminal flight of the payload over the RMI would create a sonic boom carpet along its flight path. Because of the vehicle's high altitude during flight, maximum elevated sound pressure levels from sonic booms beneath the flight corridor would be 145 dB re 1 μ Pa in air) until descent. As the payload nears RTS, the vehicle would fly towards the pre-designated impact site at Illeginni Islet. During vehicle descent, a focused boom would occur over the intended site and the nearby areas of the Atoll.

At the terminal end of the flight path, the sonic boom generated by the approaching payload is estimated to peak at less than 180 dB (Table 4-2). At the point of impact, the sonic boom footprint would narrow. For payload impact at Illeginni Islet, elevated SPLs due to the sonic boom would be present in the air over land and would also be present in the surrounding waters. The duration for sonic boom overpressures produced by the payload are expected to average 75 ms where SPLs are greater than 140 dB and 270 ms where SPLs are less than 140 dB.

Approximately 1 km² (0.4 mi²) would be exposed to SPLs up to 170 dB. Noise model assumptions for estimating sonic boom overpressures likely lead to conservatively high estimates of sonic boom pressures and, therefore, conservative estimates of affected area.

Within Kwajalein Atoll, Kwajalein and Roi-Namur islets are the only populated islets under USAG-KA management. There are also Marshallese residents located on Ennubirr Islet (southeast of Roi-Namur Islet), Ebeye Islet, Carlos Islet (located a few miles northwest of Kwajalein Islet), and on a few other islets.

Noise Resources Potential Impacts:

- **No Action: No Change**
- **Preferred Impact Location: No Significant Impact**
- **Alternative Impact Locations: No Significant Impact**

While meteorological conditions can influence peak sound pressure levels, noise for these areas is estimated to peak at less than 180 dB near impact (Table 4-2). Because the sonic boom footprints at impact normally do not overlap any RMI communities, there are no residents within 18 mi (29 km) of Illeginni Islet, the sonic boom would be audible only once at any nearby location and last no more than a fraction of a second, and because range evacuation procedures are implemented during such flight tests, no residents or personnel are expected to be subjected to significant noise-related impacts.

The populated islets are located outside the sonic boom footprint and residents at these locations may not hear the noise at all. During the flight test, RTS would verify that no non-mission vessels would be in the area. Depending on a mission vessel's location, on-board personnel may be required to wear hearing protection in compliance with the Army's Hearing Conservation Program.

Noise levels during pre-test and post-flight activities at the pre-determined target site would occur in an unpopulated area without resident receptors. FE-1 flight test personnel and RTS and USAG-KA personnel also may be required to wear hearing protection in compliance with the Army's Hearing Conservation Program.

Offshore Waters – Southwest and Northeast of Kwajalein Atoll (Alternative Impact Locations)

As with an Illeginni impact, for an Offshore Waters impact, because of the vehicle's high altitude during flight, maximum elevated sound pressure levels from sonic booms beneath the flight corridor would be 145 dB re 1 μ Pa in air until descent. As the payload nears RTS, the vehicle would fly towards the pre-designated impact site. During vehicle descent, a focused boom would occur over the intended site and the nearby areas of the Atoll.

At the terminal end of the flight path, the sonic boom generated by the approaching payload is estimated to peak at less than 180 dB (Table 4-2). At the point of impact, the sonic boom footprint would narrow. For payload impact at Illeginni Islet, elevated SPLs due to the sonic boom would be present in the air over the ocean. The duration for sonic boom overpressures produced by the payload are expected to average 75 ms where SPLs are greater than 140 dB and 270 ms where SPLs are less than 140 dB.

Approximately 1 km² (0.4 mi²) would be exposed to SPLs up to 170 dB. Noise model assumptions for estimating sonic boom overpressures likely lead to conservatively high estimates of sonic boom pressures and, therefore, conservative estimates of affected area.

The populated islets are located outside the sonic boom footprint for an Offshore Waters impact and residents at these locations may not hear the noise at all. Noise from the sonic boom would be audible only once, would last no more than a fraction of a second, and would be well within the Army standard of 140 dB (peak sound pressure level) for impulse noise at the closest populated islets. During the flight test, RTS would verify that no non-mission vessels would be in the area. Depending on a mission vessel's location, on-board personnel may be required to wear hearing protection in compliance with the Army's Hearing Conservation Program.

Noise levels during pre-test and post-flight activities at the pre-determined impact site would occur in mostly in unpopulated areas without resident receptors. FE-1 flight test personnel and RTS and USAG-KA personnel may be required to wear hearing protection in compliance with the Army's Hearing Conservation Program.

As a result, noise levels for an Offshore Waters impact are not expected to have a significant impact on the human environment and implementation of the FE-1 flight test would not result in significant impacts from noise.

4.3.4 Public Health and Safety within Kwajalein Atoll

The public health and safety analysis section address issues related to the health and well-being of military personnel and civilians living on or in the vicinity of USAKA. Specifically, this section provides information on hazards associated with a single FE-1 flight test. Additionally, this section addresses the environmental health and safety risks to children.

Public Health and Safety Potential Impacts:

- **No Action: No Significant Impact**
- **Preferred Impact Location: No Significant Impact**
- **Alternative Impact Locations: No Significant Impacts**

4.3.4.1 No Action Alternative

Under the No Action Alternative, the FE-1 flight test would not occur and there would be no change to public health and safety. Therefore, no significant impacts to public health and safety would occur with implementation of the No Action Alternative.

4.3.4.2 Proposed Action

The developmental payload would descend into one of the two Offshore Waters locations or Illeginni Islet. Nominally, the payload would break up on or just before impact. The payload would not have a thrust mechanism and data would be transmitted to range safety personnel to allow a continuing evaluation of the “health” of the FTS and the performance of the payload against the safety criteria. The payload FTS would be designed to cut the nose section from the rest of the vehicle as a failsafe operation to ensure the safety of the Marshall Islands. This failsafe requires positive action to be taken by range safety personnel to allow the payload to continue flight to the pre-designated impact site. In this manner, the resulting debris would fall short of any protected or inhabited area.

Therefore, the presence of non-mission vessels and aircraft in proximity to the impact zone represents the greatest risk to public health and safety for all the FE-1 flight test alternatives.

Illeginni Islet (Preferred Impact Location)

There are no resident populations in proximity to Illeginni Islet where the payload would impact. A NOTMAR and a NOTAM are transmitted to appropriate authorities to clear commercial, private, and non-mission military vessel and aircraft traffic from caution areas and to inform the public of impending missions. The warning messages describe the time, the area affected, and safe alternate routes. The GRMI also is informed in advance of rocket launches and reentry payload missions. A fact sheet describing the project and the environmental controls would be prepared and would be provided at locations on Ebeye and Kwajalein Island. Radar and visual sweeps of hazard areas would be regularly scheduled and conducted prior to launch to clear any non-mission ships and aircraft.

Offshore Waters – Southwest and Northeast of Kwajalein Atoll (Alternative Impact Locations)

As with the land impact site, there are no resident populations in proximity to either of the Offshore Waters locations where the developmental payload would impact. The same precautions to notify the public and ensure there are no vessels or aircraft in the Illeginni Islet area would be undertaken for either deep offshore water impact zone.

In accordance with EO 13045, Protection of Children from Environmental Health and Safety Risks, since the majority of the FE-1 flight test would be conducted on DoD property and out in the open ocean, this EA/OEA has not identified any environmental health and safety risks that may disproportionately affect children.

Based on the above, implementation of the FE-1 flight test would not result in significant impacts to Public Health and Safety at USAKA.

4.3.5 Hazardous Materials and Wastes within Kwajalein Atoll

The hazardous materials and wastes analysis addresses issues related to the use and management of hazardous materials and wastes as well as the management of specific cleanup at within the ROIs at USAKA.

4.3.5.1 Hazardous Materials and Wastes within Kwajalein Atoll - No Action Alternative

Under the No Action Alternative, the FE-1 flight test would not occur and there would be no change associated with hazardous materials and wastes at Kwajalein Atoll. Therefore, no significant impacts would occur to hazardous materials and waste with implementation of the No Action Alternative.

4.3.5.2 Hazardous Materials and Wastes within Kwajalein Atoll - Proposed Action

The payload would descend into Illeginni Islet or one of the two offshore waters locations. The payload would break up on or just before impact.

Illeginni Islet (Preferred Impact Location)

As shown in Table 2-2, hazardous materials used in the developmental payload would be limited to batteries, small electro-explosive devices, and a tungsten alloy. No solid or liquid propellants, DU, Be, or radioactive materials would be carried on the developmental payload. Each battery would be environmentally qualified, including safeguards for containing accidental hazardous battery casing leak or electrical anode or cathode shorting. All explosive devices would be handled in accordance with DoD 6055.09-STD. Specific restoration actions and debris recovery, if necessary, would be determined on a case-by case basis in compliance with the UES and in coordination with the USAG-KA Environmental Office. At the conclusion of launch activities, LLNL, RTS, Navy Project, and USAG-KA personnel would remediate the impact site, all visible debris would be removed, and all equipment and materials would be recovered from Illeginni Islet. Any hazardous waste resulting from FE-1 flight test activities on Illeginni Islet would be disposed of in accordance with the UES.

Offshore Waters – Southwest and Northeast of Kwajalein Atoll (Alternative Impact Locations)

The payload would breakup prior to or upon impact with the water and recovery would not be attempted. All parts would be expected to sink to the sea floor. If there were any floating debris, it would be recovered and brought onboard a vessel for appropriate handling and disposal in accordance with the UES.

The UES, KEEP, and HMMP specified procedures for hazardous materials and waste would be followed. Activity-specific Hazardous Materials Procedures would be submitted by the project or mission proponents to the Commander, USAG-KA for approval within 15 days of receipt of any hazardous material or before use, whichever comes first. Hazardous materials would be under the direct control of the user organization to ensure these materials are stored and used in accordance with UES requirements. Identified hazardous materials would be expected to be consumed in operational processes associated with the FE-1 flight test. Disposal of wastes resulting from the FE-1 flight test also would be in accordance with the UES.

Therefore, implementation of the Proposed Action would not result in significant impacts to hazardous materials and wastes.

4.4 Summary of Potential Impacts to Resources and Impact Avoidance and Impact Avoidance and Minimization

A summary of the potential impacts associated with each of the action alternatives and the No Action Alternative and impact avoidance and minimization measures are presented in Tables 4-6 and 4-7, respectively.

Table 4-6 Potential Impacts Associated with the No Action Alternative and the Proposed Action

<i>Location</i>	<i>Resource Area</i>	<i>No Action Alternative</i>	<i>Navy SSP FE-1 Proposed Action</i>
PMRF	Air Quality	There would be no change to baseline air quality and, therefore, no significant impacts to air quality or air resources would occur with implementation of the No Action Alternative.	STARS launches have been determined to not have a significant impact on air quality. Existing aircraft exercises and support from the PMRF airfield are not restricted by the current Title V permit held by PMRF. A General Conformity Rule applicability analysis is not required for Navy actions in Hawai'i. The STARS is relatively small and the launch is a short-term, discrete event; the time between launches of the Proposed Action and other launches scheduled from SNL/KTF would allow the dispersion of greenhouse gases and ozone depleting substances. A single launch for the FE-1 flight test would have a similar air quality impact as described for the No Action Alternative.
	Water Resources	There would be no change to baseline water resources, and therefore, no significant impacts to water resources from implementation of the No Action Alternative.	Sampling and analyses of soil and water prior to and following previous STARS launches did not indicate impacts. Perchlorate analytical results indicated levels were within guidelines. The Proposed Action would not result in significant impacts to water resources.
	Biological Resources	There would be no change to biological resources, and therefore, no significant impacts to biological resources from implementation of the No Action Alternative.	Based on prior analyses, and the effects of current and past missile launch activities, the potential impacts of the Proposed Action on terrestrial biological resources are expected to be minimal. No ground clearing or construction is expected and no long term adverse impacts on vegetation are expected. No threatened or endangered plants have been observed on PMRF and critical habitat for the ohai and lau'ehu would not be affected by the action. The launch site at KTF is in an area that has routine human activity, equipment operation, and launch activity. Terrestrial species at PMRF are already habituated to high levels of noise associated with ongoing activities at this facility. Because aluminum oxide and hydrogen chloride do not bioaccumulate, no indirect effects on the food chain are

<i>Location</i>	<i>Resource Area</i>	<i>No Action Alternative</i>	<i>Navy SSP FE-1 Proposed Action</i>
			<p>anticipated from these exhaust emissions.</p> <p>Marine species at PMRF are likely already habituated to high levels of noise associated with ongoing activities at this facility. No impacts on marine wildlife due to direct contact from debris are expected during normal flight operations.</p>
	Airspace	There would be no change to airspace use or control, and therefore, no impacts to airspace from implementation of the No Action Alternative.	<p>The Navy SSP FE-1 flight test would be similar to previous ballistic missile tests, and the potential impacts on controlled and uncontrolled airspace, special use airspace, en route airways and jet routes, and airports and airfields would be similar to that described for missile launches in previous environmental documentation for PMRF and SNL/KTF.</p> <p>The advanced planning and coordination with the FAA regarding: scheduling of special use airspace, and coordination of the proposed FE-1 flight test relative to en route airways and jet routes, would result in minimal impacts on airspace.</p> <p>Therefore, implementation of the Proposed Action would not result in significant impacts to airspace.</p>
	Noise	There would be no change to noise sources, and therefore, no impacts from noise resulting from implementation of the No Action Alternative.	Launch of missiles is a routine activity from SNL/KTF. The STARS booster has been previously launched at SNL/KTF, and noise levels for the FE-1 flight test would be the same as for previous STARS launches, and would not result in significant impacts to the noise environment.
	Public Health and Safety	With only one less launch from SNL/KTF, there would be no significant change to public health and safety. No significant impacts to public health and safety would result from the No Action Alternative.	<p>The STARS booster has been previously launched at SNL/KTF. Flight testing the payload from the same site would have a similar potential health and safety impact as described for the No Action Alternative. The proposed solid propellants would be similar to past launches and would follow the same health and safety procedures developed under existing plans.</p> <p>Implementation of the Proposed Action would not result in significant impacts to public health and safety.</p>
	Hazardous Materials and Wastes	There would be no change to hazardous materials and wastes, and, therefore, no significant impacts from hazardous materials and	The FE-1 flight test launch would use similar hazardous materials and produce similar hazardous waste as previous STARS launches. The FE-1 launch is included in the overall number of missile launches proposed in the HRC EIS/OEIS. Hazardous material usage and waste generation would continue to be managed by PMRF under appropriate State and

<i>Location</i>	<i>Resource Area</i>	<i>No Action Alternative</i>	<i>Navy SSP FE-1 Proposed Action</i>
		wastes that would result from implementation of the No Action Alternative.	Federal requirements. Therefore, implementation of the Proposed Action would not result in significant impacts from hazardous materials and wastes.
Over-Ocean Flight Corridor	Air Quality	Under the No Action Alternative, the FE-1 flight test would not occur and there would be no change to baseline air quality in the over-ocean flight corridor. No significant impacts to air quality or air resources would occur with implementation of the No Action Alternative.	<p>Under the Proposed Action, following the FE-1 flight test, the majority of Al_2O_3 would be removed from the stratosphere through dry deposition and precipitation. Emissions from a STARS vehicle launch would be relatively small compared to all emissions released on a global scale. The large air volume over which the STARS emissions are spread, and the rapid dispersion of the STARS emissions by stratospheric winds would reduce potential impacts. Ozone-depleting gas emissions from the single flight test would represent such a minute increase that even incremental effects on the global atmosphere are not likely. The Proposed Action would not have a significant impact on stratospheric ozone or on the upper atmosphere.</p> <p>The amount of GHG emissions that would be released from activities associated with a single FE-1 flight test is assumed to be negligible based on the small number of vessels and aircraft utilized and the short period of time for conducting the single FE-1 flight test activities. This limited amount of emissions would not likely contribute to global warming and climate change to any discernible extent. Implementation of the Proposed Action would not result in significant impacts to Air Quality or GHG Emissions.</p>
	Biological Resources	There would be no change to biological resources, and therefore, no significant impacts to biological resources from implementation of the No Action Alternative.	<p><i>Marine Wildlife:</i></p> <p>Noise: Sonic booms overpressures would not exceed PTS, TTS, or behavioral disturbance thresholds for organisms in the BOA and therefore no adverse impacts from sonic booms are expected. Splashdown pressures would exceed PTS thresholds for high frequency cetaceans and seabirds. These pressures would also exceed TTS thresholds for high and low frequency cetaceans, Hawaiian monk seals, birds, and fish. These organisms may also be exposed to SPLs high enough to cause behavioral disturbance. While effects of elevated SPLs are possible, based on species abundance and distribution in the BOA, the chances of this occurring are likely very low. Any effects of elevated SPLs are likely to be temporary, behavioral modifications with no lasting effects. Therefore no significant impacts from elevated SPLs are expected.</p>

<i>Location</i>	<i>Resource Area</i>	<i>No Action Alternative</i>	<i>Navy SSP FE-1 Proposed Action</i>
			<p>Direct Contact: The chances of and FE-1 component directly contacting a marine mammal are very low (1 in 20,200 total for all species). The chances of direct contact with a sea turtle are also extremely low (1 in 710,000). Direct contact would not be expected to adversely impact cetaceans, sea turtles, birds, fish or EFH in the BOA.</p> <p>Hazardous Chemicals: the release of hazardous materials carried onboard a launch vehicle would not significantly impact marine life. Hazardous materials would be rapidly diluted in the seawater and, larger and heavier vehicle components would sink fairly quickly to the ocean floor to depths where consultation organisms would likely not be in contact with these materials.</p> <p>Increased Human and Vessel Activity: Vessel traffic is common in this area and the increase in human activity and vessel traffic in the BOA would be expected to be minimal; these activities would not be expected to impact marine resources including threatened and endangered species or EFH.</p>
USAKA, RMI	Cultural Resources	There would be no changes and therefore, no impacts to cultural resources from implementation of the No Action Alternative.	<p>For a land impact, the FE-1 flight test would occur on the west end of Illeginni Islet. Archaeological surveys have not found indigenous cultural materials or evidence of subsurface deposits on the Islet. The Cold War-era properties potentially eligible for listing on the RMI NRHP are located in the central and eastern portions of the Islet. Because a land impact would not occur in proximity to known or potential cultural resources on Illeginni Islet, implementation of the Preferred Alternative would not result in significant impacts.</p> <p>There are no cultural resources associated with either the southwest or northeast BOA location.</p>
Illeginni Islet	Biological Resources	There would be no change to biological resources under the No Action Alternative. Therefore, no impacts would occur to biological resources with implementation of the No Action Alternative	<p><i>Terrestrial Vegetation:</i> Terrestrial vegetation in the payload impact zone at Illeginni is vegetation of previously disturbed habitat and is predominantly managed vegetation. Therefore, no adverse impacts to terrestrial vegetation are expected.</p> <p><i>Terrestrial Wildlife:</i></p> <p>Noise: It is likely that birds would be exposed to SPLs high enough to cause behavioral disturbance. While birds might be temporarily startled by these sounds, any behavioral or physiological response is likely to be very brief and no adverse impacts to birds on or near Illeginni Islet are expected due to elevated SPLs.</p> <p>Direct Contact: While direct contact from payload debris may impact any birds in the impact zone, very few birds are expected to be within this area. Birds roosting or nesting in</p>

Location	Resource Area	No Action Alternative	Navy SSP FE-1 Proposed Action
			<p>the adjacent littoral forest and shrub habitats are not expected to be adversely impacted by payload impact While Illeginni Islet has shoreline habitat suitable for sea turtle nesting, no sea turtle nests or nesting activity have been observed on Illeginni in over 20 years. The last evidence of sea turtle nesting activity on Illeginni Islet consisted of observations of nest pits in 1996, 21 years ago. Therefore, the US Navy and USASMDC have concluded that the probability of sea turtle nesting in the area is so low as to be discountable and that FE-1 activities may but are not likely to adversely affect nesting sea turtles (US Navy and USASMDC, 2017). The USFWS has concurred with this determination (Appendix A).</p> <p>Vessel Strike: Direct collisions of birds with Navy vessels are unlikely and not expected. No adverse impacts to birds are expected from vessels transiting to and from Illeginni Islet.</p> <p>Exposure to Hazardous Chemicals: Hazardous chemicals are not expected to impact birds at Illeginni Islet. Hazardous chemicals may adversely impact nesting sea turtles, sea turtle nests, and/or sea turtle nesting habitat. Payload debris and ejecta have the potential to include hazardous chemicals including heavy metals. If these chemicals were introduced into sea turtle nesting habitat, they have the potential to dissuade females from nesting, harm sea turtle eggs, or affect the health of sea turtle hatchlings. While Illeginni Islet has shoreline habitat suitable for sea turtle nesting, no sea turtle nests or nesting activity have been observed on Illeginni in over 20 years. The last evidence of sea turtle nesting activity on Illeginni Islet consisted of observations of nest pits in 1996, 21 years ago. Therefore, the US Navy and USASMDC have concluded that the probability of sea turtle nesting in the area is so low as to be discountable and that FE-1 activities may but are not likely to adversely affect nesting sea turtles (US Navy and USASMDC, 2017). The USFWS has concurred with this determination (Appendix A).</p> <p>Human Disturbance: Disturbance from human activities and equipment operation has the potential to impact birds, especially nesting seabirds on Illeginni islet; however any disturbance is not expected to have a significant, long term impact. Disturbance from human activities and equipment operation may but is not likely to adversely impact nesting sea turtles, sea turtle nests, and/or sea turtle nesting habitat While Illeginni Islet has shoreline habitat suitable for sea turtle nesting, no sea turtle nests or nesting activity have been observed on Illeginni in over 20 years. The last evidence of sea turtle nesting activity on Illeginni Islet consisted of observations of nest pits in 1996, 21 years ago. Therefore, the US Navy and USASMDC have concluded that the probability of sea turtle nesting in the area is so low as to be discountable and that FE-1 activities may but are not likely to adversely affect nesting sea turtles (US Navy</p>

Location	Resource Area	No Action Alternative	Navy SSP FE-1 Proposed Action
			<p>and USASMDC, 2017). The USFWS has concurred with this determination (Appendix A).</p> <p>Marine Wildlife:</p> <p>Noise: The maximum SPLs for sonic booms and payload impact at the terminal end of payload flight do not exceed the PTS or TTS thresholds for cetaceans or, sea turtles, or fish. Payload impact would result in SPLs above the injury threshold for fish but only out to 2.2 m from impact; therefore injury to fish is unlikely. There is a potential for behavioral disruption in sea turtles and fish near the payload impact point. While there is a chance that up to 2 green sea turtles and 7 hawksbill turtle may be exposed to SPLs high enough to elicit behavioral response, any response is expected to be temporary and turtles would be expected to return to normal behavior within minutes. Any behavioral disturbance in fish would likely be limited to a brief startle response and behaviors would quickly return to normal. Therefore, no lasting adverse impacts are expected from elevated SPLs.</p> <p>Direct Contact: Payload impact is not expected to adversely affect cetaceans or sea turtles in the water through direct contact. Payload impact may adversely impact a very small, but indeterminable, number of larval fish, corals or mollusks. The number of larvae potentially affected is likely to be trivially small relative to their population sizes and the effects are considered discountable. Based on analyses of a worst-case scenario of a shoreline impact, direct contact from payload debris may also affect up to 9,097 coral colonies, 468 individual mollusks, and 100 juvenile and 8 adult humphead wrasses. The NMFS has been provided these analyses in a biological assessment and they found that a total of up to 9,929 colonies of consultation corals, 117 top shell snails, and 12 giant clams could be affected by direct contact, ejecta, and/or shock waves from a FE-1 payload impact near the Illeginni shoreline. The NMFS also concluded that the potential loss of these adult coral and mollusk species is not expected to eliminate them from Illeginni or to appreciable reduce the likelihood of their survival and recovery (NMFS, 2017b; Appendix E).</p> <p>Vessel Strike: Marine wildlife has the potential to be impacted by vessel strike primarily by being at the surface when a vessel travels through an area. Due to species characteristics, abundance, and distribution, and mitigation measures, no adverse impacts due to vessel strike are expected.</p> <p>Hazardous Chemicals: Post-flight cleanup of the impact area would include recovery/cleanup off all visible floating debris. Considering the small quantities of hazardous materials contained in the batteries, the planned land impact, and the dilution and mixing capabilities of the ocean and lagoon</p>

<i>Location</i>	<i>Resource Area</i>	<i>No Action Alternative</i>	<i>Navy SSP FE-1 Proposed Action</i>
			<p>waters, the battery materials released during payload impact should be of little consequence to any cetaceans, fish or sea turtles in the area. Hazardous chemicals have the potential to impact sea turtle nests and nesting. The USFWS has been provided a biological assessment and the findings of their Final Biological Opinion are included in the Final EA/OEA.</p> <p>Human Disturbance: Cetaceans, sea turtles in the water, and most fish are unlikely to be adversely impacted by increased human activity or equipment operation at Illeginni Islet. In shallow waters near Illeginni, corals, mollusks, and reef-associated fish have the potential to be disturbed by shallow water debris recovery and/or backfill operations. The NMFS has been provided a biological assessment and the findings of their Final Biological Opinion are included in Appendix F.</p>
	Noise	There would be no change to noise levels in the ROIs. Therefore, no significant impacts would occur from noise with implementation of the No Action Alternative.	While meteorological conditions can influence peak sound pressure levels, the sonic boom generated by the approaching payload is estimated to peak at less than 180 dB. At the point of impact, the sonic boom footprint would narrow and duration for sonic boom overpressures are expected to average 75 to 270 ms. Approximately 1 km ² (0.4 mi ²) would be exposed to SPLs up to 170 dB. Noise model assumptions for estimating sonic boom overpressures likely lead to conservatively high estimates of sonic boom pressures and, therefore, conservative estimates of affected area. Mission vessel personnel may be required to use hearing protection. Noise levels during pre-test and post-flight activities at the pre-determined target site would occur in an unpopulated area without resident receptors. Therefore, no significant impacts would occur from noise with implementation of the No Action Alternative.
	Public Health and Safety	There would be no change to public health and safety under the No Action Alternative.	In case of an anomaly, the payload FTS would cut the nose section from the rest of the vehicle as a failsafe operation to ensure the safety of the Marshall Islands. For impact, there are no resident populations in proximity to Illeginni Islet. NOTAMs and NOTMARs would be issued to clear traffic from caution areas prior to the test. There would be no significant impacts to public health and safety from the Proposed Action.
	Hazardous Materials and Wastes	Under the No Action Alternative, there would be no change to hazardous materials and waste at Illeginni Islet.	Hazardous materials used in the payload would be limited to batteries, small electro-explosive devices, and a tungsten alloy. No solid or liquid propellants, DU, Be, or radioactive materials would be carried on the payload. Flight test personnel would remediate the impact site, all visible debris would be removed, and all equipment and materials would be recovered from

<i>Location</i>	<i>Resource Area</i>	<i>No Action Alternative</i>	<i>Navy SSP FE-1 Proposed Action</i>
			Illeginni Islet. Any hazardous waste resulting from FE-1 flight test activities on Illeginni Islet would be disposed of in accordance with the UES. No significant impacts would occur from the Proposed Action.
USAKA, RMI Offshore Waters	Cultural Resources	There are no known cultural resources within either of the BOA deep water impact locations.	There are no known cultural resources within either of the BOA deep water impact locations. No impacts would occur to Cultural Resources from the either Alternative Action location.
	Biological Resources		<p>Terrestrial Wildlife: While no terrestrial habitat exists in the offshore waters, seabirds may forage in these areas. Based on likely seabird density and distribution in these areas, it is unlikely that seabirds would be exposed to SPLs high enough to cause injury or behavioral disturbance, direct contact, hazardous chemicals, vessel traffic, or human disturbance. Therefore seabirds are unlikely to be adversely impacted.</p> <p>Marine Wildlife:</p> <p>Noise: The maximum SPLs for sonic booms and payload impact at the terminal end of payload flight do not exceed the PTS or TTS thresholds for cetaceans or sea turtles. Payload impact would result in SPLs above the injury threshold for fish but only out to 2.2 m from impact; therefore injury to fish is unlikely. There is a potential for behavioral disruption in sea turtles and fish near the payload impact point. While there is a 1 in 4.3 chance that a sea turtle would be exposed to SPLs high enough to elicit behavioral response, any response is expected to be temporary and turtles would be expected to return to normal behavior within minutes. Any behavioral disturbance in fish would likely be limited to a brief startle response and behaviors would quickly return to normal. Therefore, no lasting adverse impacts are expected from elevated SPLs.</p> <p>Direct Contact: The total chance (all species combined) of a cetacean being directly contacted by payload impact in deep ocean waters is 1 in 278. There is a 1 in 7,315 chance that a sea turtle would be impacted by direct contact. Based on these chances, it is unlikely that a cetacean or sea turtle would be significantly impacted by direct contact from payload impact. Direct contact may adversely impact a very small, but indeterminable, number of larval fish, corals or mollusks. The number of larvae potentially affected is likely to be trivially small relative to their population sizes and the effects are considered discountable.</p> <p>Vessel Strike: Marine wildlife has the potential to be impacted by vessel strike primarily by being at the surface when a vessel travels through an area. Due to species characteristics,</p>

<i>Location</i>	<i>Resource Area</i>	<i>No Action Alternative</i>	<i>Navy SSP FE-1 Proposed Action</i>
			<p>abundance, and distribution, and mitigation measures, no adverse impacts due to vessel strike are expected.</p> <p>Hazardous Chemicals: Post-flight cleanup of the impact area would include recovery/cleanup off all visible floating debris. Considering the small quantities of hazardous materials contained in the payload and the dilution and mixing capabilities of the ocean and lagoon waters, the materials released during payload impact should be of little consequence to any cetaceans, fish or sea turtles in the area.</p> <p>Human Disturbance: Cetaceans, sea turtles in the water, and fish are unlikely to be adversely impacted by increased human activity or equipment operation at Illeginni Islet.</p>
Offshore Waters	Noise	There would be no change to the noise environment and, therefore, no impacts from noise.	<p>While meteorological conditions can influence peak sound pressure levels, the sonic boom generated by the approaching payload is estimated to peak at less than 180 dB. At the point of impact, the sonic boom footprint would narrow and duration for sonic boom overpressures are expected to average 75 to 270 ms. Approximately 1 km² (0.4 mi²) would be exposed to SPLs up to 170 dB. Noise model assumptions for estimating sonic boom overpressures likely lead to conservatively high estimates of sonic boom pressures and, therefore, conservative estimates of affected area. Mission vessel personnel may be required to use hearing protection. Noise levels during pre-test and post-flight activities at the pre-determined target site would occur in an unpopulated area without resident receptors. Therefore, no significant impacts would occur from noise with implementation of the No Action Alternative.</p>
	Public Health and Safety	There would be no change to the Public Health and Safety and, therefore, no resulting impacts.	<p>In case of an anomaly, the payload FTS would cut the nose section from the rest of the vehicle as a failsafe operation to ensure the safety of the Marshall Islands. For impact, there are no resident populations in proximity to either Offshore Waters location. NOTAMs and NOTMARs would be issued to clear traffic from caution areas prior to the test. There would be no significant impacts to public health and safety from the Proposed Action.</p>
	Hazardous Materials and Wastes	There would be no change to the Hazardous Materials and Wastes, and, therefore, no impacts would occur.	<p>Hazardous materials used in the payload would be limited to batteries, small electro-explosive devices, and a tungsten alloy. No solid or liquid propellants, DU, Be, or radioactive materials would be carried on the payload. Any hazardous waste resulting from FE-1 flight test activities from vessels or equipment would be disposed of in accordance with the UES. No significant impacts would occur from the Proposed Action.</p>

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Table 4-7 Impact Avoidance and Minimization Measures

<i>Location</i>	<i>Measure</i>	<i>Anticipated Benefit</i>	<i>Evaluating Effectiveness</i>	<i>Implementing and Monitoring</i>	<i>Responsibility</i>	<i>Estimated Completion Date</i>
PMRF	FE-1 (Proposed Action)					
	Transportation, handling, and storage of rocket motors and other ordnance would occur in accordance with DoD, Navy, and US DOT policies and regulations	Safeguard the materials from fire or other mishap	Determine the rate of successful compliance and incident prevention	Recordkeeping in accordance with DoD, Navy, and US DOT policies and regulations	Navy SSP, USAF	Within 1 year after the FONSI is signed
	Shipments would be inspected for species of plants and animals alien to the environment at Hawai'i	Prevent the introduction of alien species of plants and animals at Hawai'i and the RMI	Determine the rate of successful prevention, identifying the need for treatment applications, as necessary	Recordkeeping of all inspections and outcomes	Navy SSP	Within 1 year after the FONSI is signed
	Sandia personnel at KTF would conduct range responsibilities	Ensure appropriate launch preparation, including explosive safety, support to PMRF range safety and inter-range coordination	Determine the rate of successful compliance and incident prevention	Recordkeeping in accordance with DoD, Navy, and other applicable policies and regulations	Sandia	Within 1 year after the FONSI is signed
	Publication and circulation of Notices to Airmen (NOTAMs) and Notices to Mariners (NOTMARs) prior to launch	Provide safety and warning to personnel, including private citizens and commercial entities, concerning any potential hazard areas that should be avoided; ensure the clearance of non-critical personnel, vessels or aircraft in the vicinity	Determine the rate of successful compliance and incident prevention	Recordkeeping in accordance with DoD, Navy, and DOE policies and regulations	Navy SSP, Sandia	Within 1 year after the FONSI is signed
	Check launch pad area for safe access after vehicle liftoff	Ensure worker safety for post-launch inspection, clean-up, and maintenance	Determine the rate of successful compliance and incident prevention	Recordkeeping in accordance with DoD, Navy, and DOE policies and regulations	Sandia	Within 1 year after the FONSI is signed

Over-Ocean Flight Corridor	FE-1 (Proposed Action)					
	Payload's flight path would avoid flying over the Northwestern Hawaiian Islands	Avoid impacts to protected species and habitats	Determine that actual flight path complies	Recordkeeping and reporting in accordance with DoD, Navy, and DOE range and flight safety policies and regulations, USFWS regulations, and the ESA and MMPA	Navy SSP, Sandia	Within 1 year after the FONSI is signed
	During travel in the BOA, ship personnel would monitor for marine mammals and sea turtles to avoid potential ship strikes. Vessel operators would adjust speed based on expected animal locations, densities, and or lighting and turbidity conditions when possible.	Avoid impact on marine mammals and sea turtles.	Although unlikely, any dead or injured marine mammals or sea turtles sighted by post-flight personnel would be reported to SMDC, who would then inform NMFS and USFWS.	Recordkeeping and reporting to the appropriate authorities	Navy SSP, RTS	Within 1 year after the FONSI is signed
	Computer-monitored destruct lines, based on no-impact lines, are pre-programmed into flight safety software	Avoid debris falling on inhabited areas, ensure compliance with Space System Software Safety Engineering protocols and US range operation standards and practices	Determine the rate of successful compliance and incident prevention	Recordkeeping and reporting in accordance with DoD, Navy, and DOE range and flight safety policies and regulations	Navy SSP, Sandia	Within 1 year after the FONSI is signed
	FE-1 (Preferred Impact Location)					
USAKA, RMI Illeginni Islet	Computer-monitored destruct lines, based on no-impact lines, are pre-programmed into flight safety software	Avoid debris falling on inhabited areas, ensure compliance with Space System Software Safety Engineering protocols and US range operation standards and practices	Determine the rate of successful compliance and incident prevention	Recordkeeping and reporting in accordance with UES, DoD, Navy, and RTS range and flight safety policies and regulations	Navy SSP, RTS	Within 1 year after the FONSI is signed

	<p>Pre-flight monitoring by qualified personnel would be conducted on Illeginni Islet for sea turtles or sea turtle nests.</p> <p>On-site personnel would report any observations of sea turtles or sea turtle nests on Illeginni to appropriate test and USAG-KA personnel to provide to NMFS.</p>	Avoid impacts to sea turtles and sea turtle nests	Determine the rate of successful compliance and incident prevention or occurrence	<p>For at least 8 weeks preceding the FE-1 launch, Illeginni Islet would be surveyed by pre-test personnel for sea turtles, sea turtle nesting activity, and sea turtle nests on a bi-weekly basis. If possible, personnel would inspect the area within two days of the launch.</p> <p>If sea turtles or sea turtle nests are observed near the impact area, observations would be reported to appropriate test and USAG-KA personnel for consideration in approval of the launch and to NMFS.</p> <p>Recordkeeping and reporting in accordance with UES, DoD, Navy, and USFWS regulations</p>	RTS/USAG-KA, Navy SSP	Within 1 year after the FONSI is signed
	RTS would conduct range responsibilities	Ensure appropriate launch preparation, including explosive safety, support to Navy SSP and inter-range coordination	Determine the rate of successful compliance and incident prevention	Recordkeeping in accordance with UES, DoD, Navy, and RTS applicable policies and regulations	RTS	Within 1 year after the FONSI is signed

	During travel to and from impact zones, including Illeginni Islet, and during raft deployment, ship personnel would monitor for marine mammals and sea turtles to avoid potential vessel strikes. Vessel operators would adjust speed or raft deployment based on expected animal locations, densities, and or lighting and turbidity conditions.	Avoid impact on marine mammals and sea turtles.	Although unlikely, any dead or injured marine mammals or sea turtles sighted by post-flight personnel would be reported to the USAG-KA Environmental Office and SMDC, who would then inform NMFS and USFWS. USAG-KA aircraft pilots otherwise flying in the vicinity of the impact and test support areas would also similarly report any opportunistic sightings of dead or injured marine mammals or sea turtles.	If personnel observe sea turtles or marine mammals in potential impact zones, sightings would be reported to appropriate test and USAG-KA personnel for consideration in launch planning, recordkeeping and reporting in accordance with UES, DOD, Navy, and RTS policies and regulations.	Navy SSP, RTS	Within 1 year after the FONSI is signed
	Vessel and equipment operations would not involve any intentional discharges of fuel, toxic wastes, or plastics and other solid wastes that could harm terrestrial or marine life. Hazardous materials would be handled in adherence to the hazardous materials and waste management systems of USAG-KA. Hazardous material releases would comply with the emergency	Avoid introduction of hazardous chemicals into terrestrial and marine environments.	Determine the rate of successful compliance and incident prevention	Vessel and heavy equipment operators would inspect and clean equipment for fuel or fluid leaks prior to use or transport, recordkeeping of all incidents and outcomes	Navy SSP, RTS	Within 1 year after the FONSI is signed

	procedures set out in the KEEP and the UES.					
	All equipment and packages shipped to USAG-KA would undergo inspection prior to shipment.	Prevent the introduction of alien species of plants and animals to Kwajalein Atoll	Determine the rate of successful prevention, identifying the need for treatment applications, as necessary	Recordkeeping of all inspections and outcomes	Navy SSP	Within 1 year after the FONSI is signed
	Sensor rafts would not be located in waters less than 3 m (10 ft) deep.	To avoid impacts on coral heads off Illeginni Islet	Determine the rate of successful compliance and incident prevention	Recordkeeping of deployments and outcomes	Navy SSP, LLNL	Within 1 year after the FONSI is signed
	Publication and circulation of Notices to Airmen (NOTAMs) and Notices to Mariners (NOTMARs) prior to launch	Provide safety and warning to personnel, including private citizens and commercial entities, concerning any potential hazard areas that should be avoided; ensure the clearance of non-critical personnel, vessels or aircraft in the vicinity	Determine the rate of successful compliance and incident prevention	Recordkeeping in accordance with UES, DoD, Navy, and RTS policies and regulations	Navy SSP, RTS	Within 1 year after the FONSI is signed
	FTS on the payload would include a failsafe operation	Further ensure the safety of the Marshall Islands and avoid debris falling on inhabited areas or any protected area, ensure compliance with Space System Software Safety Engineering protocols and US range operation standards and practices	Determine the rate of successful compliance and incident prevention	Recordkeeping in accordance with UES, DoD, Navy, and RTS policies and regulations	Navy SSP, Sandia, RTS	Within 1 year after the FONSI is signed
	Payload impact would be in the non-forested area, place scarecrows, Mylar flags, helium-filled balloons, and strobe lights or tarp coverings on or	Avoid affecting the bird habitat	Determine the rate of successful compliance and incident prevention or occurrence	Recordkeeping and reporting in accordance with UES, DoD, Navy, RTS, USFWS, and RMIEPA policies and	Navy SSP, RTS	Within 1 year after the FONSI is signed

	near equipment and the impact area			regulations		
	The impact area would be searched for seabird nests, including eggs and chicks, prior to pre-flight activity. Any discovered seabird nest would be covered with an A-frame structure to protect eggs or chicks and to warn project personnel	Avoid impacts to seabirds, especially black-napped terns	Post-test monitoring to observe impacts to seabirds, especially black-napped terns, their nests, eggs, or chicks	Results of monitoring would be reported to USAG-KA Environmental and to USFWS		
	Debris recovery and site cleanup would be performed for land or shallow water impacts.	To minimize long-term risks to terrestrial and marine life	Comparison of recovered debris to known materials in the payload	All visible project-related debris would be recovered during post-flight operations, including debris in shallow lagoon or shallow ocean waters by range divers. In all cases, recovery and cleanup would be conducted in a manner to minimize further impacts on biological resources Protected marine species including invertebrates would be avoided or effects to them would be minimized, which may include movement of these organisms out of the area likely to be affected.	RTS, Navy SSP	Within 1 year after the FONSI is signed

	Should any missile components or debris impact areas of sensitive biological resources (i.e., sea turtle nesting habitat or coral reef), a USFWS or NMFS biologist would be allowed to provide guidance and/or assistance in recovery operations to minimize impacts on such resources	Minimize impacts on terrestrial and marine biological resources	Determine whether components or debris impact sensitive resources, determine if a USFWS or NMFS biologist was contacted and allowed to provide guidance	Recordkeeping and reporting in accordance with UES, DoD, Navy, RTS, USFWS and NMFS policies and regulations	Navy SSP	Within 1 year after the FONSI is signed
	Should personnel observe endangered, threatened, or other species requiring consultation moving into the area, work would be delayed until such species leave the area or were out of harm's way.	Avoid impacts to terrestrial and marine wildlife	Determine the rate of successful compliance and incident prevention	Recordkeeping and reporting with UES, DoD, Navy, RTS, USFWS, and RMIEPA policies and regulations	Navy SSP	Within 1 year after the FONSI is signed
	Evacuation of nonessential personnel and sheltering all other personnel remaining within the Mid-Atoll Corridor; publication and circulation of Notices to Airmen (NOTAMs) and Notices to Mariners (NOTMARs); perform radar and visual sweeps of the hazard area immediately prior to test flights	Provide safety and warning to personnel, including native Marshallese citizens, concerning any potential hazard areas that should be avoided; ensure the clearance of non-critical personnel, vessels or aircraft in the vicinity	Determine the rate of successful compliance and incident prevention	Recordkeeping in accordance with UES, DoD, Navy, and RTS policies and regulations	Navy SSP, RTS	Within 1 year after the FONSI is signed
	Ordnance personnel survey of impact site, removal of residual	Ensure post-test personnel safety, avoid impacts to terrestrial and	Determine the rate of successful compliance and incident	Recordkeeping in accordance with UES, DoD, Navy, and RTS	RTS	Within 1 year after the FONSI is signed

	explosive materials, manual cleanup and removal of debris including hazardous materials, backfill impact crater, dive team or ROV survey and debris recovery for deeper water lagoon impact	marine vegetation and wildlife	prevention with appropriate disposition of recovered materials	policies and regulations		
	Inspect reef, reef flat, or shallow waters within 24 hours if inadvertently impacted, assess damage, decide on any mitigation measures	Avoid or minimize impacts to marine vegetation and wildlife	Determine the rate of successful compliance and incident prevention	Recordkeeping and reporting in accordance with UES, DoD, Navy, RTS and RMIEPA policies and regulations	RTS, Navy SSP, possibly NMFS/USFWS	Within 1 year after the FONSI is signed
	Ensure that all relevant personnel associated with this project are fully briefed on the BMP and the requirement to adhere to them for the duration of this project.	Ensure awareness of and application of BMP for the duration of the FE-1 flight test	Determine the rate of successful compliance and incident prevention	Recordkeeping in accordance with UES, DoD, Navy, RTS, USFWS and NMFS policies, regulations, and guidance	US Navy SSP	Within 1 year after the FONSI is signed
	In the event the payload land impact affects the reef at Illeginni, personnel shall secure or remove from the water any substrate or coral rubble from the ejecta impact zone that may become mobilized by wave action as soon as possible. Ejecta greater than six inches in any dimension shall be removed from the water or positioned such that it would not become mobilized by	Avoid impacts to marine wildlife, determine impacts to reef and disposition of ejecta	Determine the rate of successful compliance and incident prevention	Recordkeeping and reporting in accordance with UES, DoD, Navy, RTS, USFWS and NMFS policies, regulations, and guidance	US Navy SSP, USAG-KA	Within 1 year after the FONSI is signed

	<p>expected wave action, including replacement in the payload crater.</p> <p>If possible, coral fragments greater than six inches in any dimension shall be positioned on the reef such that they would not become mobilized by expected wave action, and in a manner that would enhance its survival; away from fine sediments with the majority of the living tissue (polyps) facing up. UES consultation coral fragments that cannot be secured in-place should be relocated to suitable habitat where it is not likely to become mobilized.</p>					
	<p>In the event the payload land impact affects the reef at Illeginni, the USASMDC/ARSTRAT shall require its personnel to reduce impacts on top shell snails.</p> <p>Rescue and reposition any living top shell snails that are buried or trapped by rubble. Relocate to suitable habitat, any living top shell snails that are in the</p>	Avoid impacts to marine wildlife	Post-test monitoring to observe impacts to reef and top shell snails, and determine disposition of ejecta	Recordkeeping and reporting in accordance with UES, DoD, Navy, RTS, USFWS and NMFS policies, regulations, and guidance	US Navy SSP, USAG-KA	Within 1 year after the FONSI is signed

	path of any heavy equipment that must be used in the marine environment.					
	<p>In the event the payload land impact affects the reef at Illeginni, personnel shall be required to reduce impacts on clams.</p> <p>Rescue and reposition any living clams that are buried or trapped by rubble.</p> <p>Relocate to suitable habitat, any living clams that are in the path of any heavy equipment that must be used in the marine environment.</p>	Avoid impacts to marine wildlife	Post-test monitoring to observe impacts to reef and living clams, and determine disposition of ejecta	Recordkeeping and reporting in accordance with UES, DoD, Navy, RTS, USFWS and NMFS policies, regulations, and guidance	US Navy SSP, USAG-KA	Within 1 year after the FONSI is signed
	Appropriately qualified personnel shall be assigned to record all suspected incidences of take of any UES-consultation species.	Ensure accuracy of data collection and applicability to incidences of take	Identification or refutation of all suspected incidences of take	Recordkeeping and reporting in accordance with UES, DoD, Navy, RTS, USFWS and NMFS policies, regulations, and guidance	US Navy SSP, USAG-KA	Within 1 year after the FONSI is signed
	<p>Digital photography shall be utilized to record any UES-consultation species found injured or killed in or near the ocean target areas and/or at Illeginni.</p> <p>As practicable:</p> <p>1) Photograph all damaged corals and/or other UES-consultation species that may be observed injured or dead;</p>	Ensure accuracy of data collection and applicability to incidences of take	Photodocumentation prepared as per NMFS guidance	Recordkeeping and reporting in accordance with UES, DoD, Navy, RTS, USFWS and NMFS policies, regulations, and guidance	US Navy SSP, USAG-KA	Within 1 year after the FONSI is signed

	2) Include a scaling device (such as a ruler) in photographs to aid in the determination of size; and 3) Record the location of the photograph.					
	In the event the payload land impact affects the reef at Illeginni, personnel shall be required to reduce impacts on clams. Rescue and reposition any living clams that are buried or trapped by rubble. Relocate to suitable habitat, any living clams that are in the path of any heavy equipment that must be used in the marine environment.	Avoid impacts to marine wildlife	Post-test monitoring to observe impacts to reef and living clams, and determine disposition of ejecta	Recordkeeping and reporting in accordance with UES, DoD, Navy, RTS, USFWS and NMFS policies, regulations, and guidance	US Navy SSP, USAG-KA	Within 1 year after the FONSI is signed
	Appropriately qualified personnel shall be assigned to record all suspected incidences of take of any UES-consultation species.	Ensure accuracy of data collection and applicability to incidences of take	Identification or refutation of all suspected incidences of take	Recordkeeping and reporting in accordance with UES, DoD, Navy, RTS, USFWS and NMFS policies, regulations, and guidance	US Navy SSP, USAG-KA	Within 1 year after the FONSI is signed
	Digital photography shall be utilized to record any UES-consultation species found injured or killed in or near the ocean target areas and/or at Illeginni. As practicable: 1) Photograph all damaged corals and/or other UES-consultation	Ensure accuracy of data collection and applicability to incidences of take	Photodocumentation prepared as per NMFS guidance	Recordkeeping and reporting in accordance with UES, DoD, Navy, RTS, USFWS and NMFS policies, regulations, and guidance	US Navy SSP, USAG-KA	Within 1 year after the FONSI is signed

	species that may be observed injured or dead; 2) Include a scaling device (such as a ruler) in photographs to aid in the determination of size; and 3) Record the location of the photograph.					
	In the event the payload impact affects the reef at Illeginni, personnel shall survey the ejecta field for impacted corals, top shell snails, and clams. Also be mindful for any other UES- consultation species that may have been affected.	Avoid impacts to marine wildlife; ensure accuracy of data collection and applicability to incidences of take	Post-test monitoring to observe impacts to reef and identified organisms, including UES consultation species	Recordkeeping and reporting in accordance with UES, DoD, Navy, RTS, USFWS and NMFS policies, regulations, and guidance	US Navy SSP, USAG-KA	Within 60 days of completing post-test clean-up and restoration
	Within 60 days of completing post-test clean-up and restoration, provide photographs and records to the USAG-KA Environmental Office. USAG-KA and NMFS biologists will review the photographs and records to identify the organisms to the lowest taxonomic level accurately possible to assess impacts on consultation species.	Ensure accuracy of data collection and applicability to incidences of take	Submittal of photographs and records within 60 days of completing post-test clean-up and restoration	Recordkeeping and reporting in accordance with UES, DoD, Navy, RTS, USFWS and NMFS policies, regulations, and guidance	US Navy SSP, USAG-KA	Within 60 days of completing post-test clean-up and restoration
	Within 6 months of completion of the action, US Navy SPP shall provide a report to USAG-KA to forward to NMFS. The report shall identify:	Ensure compliance with UES and NMFS Biological Opinion Terms and Conditions	Submittal of report within 6 months of completing the action	Recordkeeping and reporting in accordance with UES, DoD, Navy, RTS, USFWS and NMFS policies, regulations,	US Navy SSP, USAG-KA	Within 6 months of completion of the action

	1) The flight test and date; 2) The target area; 3) The results of the pre- and post-flight surveys; 4) The identity and quantity of affected resources (include photographs and videos as applicable); and 5) The disposition of any relocation efforts.			and guidance		
	Prepare a project specific NPA and DEP	Ensure UES compliance	Complete the NPA and DEP prior to occurrence of the Proposed Action	Final DEP authorized with UES Appropriate Agencies' signatures prior to occurrence of the Proposed Action	Navy SSP	Within 1 year after the FONSI is signed
USAKA, RMI Southwest or Northeast Offshore Waters	FE-1 (Alternative Impact Locations)					
	Computer-monitored destruct lines, based on no-impact lines, are pre-programmed into flight safety software	Avoid debris falling on inhabited areas, ensure compliance with Space System Software Safety Engineering protocols and US range operation standards and practices	Determine the rate of successful compliance and incident prevention	Recordkeeping and reporting in accordance with UES, DoD, Navy, and RTS range and flight safety policies and regulations	Navy SSP, RTS	Within 1 year after the FONSI is signed
	Raft would have running lights and station-keeping; no intentional ocean dumping should the instrumentation raft be inadvertently struck during the conduct of the mission; possible use of scarecrows, Mylar flags, helium-filled balloons, and strobe lights.	Maritime safety; compliance with international policy; visual deterrents to avoid inadvertent impacts to birds that might be on the raft	Determine the rate of successful compliance and incident prevention or occurrence	Recordkeeping and reporting in accordance with UES, DoD, Navy, and RTS range and flight safety policies and regulations	Navy SSP, RTS, LLNL	Within 1 year after the FONSI is signed; reporting on bird impacts before the end of the year in which the FE-1 flight test occurs
	FTS on the payload would include a failsafe	Further ensure the safety of the Marshall Islands	Determine the rate of successful compliance	Recordkeeping in accordance with UES,	Navy SSP, RTS	Within 1 year after the FONSI is signed

	operation to further ensure the safety of the Marshall Islands	and avoid debris falling on inhabited areas or into any protected area, ensure compliance with Space System Software Safety Engineering protocols and US range operation standards and practices	and incident prevention	DoD, Navy, and RTS policies and regulations		
	Visible debris on the water surface would be recovered and removed	Avoid physical impacts to marine life	Collection of any visible debris on the water surface or documentation of the lack of visible debris	All visible project-related debris on the water surface would be recovered during post-flight operations. In all cases, recovery and cleanup would be conducted in a manner to minimize further impacts on biological resources. Recordkeeping and reporting in accordance with UES, DoD, Navy, and RTS, policies and regulations	RTS/USAG-KA, Navy SSP	Within 1 year after the FONSI is signed
	Evacuation of nonessential personnel and sheltering all other personnel remaining within the Mid-Atoll Corridor; publication and circulation of Notices to Airmen (NOTAMs) and Notices to Mariners (NOTMARs); a fact sheet describing the project and the environmental	Provide safety and warning to personnel, including native Marshallese citizens, concerning any potential hazard areas that should be avoided; ensure the clearance of non-critical personnel, vessels or aircraft in the vicinity	Determine the rate of successful compliance and incident prevention	Recordkeeping in accordance with UES, DoD, Navy, and RTS policies and regulations	Navy SSP, RTS	Within 1 year after the FONSI is signed

	controls would be prepared and would be provided at locations on Ebeye and Kwajalein Island; perform radar and visual sweeps of the hazard area immediately prior to test flights.					
	Ordnance personnel survey of impact site, removal of residual explosive materials, manual cleanup and removal of surface floating debris including hazardous materials	Ensure post-test personnel safety, avoid impacts to marine vegetation and wildlife	Determine the rate of successful compliance and incident prevention with appropriate disposition of recovered materials	Recordkeeping in accordance with UES< DoD, Navy, and RTS policies and regulations	RTS	Within 1 year after the FONSI is signed
	Prepare a project specific NPA and DEP	Ensure UES compliance	Complete the NPA and DEP prior to occurrence of the Proposed Action	Final DEP authorized with UES Appropriate Agencies' signatures prior to occurrence of the Proposed Action	Navy SSP	Within 1 year after the FONSI is signed
	During travel to and from impact zones, ship personnel would monitor for marine mammals and sea turtles to avoid potential ship strikes. Vessel operators would adjust speed based on expected animal locations, densities, and or lighting and turbidity conditions.	Avoid impact on marine mammals and sea turtles.	Although unlikely, any dead or injured marine mammals or sea turtles sighted by post-flight personnel would be reported to the USAG-KA Environmental Office and SMDC, who would then inform NMFS and USFWS. USAG-KA aircraft pilots otherwise flying in the vicinity of the impact and test support areas would also similarly report any opportunistic sightings	If personnel observe sea turtles or marine mammals in potential impact zones, sightings would be reported to appropriate test and USAG-KA personnel for consideration in launch planning.	Navy SSP, RTS	Within 1 year after the FONSI is signed; reporting on marine mammal or sea turtle impacts before the end of the year in which the FE-1 flight test occurs

			of dead or injured marine mammals or sea turtles.			
	<p>Vessel and equipment operations would not involve any intentional discharges of fuel, toxic wastes, or plastics and other solid wastes that could harm marine life.</p> <p>Hazardous materials would be handled in adherence to the hazardous materials and waste management systems of USAG-KA. Hazardous material releases would comply with the emergency procedures set out in the KEEP and the UES.</p>	Avoid introduction of hazardous chemicals into marine environments.	Determine the rate of successful compliance and incident prevention	Vessel and heavy equipment operators would inspect and clean equipment for fuel or fluid leaks prior to use or transport, recordkeeping and reporting in accordance with UES, DoD, Navy, RTS, and RMIEPA policies and regulations	Navy SSP	Within 1 year of completion of the FONSI
	Should personnel observe endangered, threatened, or other species requiring consultation moving into the area, work would be delayed until such species leave the area or were out of harm's way.	Avoid impacts to terrestrial and marine wildlife.	Determine the rate of successful compliance and incident prevention	Recordkeeping and reporting in accordance with UES, DoD, Navy, RTS, NMFS, USFWS, and RMIEPA policies and regulations	Navy SSP, RTS	Within 1 year after the FONSI is signed; reporting on any impacts before the end of the year in which the FE-1 flight test occurs
	Ensure that all relevant personnel associated with this project are fully briefed on the BMP and the requirement to adhere to them for the duration of this project.	Ensure awareness of and application of BMP for the duration of the FE-1 flight test	Determine the rate of successful compliance and incident prevention	Recordkeeping in accordance with UES, DoD, Navy, RTS, USFWS and NMFS policies, regulations, and guidance	US Navy SSP	Within 1 year after the FONSI is signed
	Appropriately qualified	Ensure accuracy of data	Identification or	Recordkeeping and	US Navy SSP,	Within 1 year after

	personnel shall be assigned to record all suspected incidences of take of any UES-consultation species.	collection and applicability to incidences of take	refutation of all suspected incidences of take	reporting in accordance with UES, DoD, Navy, RTS, USFWS and NMFS policies, regulations, and guidance	USAG-KA	the FONSI is signed
	Digital photography shall be utilized to record any UES-consultation species found injured or killed in or near the ocean target areas and/or at Illeginni. As practicable: 1) Photograph all damaged corals and/or other UES-consultation species that may be observed injured or dead; 2) Include a scaling device (such as a ruler) in photographs to aid in the determination of size; and 3) Record the location of the photograph.	Ensure accuracy of data collection and applicability to incidences of take	Photodocumentation prepared as per NMFS guidance	Recordkeeping and reporting in accordance with UES, DoD, Navy, RTS, USFWS and NMFS policies, regulations, and guidance	US Navy SSP, USAG-KA	Within 1 year after the FONSI is signed
	Within 60 days of completing post-test clean-up and restoration, provide photographs and records to the USAG-KA Environmental Office. USAG-KA and NMFS biologists will review the photographs and records to identify the organisms to the lowest taxonomic level accurately possible to assess impacts on consultation species.	Ensure accuracy of data collection and applicability to incidences of take	Submittal of photographs and records within 60 days of completing post-test clean-up and restoration	Recordkeeping and reporting in accordance with UES, DoD, Navy, RTS, USFWS and NMFS policies, regulations, and guidance	US Navy SSP, USAG-KA	Within 60 days of completing post-test clean-up and restoration

	<p>Within 6 months of completion of the action, US Navy SPP shall provide a report to USAG-KA to forward to NMFS. The report shall identify:</p> <ol style="list-style-type: none"> 1) The flight test and date; 2) The target area; 3) The results of the pre- and post-flight surveys; 4) The identity and quantity of affected resources (include photographs and videos as applicable); and 5) The disposition of any relocation efforts. 	Ensure compliance with UES and NMFS Biological Opinion Terms and Conditions	Submittal of report within 6 months of completing the action	Recordkeeping and reporting in accordance with UES, DoD, Navy, RTS, USFWS and NMFS policies, regulations, and guidance	US Navy SSP, USAG-KA	Within 6 months of completion of the action
	Perform a bench study to develop measurements of dissolution and potential migration of the tungsten alloy in Illeginni Islet soils	Inform future biological resources analyses of potential effects	Completion of the study and determination of findings	Report of study and findings made available to DOD partners, USEPA, NMFS, USFWS, and the RMIEPA	Navy SSP, LLNL	Final Report to be completed before EA/OEA finalized

5 Cumulative Impacts

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

5.1 Definition of Cumulative Impacts

The approach taken in the analysis of cumulative impacts follows the objectives of NEPA, CEQ regulations, and CEQ guidance. Cumulative impacts are defined in 40 CFR section 1508.7.

The impact on the environment that results from the incremental impact 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 impacts can result from individually minor but collectively significant actions taking place over a period of time.

To determine the scope of environmental impact statements, agencies shall consider cumulative actions, which when viewed with other proposed actions have cumulatively significant impacts and should therefore be discussed in the same impact statement.

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 (CEQ 2005) and Consideration of Cumulative Impacts in USEPA Review of NEPA Documents (USEPA, 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 proposed action 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 proposed action 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 proposed action 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 proposed action and another action could be expected to interact, would the proposed action 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 proposed action is considered alone?

5.2 Scope of Cumulative Impacts Analysis

The scope of the cumulative impacts analysis involves both the geographic extent of the effects and the time frame in which the effects could be expected to occur. For this EA/OEA, the study area delimits the geographic extent of the cumulative impacts analysis. In general, the study area would include those areas previously identified in Chapter 4 for the respective resource areas. The time frame for cumulative impacts centers on the timing of the proposed action.

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 proposed action, 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.

5.3 Past, Present, and Reasonably Foreseeable Actions

This section will focus on past, present, and reasonably foreseeable future projects at and near SNL/KTF, the over-ocean flight corridor, and RTS, Kwajalein Atoll. In determining which projects to include in the cumulative impacts analysis, a preliminary determination was made regarding the past, present, or reasonably foreseeable action. Specifically, using the first fundamental question included in Section 5.1, it was determined if a relationship exists such that the affected resource areas of the Proposed Action (included in this EA/OEA) might interact with the affected resource area of a past, present, or reasonably foreseeable action. If no such potential relationship exists, the project was not carried forward into the cumulative impacts analysis. In accordance with CEQ guidance (CEQ 2005), these actions considered but excluded from further cumulative effects analysis normally are not catalogued here as the intent is to focus the analysis on the meaningful actions relevant to inform decision-making. However, in response to a comment on the Draft FE-1 EA/OEA by the RMIEPA, projects preliminarily reviewed but not carried forward for analysis are described briefly in section 5.3.1.1 for informational purposes. Projects included in this cumulative impacts analysis are listed in Table 5-1 and briefly described in the following subsections.

5.3.1 Past Actions

There have been less than 10 STARS launches in the last 25 years from KTF. The most recent STARS launch was in 2011. Other past actions have included testing and training for Navy and other government agencies. Actions have included RDT&E activities in the HRC, Major Exercises, and maintenance of the technical and logistical facilities that support these activities and exercises.

MMIII ICBM missile RVs have routinely impacted at KMISS and Illeginni Islet in the past. An EA with a FONSI was completed for MMIII modifications in 2004, and a Supplemental EA is in process for additional missile configuration updates (2017). Both Be and DU remain in the soil at Illeginni Islet from MMIII land impacts.

The Advanced Hypersonic Weapon program had a single payload that previously impacted at Illeginni Islet following a launch using a STARS booster from SNL/KTF.

Kwajalein Echo Pier repairs improved the ability to receive and ship goods and mission-related items at USAKA.

The KMISS refurbishment replaced cabling and hydrophones to re-establish the accuracy required for ICBM testing and improve data collection for other programs that may have impacts within the KMISS area.

5.3.2 Past Actions Not Carried Forward for Analysis

A MMIII Extended Range flight test occurred in 2013. The single flight test from Vandenberg AFB to a BOA in the Republic of Palau was evaluated in a MM III Supplemental Environmental Assessment, which resulted in a FONSI. Personnel and equipment for the flight test were moved through USAKA; however, the flight test was conducted between Vandenberg Air Force Base in California and a BOA in the Republic of Palau. There were no effects to USAKA, Illeginni Islet or the Offshore Waters locations from this activity and it was not carried forward for cumulative analysis.

The North Pacific Target Launch EA (2001) evaluated use of Strategic Target System launch vehicles from Kodiak Launch Complex [Pacific Spaceport Complex Alaska] in Alaska or from KTF to a BOA impact site in either USAKA or off of the Baja California in Mexico. Nine flight tests were planned through 2008, however, not all of the flights were successful or had launches utilizing USAKA. All target launches occurred from Kodiak Launch Complex and ultimately none involved intercept launches from RTS. The trajectories for actual flights did not overlapped the Over-Ocean Flight Corridor between KTF and RTS, and there were no impacts or intercepts within USAKA. There was no impact to resources at USAKA, Illeginni Islet or the Offshore Waters locations from this activity and it was not carried forward for cumulative analysis.

Integrated Flight Tests at USAKA and Wake Island were conducted by the US Missile Defense Agency in 2012 and 2013. Personnel and equipment were situated on several islands at USAKA. Placement of a radar and launch of air-breathing targets for these flight tests occurred at Illeginni Islet. Target intercepts occurred over BOAs north/northwest of Kwajalein Atoll and east/southeast of Wake Island. There was no significant impact to resources at USAKA, Illeginni Islet or the Offshore Waters locations from this activity and it was not carried forward for cumulative analysis.

Kwajalein Echo Pier repairs improved the ability to receive and ship goods and mission-related items at USAKA. This provided increased efficiencies in moving goods to and from the island of Kwajalein. Biological resources on and near the pier were managed in coordination and consultation with NMFS and USFWS. There were no effects to Illeginni Islet or the Offshore Waters locations from this activity and it was not carried forward for cumulative analysis.

A USAPHC Fish Study was completed in 2014 for the USAG-KA Cleanup Program (USAPHC, 2014). The study identified, "Unacceptable cancer risk for Marshallese adults [from consumption of fish] at Illeginni [harbor] is attributable to the pesticide, chlordane." Chlordane is a pesticide used to treat wood and wood structures for control of pests, particularly termites, and is not associated with previous missile flight tests impacting at Illeginni. Although Be and DU are known to exist in soil at Illeginni from MMIII RV impacts, they are at levels below USEPA Residential RSLs and they were not identified as a contaminant in fish harvested at Illeginni for the study. Therefore, the fish study was not carried forward for cumulative impacts analysis with FE-1.

A second Advanced Hypersonic Weapon flight test failed upon launch from Kodiak Launch Complex; the booster landed in a BOA of the North Pacific Ocean between Alaska and Hawai'i. There were no effects to USAKA, Illeginni Islet or the Offshore Waters locations from this activity and it was not carried forward for cumulative analysis.

5.3.3 Present and Reasonably Foreseeable Actions

MMIII ICBM missile RVs are planned to impact at KMISS; land impacts are no longer proposed for that program.

The actions associated with testing and training for Navy and other government agencies are still occurring and are expected to occur well into the future. The actions that include RDT&E activities in the HRC, Major Exercises, and maintenance of the technical and logistical facilities that support these activities and exercises are also still occurring and are expected to continue.

Table 5-1 NEPA Analyses Performed for Actions Considered in Cumulative Action Evaluation

<i>Location</i>	<i>Action</i>	<i>Level of NEPA Analysis Completed</i>
PMRF	Past Actions	
	Strategic Target System Launches	EIS/ROD
	Navy Testing and Training	EIS/OEIS/ROD
	Present and Reasonably Foreseeable Future Actions	
	Navy Testing and Training	EIS/OEIS/ROD
Over-Ocean Flight Corridor	Past Actions	
	Minuteman III Flight Testing	EA/FONSI
	Advanced Hypersonic Weapon Flight Testing	EA/FONSI
	Present and Reasonably Foreseeable Future Actions	
	Minuteman III Flight Testing	(S)EA/FONSI
USAKA, RMI Illeginni Islet	Past Actions	
	Minuteman III RV Impacts	EA/FONSI
	Present and Reasonably Foreseeable Future Actions	
	US Navy SSP FE-2 and FE-3 (potentially)	EA/FONSI (Expected)
	Past Actions	
USAKA, RMI Offshore	Minuteman III RV Impacts at KMISS	EA/FONSI
	Present and Reasonably Foreseeable Future Actions	
	Minuteman III RV Impacts at KMISS	EA/FONSI
	US Navy SSP FE-2 and FE-3 (potentially)	EA/FONSI (Expected)

5.4 Cumulative Impact Analysis

Where feasible, the cumulative impacts were assessed using quantifiable data; however, for many of the resources included for analysis, quantifiable data are not available and a qualitative analysis was undertaken. In addition, where an analysis of potential environmental effects for future actions has not been completed, assumptions were made regarding cumulative impacts related to this EA/OEA where possible. The analytical methodology presented in Chapter 4, which was used to determine potential impacts to the various resources analyzed in this document, was also used to determine cumulative impacts.

5.4.1 PMRF

5.4.1.1 Description of Geographic Study Area

There has been no significant change in resources at PMRF as a result of past and present actions. No changes are anticipated in the future.

5.4.1.2 Relevant Past, Present, and Future Actions

The launching of missiles both from PMRF and ships offshore would continue as part of the RDT&E and training mission of PMRF.

5.4.1.3 Cumulative Impact Analysis

No past, present, or reasonably foreseeable actions has been identified that might interact with the affected resource areas of the Proposed Action and result in significant impacts.

5.4.2 Over-Ocean Flight Corridor

5.4.2.1 Description of Geographic Study Area

The Over-Ocean Flight Corridor between KTF and RTS is the geographic study area for cumulative impacts from FE-1 and other relevant past, present, and future actions. There has been no known significant change in air quality or biological resources within the Over-Ocean Flight Corridor.

5.4.2.2 Relevant Past, Present, and Future Actions

MMIII ICBM missile testing between Vandenberg AFB, California, and RTS has occurred and will continue to occur on an annual basis. Up to four MM III missile flight tests would be conducted annually through 2030, and four Fuze Modernization flight tests would occur over a four-year period. EAs with FONSIs were prepared for the MMIII missile testing in 2001 and 2004. An additional Supplemental Environmental Assessment is in process for the modification and fuze modernization flight tests through 2030. The trajectory for these flights partially overlaps the Over-Ocean Flight Corridor between KTF and RTS.

In November 2011, the USASMDC/ARSTRAT performed a test flight of the Advanced Hypersonic Weapon (AHW) concept. The test vehicle was launched from the KTF to RTS. The flight path for this flight test was the same as the Over-Ocean Flight Corridor between KTF and RTS for FE-1.

A second US Navy SSP Flight Experiment (FE-2) and possibly a third (FE-3) are being considered as future actions. During the original preparation of the Draft FE-1 EA/OEA, additional flights were not considered as a reasonable future activity. After the public release of the Draft EA/OEA, the DoD and the US Navy SSP made the decision to investigate the possibility of one other flight, or possibly two. Details are not completely firm, but the second flight would probably be substantively similar to FE-1. With regard to a possible third flight, discussions are at least two years in the future and no specifics are currently available. The flight path for FE-2 is anticipated to use the same Over-Ocean Flight Corridor between KTF and RTS as FE-1.

5.4.2.3 Cumulative Impact Analysis

Although there have been several missile flight tests within the same or part of the same Over-Ocean Flight Corridor as FE-1, the majority of these flight test used the STARS boosters or a launch vehicle of comparable size. As shown in section 4.2.1.2, the STARS booster is relatively small and on a global scale the level of emissions from each STARS booster would not be statistically significant. Because the

emissions of HCl, Al₂O₃, and NO_x from each launch of a STARS booster would be relatively small, the air volume over which these emissions are spread is large, the emissions are rapidly dispersed by stratospheric winds, and the length of time between discreet launches is measured in months or years, these missile flight tests within the Over-Ocean Flight Corridor would not have a significant cumulative impact. Therefore, cumulative impacts from the FE-1 flight test and the other evaluated flight tests would not be expected to have a significant impact on the upper atmosphere or stratospheric ozone depletion.

Impacts to biological resources within the Over-Ocean Flight Corridor for the referenced missile flight tests were not identified as being significant. The potential for impacts from noise or direct contact from boosters or other missile components was extremely low given the size of the area, the size of missile components, and the low densities of marine mammals across the corridor.

No past, present, or reasonably foreseeable actions have been identified in the Over-Ocean Flight Corridor that might interact with the affected resource areas of the FE-1 Proposed Action and result in significant cumulative impacts.

5.4.3 USAKA, RMI

5.4.3.1 Illeginni Islet

5.4.3.1.1 Description of Geographic Study Area

The northwest end of Illeginni Islet is the geographic study area for cumulative impacts from FE-1 and other relevant past, present, and future actions. There has been no significant change in cultural resources, biological resources, noise, public health and safety, and hazardous materials and wastes at Illeginni Islet. Although there are Be and DU in the soil at Illeginni Islet from past MMIII RV impacts, analytical results indicate the levels are below USEPA residential regulatory limits. (Robison et al., 2013) The USAPHC Fish Study (2014) noted that "unacceptable cancer risk for Marshallese adults at Illeginni [harbor] is attributable to the pesticide, chlordane." Chlordane is a pesticide used to treat wood and wood structures for control of pests, particularly termites, and is not associated with previous missile flight tests impacting at Illeginni.

5.4.3.1.2 Relevant Past, Present, and Future Actions

MMIII ICBM missile testing between Vandenberg AFB, California, and RTS has occurred and will continue to occur on an annual basis. Up to four MMIII missile flight tests would be conducted annually through 2030, and four Fuze Modernization flight tests would occur over a four-year period. In 2016, USAFGSC determined that land impacts at Illeginni Islet would no longer occur. EAs with FONSI were prepared for the MMIII missile testing in 2001 and 2004. An additional Supplemental Environmental Assessment is in process for the modification and fuze modernization flight tests through 2030. Past RV impacts occurred on Illeginni Islet; future RV impacts would only occur at KMISS. For past flight tests, the impact crater was screened for debris and all other visible debris from around the impact was manually recovered and disposed of in accordance with the UES.

As noted in the section 5.4.2.2, a second US Navy SSP Flight Experiment (FE-2) and possibly a third (FE-3) are being considered as future actions. A second flight would probably be substantively similar to FE-1. Discussions are at least two years in the future regarding a third flight test and no specifics are currently available. The Preferred Alternative impact at Illeginni Islet is anticipated to be the same for FE-2 as for FE-1.

5.4.3.1.3 Cumulative Impact Analysis

MMIII ICBM missile testing from Vandenberg AFB, California, to Illeginni Islet has occurred in the past. Be and DU from past MMIII RV impacts remain in the soil at Illeginni Islet; analytical results indicate the levels are below USEPA residential regulatory limits (Robison et al., 2013). No future MMIII impacts are planned for Illeginni Islet. MMIII flight test have been and will continue to be conducted in accordance with biological opinions from NMFS and USFWS, in addition to program specific DEPs and the UES.

The AHW flight was conducted in accordance with the Illeginni Impacts DEP and the UES. Payload impacts were less than those of the MMIII RVs (USASMDC, 2011). There was no significant impact to resources at Illeginni Islet from the AHW flight test.

For FE-1, a 2008 study of geochemical parameters influencing tungsten mobility in soils (Bednar et al., 2008) found that dissolved tungsten reached equilibrium in soil after approximately 48 hours and mobility decreased by approximately one-half within a 4 month period. The “long term known impact or potential risk” (RMIEPA, 2017) is not conclusively identified in peer reviewed literature. For the US Navy SSP flight test impacts, the bench study and model results indicate levels of tungsten in Illeginni Islet soil would be below the USEPA Residential RSLs (LLNL, 2017) for soil and drinking water (although this area is not designated as potable drinking water) from the end of the flight test to 25 years out, the period for which the model was run.

For potential cumulative effects of tungsten in the soil from a second US Navy SSP flight test, the US Navy anticipates remediation activities could be required after the second flight. The accumulation of tungsten following the two flight test could potentially approach or exceed USEPA Residential RSLs. Sampling and analyses of tungsten and other alloy metals in soil at Illeginni will be conducted prior to and after FE-1 and after the FE-2 flight test. If analyses of FE-2 post-flight test soil samples indicated tungsten levels above RSLs, phytoremediation, using plants to draw up metals from the soil, would be considered, as suggested for consideration by the USEPA. In particular, some ryegrass species can take up tungsten in direct relation to the amount of material in soil (Strigul et al., 2005), i.e., the more material left in the soil, the more is taken up into the plants (Markum and Pessarakli, 2010). Application of this methodology as phytoremediation at Illeginni Islet would introduce an exotic species to the Atoll and present a poor growth environment for ryegrass (i.e., calcareous sand with low organic content and high soluble salt content, heavy rainfall, and high temperatures, at which ryegrass becomes dormant). Any type of remediation would only occur after field-portable elemental analysis such as laser-induced breakdown spectroscopy, or other in-situ detection systems, to determine the level of tungsten remaining in the soil and a need for additional cleanup to bring the concentration of tungsten in soil below the USEPA Residential RSLs. If phytoremediation were employed, following an initial growth period, the plants would be removed and laboratory analyzed to determine their effectiveness. Any plant remains would then be appropriately disposed of as hazardous waste IAW with the UES.

No past, present, or reasonably foreseeable actions have been identified at Illeginni Islet that might interact with the affected resource areas of the FE-1 Proposed Action and result in significant cumulative impacts.

5.4.3.2 Offshore Waters – Southwest and Northeast

5.4.3.2.1 Description of Geographic Study Area

The Offshore Waters impact alternatives are in deep ocean regions southwest of Illeginni Islet and within the KMISS area southeast of Gagan Islet. MMIII ICBM missile testing between Vandenberg AFB, California, and RTS, has occurred.

5.4.3.2.2 Relevant Past, Present, and Future Actions

MMIII ICBM missile testing between Vandenberg AFB, California, and KMISS have occurred and will continue to occur annually. KMISS is the selected site for all future impacts for MMIII.

The KMISS refurbishment replaced failing cabling and hydrophones to re-establish the accuracy required for ICBM testing and improve data collection for programs that may have impacts within the KMISS area. At depth, the ocean bottom consists of soft silt sediment which, when disturbed, tends to rapidly settle from the water column due to a high composition of sand. Biological resource impacts were managed through consultation and coordination with NMFS and USFWS. Although one alternative impact location for the FE-1 flight test is within the KMISS, the Preferred Alternative is to impact on land.

US Navy SSP FE-2 would most likely also consider the Offshore Waters for potential payload impact. As with FE-1, the Preferred Alternative would be a land impact at Illeginni Islet, although this has yet to be determined.

5.4.3.2.3 Cumulative Impact Analysis

The KMISS refurbishment improved data collection for programs that may have impacts within the KMISS area. Although this contributes to the success of missile flight testing, the environmental impact of cable and hydrophone replacements in deep waters would not contribute to cumulative impacts from two US Navy SSP flight experiments. Biological resource impacts from the refurbishment were managed through consultation and coordination with NMFS and USFWS. The bench study and model results (LLNL, 2017) indicate very slow dissolution and passivation (i.e., natural chemical encapsulation) of tungsten from FE-1 may occur in sea water. Although one alternative impact location for the FE-1 flight test is within the KMISS, the Preferred Alternative is to impact on land.

While the effects of tungsten alloys in ecosystems are largely unknown, as noted in the USEPA Technical Fact Sheet for tungsten (2014), with no known studies of marine ecosystems, there are some studies that indicate tungsten exposure may have health impacts. According to the USEPA Technical Fact Sheet, direct occupational exposure is the most common scenario (but which does not apply to the FE-1 flight test conditions) and, “may cause eye and skin irritation, cough, nausea, diffuse interstitial pulmonary fibrosis and changes in blood.” However, the Fact Sheet also states, “Tungsten has not been classified for carcinogenic effects by the Department of Health and Human Services, the International Agency for Research on Cancer or the [US]EPA.”

No past, present, or reasonably foreseeable actions have been identified in the KMISS or southwest BOA that might interact with the affected resource areas of the FE-1 Proposed Action and result in significant cumulative impacts.

6 Other Considerations Required by NEPA

6.1 Consistency with Other Federal, State, and Local Laws, Plans, Policies, and Regulations

In accordance with 40 CFR section 1502.16(c), analysis of environmental consequences shall include discussion of possible conflicts between the Proposed Action and the objectives of federal, regional, state and local land use plans, policies, and controls. Table 6-1 identifies the principal federal and state laws and regulations that are applicable to the Proposed Action, and describes briefly how compliance with these laws and regulations would be accomplished.

6.2 Coastal Zone Management

The federal Coastal Zone Management Act (CZMA) of 1972 establishes a federal-state partnership to provide for the comprehensive management of coastal resources. Coastal states and territories develop site-specific coastal management programs based on enforceable policies and mechanisms to balance resource protection and coastal development needs. The Hawai'i Coastal Zone Management Program lays out the policy to guide the use, protection, and development of land and ocean resources within the state's coastal zone. Under the Act, federal activity in, or affecting, a coastal zone requires preparation of a Coastal Zone Consistency Determination or a Negative Determination. In other words, any federal agency proposing to conduct or support an activity within or outside the coastal zone that will affect any land or water use or natural resource of the coastal zone is required to do so in a manner consistent with the CZMA or applicable state coastal zone program to the maximum extent practicable. However, Federal lands, which are "lands the use of which is by law subject solely to the discretion of...the Federal Government, its officers, or agents," are statutorily excluded from the State's "coastal zone". If, however, the proposed federal activity affects coastal resources or uses beyond the boundaries of the federal property (i.e., has spillover effects), the CZMA Section 307 federal consistency requirement applies. As a federal agency, the Navy is required to determine whether its proposed activities would affect the coastal zone. This takes the form of either a Negative Determination or a Consistency Determination.

Military testing and training at PMRF has been included in a list of US Navy de minimis activities under the CZMA. The Hawai'i Coastal Zone Management Program determined the listed activities "are expected to have insignificant direct or indirect (cumulative and secondary) coastal effects, and should not be subject to further review by the Hawai'i CZM program." (Mayer, 2009).

6.3 Relationship between Short-Term Use of the Environment and Long-Term Productivity

NEPA requires an analysis of the relationship between a project's short-term impacts on the environment and the effects that these impacts may have on the maintenance and enhancement of the long-term productivity of the affected environment. Impacts that narrow the range of beneficial uses of the environment are of particular concern. This refers to the possibility that choosing one development site reduces future flexibility in pursuing other options, or that using a parcel of land or other resources often eliminates the possibility of other uses at that site.

Operations would not significantly impact the long-term natural resource productivity in any of the Proposed Action areas. The Proposed Action would not result in any impacts that would significantly reduce environmental productivity or permanently narrow the range of beneficial uses of the environment.

Table 6-1 Principal Federal and State Laws Applicable to the Proposed Action

<i>Federal, State, Local, and Regional Land Use Plans, Policies, and Controls</i>	<i>Status of Compliance</i>
National Environmental Policy Act (NEPA) (42 U.S.C. section 4321 et seq.); CEQ NEPA implementing regulations (40 CFR parts 1500-1508; Navy procedures for Implementing NEPA ((32 CFR part 775 and OPNAVINST 5090.1D)	Compliant
Clean Air Act (42 U.S.C. section 7401 et seq.)	Compliant
Clean Water Act (33 U.S.C. section 1251 et seq.)	Compliant
Coastal Zone Management Act (16 U.S.C. section 1451 et seq.)	Compliant
National Historic Preservation Act (Section 106, 16 U.S.C. section 470 et seq.)	Compliant
Endangered Species Act (16 U.S.C. section 1531 et seq.)	Compliant
Marine Mammal Protection Act (16 U.S.C. section 1361 et seq.)	Compliant
Migratory Bird Treaty Act (16 U.S.C. sections 703-712)	Compliant
Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (16 U.S.C. section 1801 et seq.)	Compliant
US Public Law 108-188, Compact of Free Association Amendments Act of 2003	Compliant
Executive Order 11988, Floodplain Management	Compliant
Executive Order 12088, Federal Compliance with Pollution Control Standards	Compliant
Executive Order 12114, Environmental Effects Abroad of Major Federal Actions	Compliant
Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations	Compliant
Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks	Compliant
Executive Order 13089, Coral Reef Protection	Compliant
Executive Order 13423, Strengthening Federal Environmental, Energy, and Transportation Management	Compliant
Executive Order 13175, Consultation and Coordination with Indian Tribal Governments	Compliant
Executive Order 13696, Planning for Federal Sustainability in the Next Decade	Compliant

7 References

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Appendix A

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Appendix B

Biological Resources at Kwajalein Atoll

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Table B-1. Fish Species Requiring Consultation (Bold) and Coordination that may Occur near Kwajalein Atoll.

<i>Scientific Name</i>	<i>Common Name</i>	<i>Listing Status*</i>	<i>LoO in deep offshore waters near Kwajalein Atoll**</i>	<i>LoO near Illeginni Islet</i>
<i>Alopias superciliosus</i>	Bigeye thresher shark	ESA-Candidate	P	U
<i>Carcharhinus longimanus</i>	Oceanic whitetip shark	ESA-Candidate	P	U
<i>Cheilinus undulatus</i>	Humphead wrasse	ESA-Candidate, SOSBI	U	L
<i>Manta alfredi</i>	Reef manta ray	ESA-Candidate	P	P
<i>M. birostris</i>	Oceanic giant manta ray	ESA-Candidate	P	U
<i>Sphyrna lewini</i>	Scalloped hammerhead	ESA- Threatened (Indo-West Pacific Distinct Population Segment)	U	P
<i>Plectropomus laevis</i>	Giant coral trout	UES, SOSBI	U	L
<i>Thunnus orientalis</i>	Pacific bluefin tuna	ESA-Candidate	P	U

Sources: USASMDC/ARSTARAT 2014, USAFGSC and USASMDC/ARSTRAT 2015

* Listing Status; ESA: Endangered Species Act, SOSBI: Species of Significant Biological Importance, UES: UES protection (USASMDC/ARSTRAT 2011a Section3-4.5.1)

**LoO – Likelihood of Occurrence; L-Likely; P – Potential; U – Unlikely

Table B-2. Mollusk Species Requiring Consultation (Bold) and Coordination Found at Illeginni Islet during the 2008 and 2010 Biological Inventories of USAKA.

<i>Scientific Name</i>	<i>Common Name</i>	<i>Listing Status</i>	<i>Frequency of Occurrence at Illeginni (n=5)</i>	<i>Frequency of Occurrence Throughout USAKA (n=66)</i>
Class Gastropoda				
Family Trochidae				
<i>Trochus niloticus*</i>	Top shell snail	UES	1.0	0.63
Family Strombidae				
<i>Lambis truncata</i>	Giant spider conch	UES	0.20	0.45
Class Bivalvia				
Family Pteriidae				
<i>Pinctada margaritifera</i>	Black-lipped pearl oyster	UES	0.20	0.10
Family Tridacnidae				
<i>Tridacna gigas</i>	Giant clam	UES	0.20	0.12
<i>T. maxima</i>	Giant clam	UES	1.0	0.69
<i>T. squamosa</i>	Giant clam	UES	0.20	0.23

Sources: USFWS 2011; USFWS and NMFS 2012.

* Synonymous with *Trochus maximus*, *Tectus niloticus*, and *Tectus maximus*.

** UES: UES protection (USASMDC/ARSTRAT 2014, Section3-4.5.1)

Table B-3. Hard Coral Species Requiring Consultation (Bold) and Coordination Observed at Illeginni Islet in 2010 with Frequency of Occurrence at Survey Sites Compared with Atoll-Wide Frequencies.

Scientific Name	Illeginni Frequency (n=4 Sites)	Atoll-Wide Frequency (n=52 Sites)	Number of Islets Observed On (n=11)
Acroporidae			
<i>Acropora abrotanoides</i>	0.50	0.48	9
A. aculeus	0.25	0.06	4
<i>A. austra</i>	0.75	0.67	11
A. aspera*	-	0.23	5
<i>A. cytherea</i>	0.50	0.52	8
A. dendrum	0.25	0.15	7
<i>A. digitifera</i>	0.75	0.88	11
<i>A. gemmifera</i>	1.00	0.77	11
<i>A. granulosa</i>	0.25	0.44	9
<i>A. humilis</i>	1.00	0.83	11
<i>A. hyacinthus</i>	0.50	0.33	7
<i>A. latistella</i>	1.00	0.63	10
A. listeria	-	0.06	3
A. microclados	1.00	0.71	10
<i>A. monticulosa</i>	0.75	0.44	10
<i>A. nasuta</i>	1.00	0.87	11
<i>A. palifera</i>	1.00	0.52	10
A. polystoma*	-	0.02	1
<i>A. robusta</i>	0.50	0.40	7
<i>A. secale</i>	0.25	0.42	10
A. speciosa**	-	-	-
A. tenella	0.25	0.08	2
<i>A. tenuis</i>	1.00	0.75	11
<i>A. valida</i>	0.75	0.63	11
A. vauhani	0.25	0.19	7
<i>Astreopora gracilis</i>	0.25	0.10	6
<i>A. myriophthalma</i>	1.00	0.77	11
<i>A. randalli</i>	0.50	0.12	4
<i>Montipora aequituberculata</i>	1.00	0.77	11
M. caliculata	0.75	0.38	9
<i>M. digitata</i>	0.25	0.29	4
<i>M. floweri</i>	0.25	0.13	7
<i>M. grisea</i>	0.25	0.27	8
<i>M. hoffmeisteri</i>	0.50	0.27	8
<i>M. peltiformis</i>	0.25	0.06	4
<i>M. tuberculosa</i>	0.50	0.54	10
<i>M. verrucosa</i>	0.25	0.27	9
Agariciidae			
<i>Gardineroseris planulata</i>	0.75	0.33	9
Leptoseris incrustans*	-	0.08	3
<i>Pachyseris speciosa</i>	0.25	0.04	3
Pavona cactus*	-	0.31	6
Pavona decussata	1.00	0.08	5
<i>P. maldivensis</i>	0.50	0.31	10
<i>P. varians</i>	1.00	0.90	11
P. venosa	0.25	0.38	10
Astrocoeniidae			
<i>Stylocoeniella armata</i>	0.25	0.08	5
Turbinaria reniformis	0.75	0.15	5
T. stellulata	0.50	0.08	5

Table B-3. Hard Coral Species Requiring Consultation (Bold) and Coordination Observed at Illeginni Islet in 2010 with Frequency of Occurrence at Survey Sites Compared with Atoll-Wide Frequencies.

Scientific Name	Illeginni Frequency (n=4 Sites)	Atoll-Wide Frequency (n=52 Sites)	Number of Islets Observed On (n=11)
Euphyllidae			
<i>Plerogyra sinuosa</i>	0.50	0.08	3
Faviidae			
<i>Cyphastrea agassizi</i>	0.50	0.08	4
<i>Echinopora pacificus</i>	0.25	0.25	7
<i>Favia fava</i>	0.25	0.08	4
<i>F. matthaii</i>	1.00	0.69	10
<i>F. pallida</i>	1.00	0.67	11
<i>F. rotumana</i>	0.50	0.04	3
<i>F. speciosa</i>	0.50	0.31	8
<i>F. veroni</i>	0.25	0.25	8
<i>Favites halicora</i>	0.25	0.50	11
<i>F. pentagona</i>	0.25	0.08	5
<i>Goniastrea edwardsi</i>	1.00	0.69	11
<i>G. pectinata</i>	0.50	0.63	10
<i>G. reniformis</i>	0.25	0.54	10
<i>Leptastrea pruinosa</i>	1.00	0.37	10
<i>L. purpurea</i>	1.00	0.75	11
<i>L. transversa</i>	0.75	0.52	11
<i>Montastrea curta</i>	0.75	0.40	9
<i>Oulophyllia crispa</i>	0.50	0.12	5
<i>Platygyra daedalea</i>	0.75	0.35	9
<i>P. pini</i>	0.75	0.25	9
<i>P. ryukyuensis</i>	0.50	0.04	3
<i>P. sinensis</i>	1.00	0.69	11
Fungiidae			
<i>Ctenactis echinata</i>	0.50	0.15	6
<i>Fungia fungites</i>	1.00	0.75	11
<i>F. granulosa</i>	0.50	0.25	8
<i>F. horrida</i>	0.25	0.12	6
<i>F. paumotensis</i>	0.75	0.56	11
<i>F. repanda</i>	0.50	0.50	11
<i>F. scutaria</i>	0.75	0.50	11
<i>Halomitra pileus</i>	0.50	0.40	10
<i>H. limax</i>	0.75	0.50	11
Helioporidae			
<i>Heliopora coerulea</i>	1.00	0.42	11
Merulinidae			
<i>Hydnophora exesa</i>	0.25	0.10	6
<i>H. microconis</i>	0.50	0.50	10
<i>Merulina ampliata</i>	0.75	0.42	10
<i>Millepora exaesa</i>	1.00	0.92	11
<i>M. platyphylla</i>	0.75	0.33	9
<i>M. tenella</i>	1.00	0.37	9
Mussidae			
<i>Acanthastrea brevis</i>	0.50	0.08	5
<i>A. echinata</i>	0.75	0.13	6
<i>Lobophyllia hemprichii</i>	1.00	0.60	11
<i>L. robusta</i>	0.50	0.25	6
<i>Symphyllia recta</i>	0.75	0.17	6
Oculinidae			

Table B-3. Hard Coral Species Requiring Consultation (Bold) and Coordination Observed at Illeginni Islet in 2010 with Frequency of Occurrence at Survey Sites Compared with Atoll-Wide Frequencies.

Scientific Name	Illeginni Frequency (n=4 Sites)	Atoll-Wide Frequency (n=52 Sites)	Number of Islets Observed On (n=11)
<i>Galaxea horrescens</i>	0.25	0.15	6
Pectiniidae			
<i>Echinophyllia aspera</i>	0.25	0.13	5
Pocilloporidae			
<i>Pocillopora damicornis</i>	0.25	0.73	11
<i>P. eydouxi</i>	1.00	0.96	11
<i>P. meandrina</i>	1.00	0.90	11
<i>P. verrucosa</i>	1.00	0.85	11
<i>P. woodjonesi</i>	0.25	0.15	5
<i>Seriatophora hystrix</i>	0.25	0.29	8
<i>Stylophora pistillata</i>	0.75	0.27	9
Poritidae			
<i>Alveopora verrillana</i>	0.50	0.06	3
<i>Goniopora lobata</i>	0.25	0.08	4
<i>G. minor</i>	0.25	0.29	10
<i>G. norfolkensis</i>	0.50	0.04	2
<i>G. pandoraensis</i>	0.25	0.10	4
<i>G. tenuidens</i>	0.50	0.02	2
<i>Porites cylindrica</i>	0.50	0.42	10
<i>P. lobata</i>	1.00	0.75	11
<i>P. lutea</i>	1.00	0.98	11
<i>P. rus</i>	1.00	0.69	11
<i>P. solida</i>	0.25	0.02	2
Siderastreidae			
<i>Coscinaria columna</i>	0.25	0.10	6
<i>Psammocora haimeana</i>	0.50	0.44	10
<i>P. nierstraszi</i>	0.50	0.27	8
Average Frequency/Number	0.60	0.39	8.07

Source: USFWS and NMFS 2012

* *Acropora aspera*, *A. listeria*, *A. polystoma*, *Leptoseris incrustans*, and *Pavona cactus* were not observed during surveys of Illeginni Islet during 2010, however, these consultation species have been observed on other surveys or have the potential to occur at Illeginni Islet.

Table B-4. Number of Birds Observed on Illeginni Islet during the 1998, 2000, 2002, 2004, 2006, 2008, and 2010 Biological Inventories

Common Name	Scientific Name	Year						
		'98	'00	'02	'04	'06	'08	'10
Great frigatebird	<i>Fregata minor</i>	-	-	-	-	1	-	-
Pacific reef heron	<i>Egretta sacra</i>	11	7	3	6	3	3	2
Pacific golden plover	<i>Pluvialis fulva</i>	59	39	24	27	41	55	15
Wandering tattler	<i>Heteroscelus incanus</i>	6	13	5	7	11	18	7
Gray-tailed tattler	<i>Heteroscelus brevipes</i>	-	-	-	-	-	-	1
Tattler spp.	<i>Heteroscelus</i> spp.	-	4	1	-	-	-	-
Whimbrel	<i>Numenius phaeopus</i>	3	3	4	2	-	4	9
Bristle-thighed curlew	<i>Numenius tahitiensis</i>	-	2	-	-	1	2	-
Godwit Sp.	<i>Limosa</i>	2	-	-	-	-	-	-
Ruddy turnstone	<i>Arenaria interpres</i>	27	3	9	19	57	49	75
Black-naped tern	<i>Sterna sumatrana</i>	8	29	24	11	13	31	1
Great crested tern	<i>Sterna bergii</i>	5	3	2	1	10	4	3
Brown noddy	<i>Anous stolidus</i>	2	4	186	1	36	15	39
Black noddy, adults (nests)	<i>Anous tenuirostris minutus</i>	90	292	135	326 (130)	378	- (339)	108 (30)
White tern	<i>Gygis alba</i>	14	15	4	5	26	14	-

Source: USFWS and NMFS, 2012

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Appendix C

Comments and Responses on Draft EA/OEA

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Appendix D

Tungsten Alloy Bench Study and Model Results Report

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Appendix E

Formal Consultation Under the Environmental Standards for United States Army Kwajalein Atoll Activities in the Republic of the Marshall Islands Biological Opinion

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