



Navy Conventional Prompt Strike Weapon System Flight Tests

Biological Assessment for Activities at Kwajalein Atoll

Final

Prepared for:

Department of the Navy Strategic Systems Programs
and
U.S. Army Space and Missile Defense Command

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Cover images from top left: Hawksbill turtle in Kwajalein lagoon, giant clam (*Tridacna maxima*) oceanside of Kwajalein Islet, giant clam (*Hippopus hippopus*) oceanside of Kwajalein Islet, steephead parrotfish in Kwajalein Lagoon, and Illeginni Islet. All images by Kristin Miller.

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Acronyms and Abbreviations

AUR	All-Up-Round
BOA	Broad Ocean Area
C	Celsius
C-HGB	Common Hypersonic Glide Body
CPS	Conventional Prompt Strike
dB	Decibel(s)
DoD	Department of Defense
DPS	Distinct Population Segment
ESA	Endangered Species Act
F	Fahrenheit
FE-2	Flight Experiment 2
ft	Feet
ft^2	Square Feet
ICBM	Intercontinental Ballistic Missile
KMISS	Kwajalein Missile Impact Scoring System
m	Meter(s)
m^2	Square Meters
MMPA	Marine Mammal Protection Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
PTS	Permanent Threshold Shift
RMI	Republic of the Marshall Islands
RTS	Ronald Reagan Ballistic Missile Defense Test Site
re	Referenced to
TTS	Temporary Threshold Shift
U.S.	United States
U.S.C.	United States Code
UES	United States Army Kwajalein Atoll Environmental Standards
USAKA	United States Army Kwajalein Atoll
USASMDC	United States Army Space and Missile Defense Command
μPa	Micropascal(s)

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1.0 Introduction

1.1 Purpose and Objectives

The purpose of this Biological Assessment is to evaluate the potential effects of proposed Navy Conventional Prompt Strike (CPS) Weapon System Flight Tests (Proposed Action) on species listed as consultation species under the Environmental Standards and Procedures for United States Army Kwajalein Atoll (USAKA) Activities in the Republic of the Marshall Islands (UES), and on designated critical habitat at Kwajalein Atoll, Republic of the Marshall Islands (RMI). The Navy Strategic Systems Programs (the Action Proponent) has prepared this Biological Assessment in accordance with the requirements of Section 3-4 of the UES with support from the U.S. Army Space and Missile Defense Command (USASMDC).

The Proposed Action consists of conducting proposed Navy CPS weapon system (missile) flight tests in both Atlantic and Pacific Ocean regions. Testing would involve up to eight flight test launches per year from various sea-based launch locations conducted over a 10-year period. All flight tests would be at-sea missile tests launched from existing naval vessels operating in Pacific and Atlantic broad ocean areas (BOAs)[1]. After launch, flight tests would include vehicle flight over the Pacific and/or Atlantic Oceans and would involve splashdown of spent boosters and fairings in Pacific and Atlantic BOAs. Navy CPS flight test payloads would impact at either target sites in the BOA or at a land-based target site. Within the RMI, payload target sites include the deep-water Kwajalein Missile Impact Scoring System (KMISS) test range and a land site on Illeginni Islet at the Ronald Reagan Ballistic Missile Defense Test Site (RTS).

Based on preliminary analyses, the Action Proponent determined that proposed Navy CPS flight test activities at Kwajalein Atoll may affect species listed as consultation species under Section 3-4.5.1 of the UES (USASMDC 2021) which includes species also listed under the Endangered Species Act (ESA). Therefore, the Action Proponent has prepared this Biological Assessment to support consultation with the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS), as designated UES Appropriate Agencies, under Section 3-4.5 of the UES (USASMDC 2021).

This Biological Assessment describes proposed Navy CPS flight test activities for the purposes of evaluating the potential effects of the Proposed Action on UES consultation species. A summary of relevant coordination and consultation history with NMFS and USFWS for the Navy CPS action is included in **Section 1.3**, *Coordination and Consultation History*.

[1] For the purposes of the Biological Assessment, BOA is defined as any ocean area that is within the Navy CPS study areas but outside of territorial seas. Under maritime law, territorial seas generally extend seaward up to 22 kilometers or 12 nautical miles from a nation's coastline (NOAA 2023f).

1.2 Regulatory Setting

This Biological Assessment addresses the potential effects of Proposed Action activities at Kwajalein Atoll on UES consultation species in compliance with Section 3-4 of the UES. For the portions of the Proposed Action that would take place in and over U.S. territory or within international waters, a separate biological evaluation has been prepared where necessary to comply with requirements under Section 7 of the ESA. This assessment addresses only the portions of the Proposed Action in and over RMI territory, including territorial waters.

United States Army Kwajalein Atoll Environmental Standards (UES)

The Compact of Free Association between the RMI and the United States (48 United States Code [U.S.C.] Section [§] 1921) requires all U.S. Government activities at U.S. Army Garrison–Kwajalein Atoll (USAG-KA) and all Department of Defense (DoD) and RTS activities in the RMI to conform to specific compliance requirements, coordination procedures, and environmental standards identified in the UES (USASMDC 2021). 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 Action, which could affect Illeginni Islet and the deep ocean waters northeast of Kwajalein Atoll, must comply with the UES (USASMDC 2021).

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, Sections (§§) 17, 23, 402, 424, and 450-452, which include provisions of the ESA (16 U.S.C. §§ 1531-1544) and other regulations applicable to biological resources. Other U.S. statutes embodied in these standards are the Fish and Wildlife Coordination Act (16 U.S.C. §§ 661-666), the Migratory Bird Treaty Act (16 U.S.C. §§ 703-712), and the Marine Mammal Protection Act (MMPA) (16 U.S.C. §§ 1361-1389, 1401-1407, 1538, and 4107). The UES also requires consultation for potential effects on certain species protected by laws of the RMI. The Marshall Islands Marine Resources Authority manages marine resources in the RMI.

The UES contains a requirement that a Biological Assessment must be prepared when a proposed activity may affect a species requiring consultation. For the purposes of this Biological Assessment, a species requiring consultation under the UES is defined as any species listed in the UES Appendix 3-4A (USASMDC 2021), which also includes any candidate species or species proposed for listing under the ESA. The Biological Assessment must contain an analysis that is sufficient to allow the appropriate regulatory agency to prepare a biological opinion or letter of concurrence. According to Section 3-4.5.3(g) of the UES, if NMFS or USFWS prepares a non-jeopardy or non-adverse modification biological opinion, an approved Document of Environmental Protection must be prepared before proceeding with the proposed activity.

1.3 Coordination and Consultation History

Early coordination and pre-consultation with NMFS and USFWS for the Proposed Action was conducted during a series of email communications including:

- 4 October 2023 – Email coordination communications between USASMDC, NMFS, and USFWS with copy to all UES Appropriate Agencies. USASMDC notified agencies of the Proposed Action, provided preliminary conclusions regarding potential effects on UES consultation species, and requested concurrence USASMDC's planned approach for meeting UES consultation requirements. USFWS responded with concurrence that the USASMDC proposed approach to UES consultation was appropriate.

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2.0 Description of the Proposed Action and Action Area

2.1 Description of the Proposed Action

The Proposed Action consists of conducting proposed Navy CPS weapon system (missile) flight tests within broad Atlantic and Pacific Ocean areas. The Proposed Action would include up to eight flight test launches at up to eight different sea-based launch locations per year, conducted over a 10-year period beginning in fiscal year 2025. All flight tests would be at-sea missile tests launched from existing naval vessels operating in Pacific and Atlantic BOAs with ocean-based or land-based payload target locations. A portion of flight tests would include utilization of payload target sites at Kwajalein Atoll in the RMI.

The following subsections summarize the CPS flight test vehicle (**Section 2.1.1**), sea-based launch platforms and support vessels (**Section 2.1.2**), launch preparations and operations (**Section 2.1.3**), downrange preparations and operations (**Section 2.1.4**), the flight test scenario (**Section 2.1.5**), and post-flight test activities (**Section 2.1.6**). Descriptions are intended to give a broad description of the entire Proposed Action with more detailed information provided about activities which would occur at Kwajalein Atoll, as these are the activities evaluated in this Biological Assessment.

2.1.1 CPS Flight Test Vehicle

The proposed CPS flight test vehicle missile body consists of a two-stage booster system and payload adapter. When combined with the payload, the vehicle is referred to as an All-Up-Round (AUR) missile. Shown in **Figure 1**, the AUR missile body is approximately 10 meters (m) (30 feet [ft]) in length and 1 m (3 ft) in diameter.

The AUR first and second stage rocket motors would contain a total of up to 9,000 kilograms (20,000 pounds) of rocket propellant. Other ordnance carried on the test vehicle is a Flight Termination System used only if the vehicle were to deviate from its course or should other problems occur during flight. The Flight Termination System serves as a destruct package that would stop forward thrust when activated, causing the vehicle to terminate flight and fall into the ocean. A list of characteristics for the missile body portion of the AUR is presented in **Table 1**.

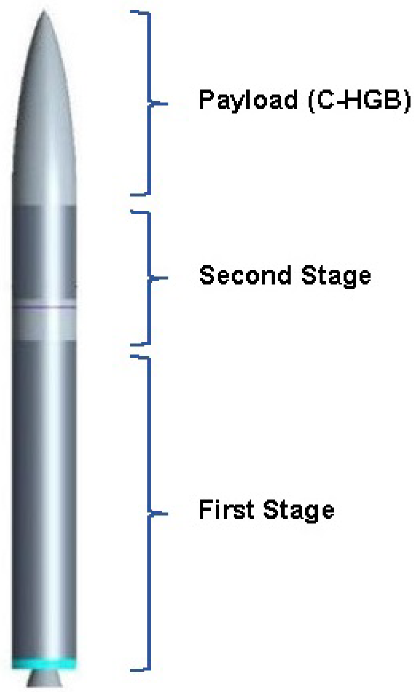

Figure 1. CPS Flight Test Vehicle

Table 1. CPS Missile Body Characteristics

Major Components	Rocket motors, magnesium thorium, nitrogen gas, halon, asbestos
Communications	Various 5- to 20-watt radio frequency transmitters; one maximum 400-watt radio frequency pulse
Power	Up to 9 lithium ion polymer and silver zinc batteries, each weighing between 1 and 18 kg (3 and 40 lb)
Propulsion/Propellant	Rocket propellant and approximately 1 kg (3 lb) of pressurized nitrogen gas
Other	Small electro-explosive devices for the Flight Termination System

Abbreviations: kg = kilogram(s), lb = pound

A Common Hypersonic Glide Body (C-HGB) would be used as the missile payload (**Figure 1**). The C-HGB payload is a hypersonic glider designed to deliver a conventional warhead payload. Once launched and released from the booster system in the upper atmosphere, the C-HGB payload would glide to a predetermined target location without any propulsion. The C-HGB payload would not contain any propellants or radioactive materials. Flight test payloads may be conventional or may be inert and incorporate a mass simulator. A list of characteristics for the C-HGB payload is presented in **Table 2**.

Table 2. CPS Payload Characteristics

Structure	Aluminum, steel, titanium, magnesium and other alloys, copper, fiberglass, chromate coated hardware, tungsten, plastic, Teflon, quartz, silicone
Communications	Two up-to 20-watt radio frequency transmitters
Power	Up to 3 lithium ion polymer batteries and 1 thermal battery, each weighing between 1 and 23 kg (3 and 50 lb)
Propulsion/Propellant	None
Other	Small electro-explosive devices for safety and subsystems operations

Abbreviations: kg = kilogram(s), lb = pound

For safe handling and rapid fielding, the AUR would be encased in a launch canister (**Figure 1**). The function of the canister would be to protect the missile from damage during storage, transport, and loading onto naval vessels[2]; and to help facilitate missile launch.

2.1.2 Sea-Based Launch Platforms and Support Ships

All proposed CPS flight tests would involve AUR launches conducted at sea from several existing naval surface ships and submarines that have been modernized to accommodate the new missile systems and launch canisters. All launches are expected to be conducted from surface and sub-surface firing platforms that are under the control of the Naval Sea Systems Command.

In addition to the sea-based launch platforms, other smaller ships and watercraft would be used in support of the CPS flight tests downrange. These support vessels would host various sensor systems, including telemetry and radar, and support target placement and recovery operations at designated target sites.

2.1.3 Launch Preparations and Operations

The proposed CPS flight tests would occur within the BOAs shown in **Figure 2** for the Atlantic region, and in **Figures 3** and **4** for the Pacific region. Logistical and operational support for the launch vessels would be provided at various naval installations shown in **Figures 2** through **4**. With the exception of Naval Base Ventura County, Point Mugu in California, the launch vessels would be readied for testing at any of these locations prior to departure to a predetermined launch point in the BOA.

[2] For the purposes of this Biological Assessment, the term "vessel" is inclusive of surface ships and submarines.

Figure 2. Atlantic Study Area for CPS Flight Tests

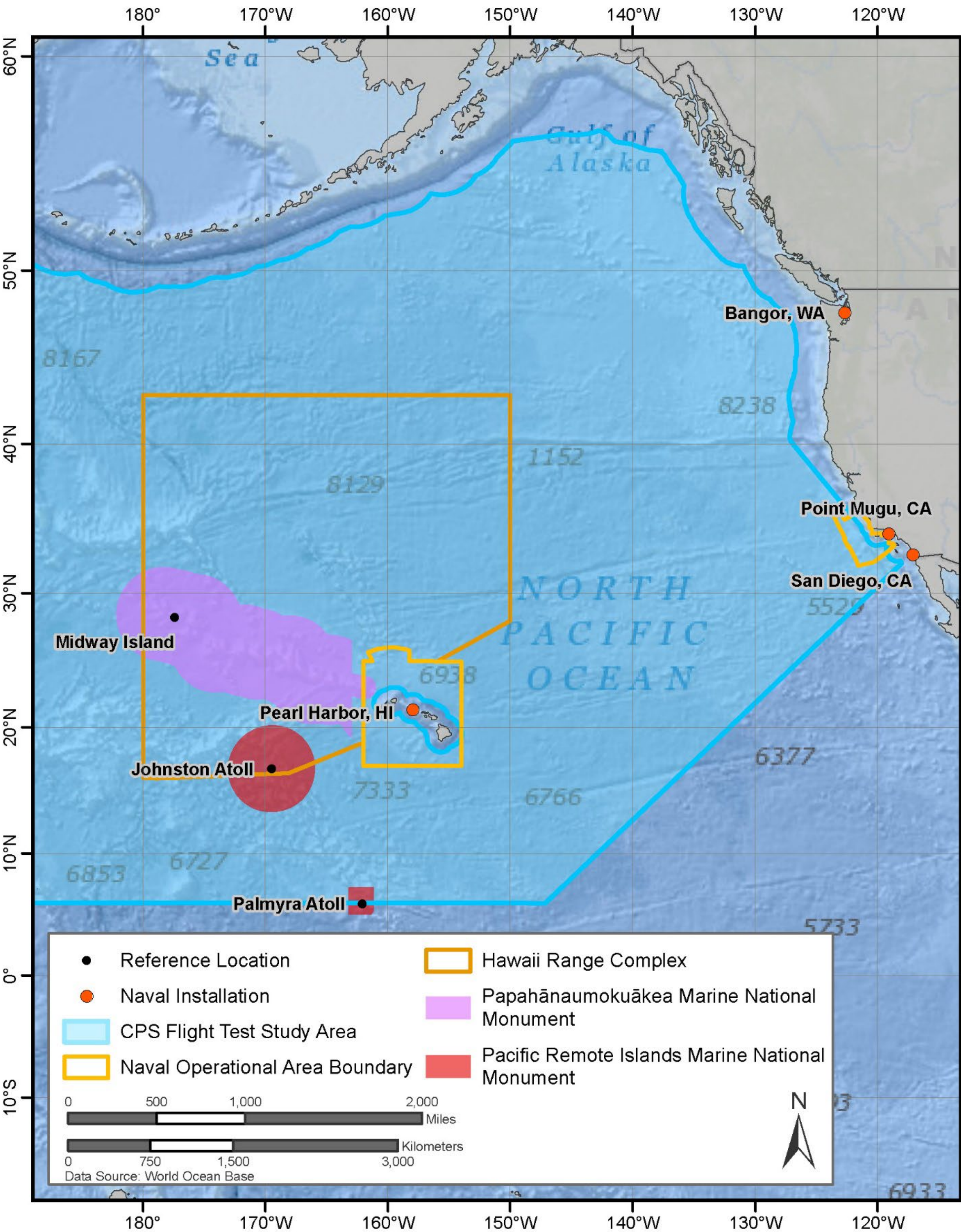

Figure 3. Pacific Study Area (East) for CPS Flight Tests

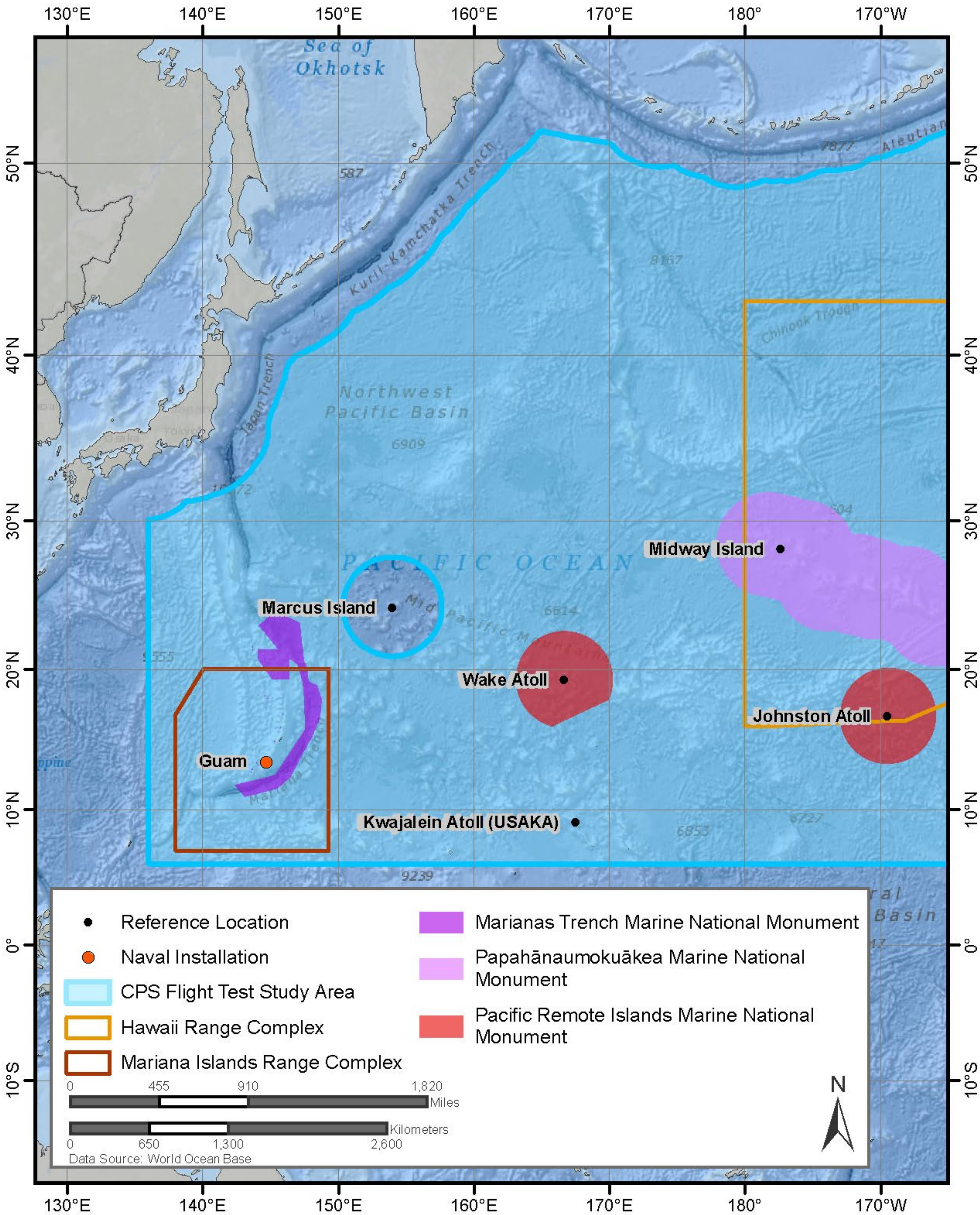

Figure 4. Pacific Study Area (West) for CPS Flight Tests

After a launch platform vessel departs and is in transit to the launch point in the BOA, crew members would conduct basic and routine unit-level activities such as surveillance, training, and vessel maintenance as part of other Navy fleet programs. In all instances, vessels would be operated in accordance with applicable navigation rules, including international laws and regulations, and established standard operating procedures for fleet operations. Personnel are assigned to stand watch at all times, day and night, when vessels are moving through the water (underway) for safety of navigation, collision avoidance, range clearance, and man-overboard precautions. Environmental mitigation measures and standard operating procedures used by the Navy, including adherence to uniform national discharge standards, benefit public health and safety, marine animals, and seafloor resources through identifying potential hazards and reducing the potential for vessel strikes.

In all instances, test vehicle launches would be conducted at least 93 kilometers (50 nautical miles) offshore, usually within the existing naval operating areas, sea ranges, and range complexes shown on **Figures 2** through **4** so as to maximize use of fleet assets. For some tests, however, launches could occur from more distant locations in international waters within the BOAs. No launches would occur within the Marine National Monuments located in the BOAs.

2.1.4 Downrange Preparations and Operations

For each flight test, there would be two to three additional support ships downrange from the launch point serving as host platforms for various sensors including telemetry and radar. Other smaller ships and watercraft would be used in the terminal area to support pre-flight test target placement/set-up, and post-flight test recovery and clean-up activities. Just as for the launch vessels described in **Section 2.1.3**, support ships and watercraft used downrange would operate in accordance with applicable navigation rules and standard operating procedures, including international laws and regulations, and monitor for marine mammals and sea turtles to avoid potential vessel strikes. Prior to downrange Navy support ship and watercraft operations in the BOA, Navy personnel would use the Navy's Protective Measures Assessment Protocol to identify applicable environmental mitigation requirements relating to the test event which minimize potential impacts to protected marine species.

At the terminal end of the CPS flight test would be a target site for the payload. Target sites primarily would be located in the BOA in deep waters. In addition to BOA target sites, one island location in an established range operational area would serve as an occasional land-based target site. Most sea-based target sites would be within existing DoD sea-based ranges and range complexes located away from populated areas. All BOA target sites would be at least 370 kilometers (200 nautical miles) offshore in international waters. These sea-based and land-based target sites are further described in the following sections.

Broad Ocean Area Target Sites

All BOA payload target sites would be at least 370 kilometers (200 nautical miles) offshore in international waters. In preparation for using target sites in the Atlantic and Pacific BOAs, the Navy may place self-stationing instrumented rafts around the targeted site for purposes of measuring and recording the payload ocean impact. Equipped with radar, telemetry, and acoustic and optical sensors, the sensor rafts would use battery powered trolling motors to maintain position; no anchoring systems would be used. Up to 12 sensor rafts would be deployed from a support ship prior to each flight test, which would then depart to a safe zone.

For some target sites in the BOA, a floating target raft may be used. Floating target rafts would be pontoon rafts approximately 3 m wide by 4 m long (11 ft by 13 ft). For flight tests involving a floating target raft, the raft would be deployed from a support ship prior to the fight test and would remain on-station for several hours using small electric motors. Target rafts would include several sensor types and scoring devices.

Kwajalein Missile Impact Scoring System

Another deep-ocean target site being considered is KMISS located just east of Kwajalein Atoll in the RMI (**Figure 5**). KMISS, which is part of RTS, is a deep-ocean range just off of Gagan Islet (**Figure 5**) with depths ranging from 2,100 to 3,700 m (7,000 to 12,000 ft). KMISS uses fixed underwater hydrophones to detect and locate surface impacts of missiles in all weather conditions (USASMDC 2014). KMISS has been used for missile impact scoring for a number of other missile test programs (e.g., U.S. Air Force 2020a, U.S. Air Force 2021, U.S. Army 2021, DON 2019a).

No floating targets or platforms would be used at the KMISS target site.

Land-Based Target Site

There is one Pacific region island proposed as a Navy CPS payload target site: Illeginni Islet located at RTS in the RMI. The land payload target site is included as part of the proposed CPS flight tests so as to collect real-time performance data and critically important post-mission information. The Navy anticipates approximately one land impact per year would occur at Illeginni Islet throughout the flight test program's 10-year period.

The CPS flight test payload target site at Illeginni Islet is an approximate 7.6-acre area on the west end of the islet that includes the islet's helipad (**Figure 6**). This target site on Illeginni Islet has been used as a target site by the U.S. military for various hypersonic missile programs since the early 1990s (U.S. Air Force 2004, U.S. Air Force 2010, U.S. Air Force 2021, USASMDC 2011, DON 2019a). A payload impact within the islet's forested area or in the adjacent reef and shallow waters would be unintentional and is unlikely to occur.

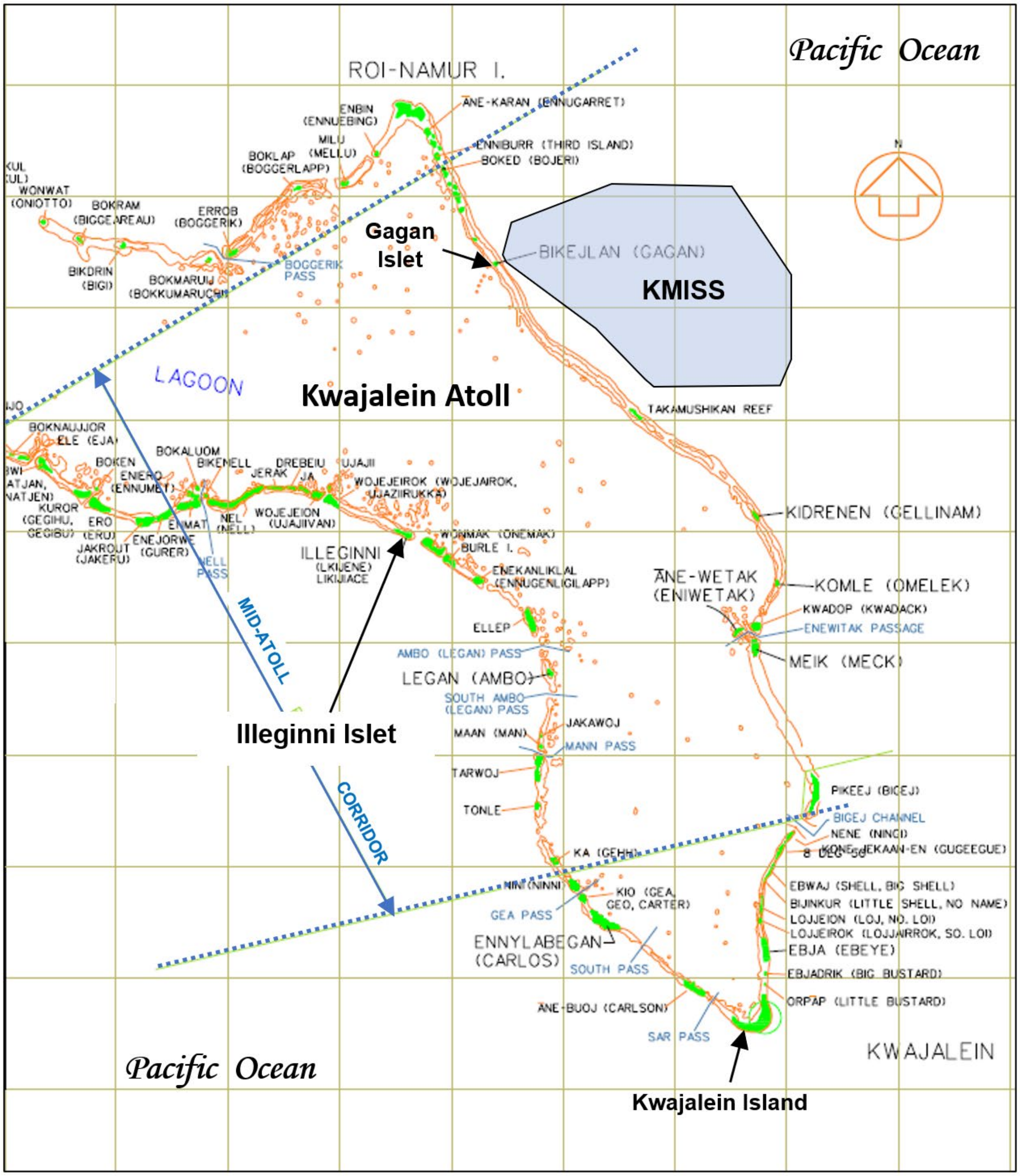

Figure 5. Kwajalein Atoll in the RMI

Figure 6. Illeginni Islet Target Site at Kwajalein Atoll in the RMI

2.1.5 Flight Test Scenario

Once the launch vessel has reached the designated launch point in the BOA and is cleared by range safety to commence testing, the AUR would be launched. During the boost phase following launch of the AUR, the first-stage motor would burn out downrange and separate from the second stage. Farther into flight, the second stage would burn out and separate, then the payload adapter would be jettisoned from the payload. Jettison of the second stage booster and payload adaptor would occur outside the atmosphere. The spent booster stages and payload adapter would splash down in the BOA at different points downrange. All booster and payload adapter splashdown locations would be within the BOAs and would occur at least 370 kilometers (200 nautical miles) offshore of any land areas. The payload would continue flying towards the predesignated sea-based or land-based target site before impact.

The CPS missile flight paths would be designed to avoid Bermuda in the Atlantic, Marcus Island in the Pacific, and any other populated islands. With the exception of the land-based target site, no missile components are expected to splash down or impact within territorial seas or exclusive economic zones. Additionally, the Navy would plan all missile component splashdowns and payload impacts to avoid Marine National Monuments. If flight data were to indicate insufficient energy for the payload to reach the target site, the vehicle could be directed to descend in a controlled termination into the BOA.

2.1.6 Post-Flight Test Activities

Following completion of each CPS flight test, the launch vessel would depart from the launch point and continue normal operations before returning to port. Downrange, sensor support ships would also return to port. Post-flight test activities for each target site are described in the following subsections.

Broad Ocean Area Target Sites

For the sea-based target sites in the BOA, support ships would retrieve instrumented rafts and search for any floating debris before returning to port. All or most of the missile components would be expected to sink to the ocean bottom, including the spent booster stages. Any visible payload or other missile debris found floating would be recovered, as much as practicable.

For those flight tests involving a floating target raft, a support vessel would return to the BOA target site to retrieve the target. It is not planned or expected that target rafts would be sunk during flight test activities. Safety and other test support personnel would: (1) inspect the target raft for any hazards; (2) conduct an impact assessment of the raft and the test support equipment on the raft; and (3) recover any visible C-HGB or other test debris to the extent practicable. The raft would then be loaded onto a support ship for transport back to the appropriate port to remove the equipment, further evaluate damage to the raft, and determine whether the raft can be reused as a target.

Kwajalein Missile Impact Scoring System

Following completion of a flight test at KMISS, a vessel or aircraft from USAG-KA would inspect the ocean payload impact site for any floating debris. Any visible C-HGB payload debris found floating would be recovered, as much as practicable. No debris would be retrieved from the ocean bottom.

Land-Based Target Site

For payload impacts at Illeginni Islet, Navy personnel would arrive via aircraft or surface vessel to first secure the area. The payload impact is expected to form a crater up to several feet in diameter and eject soil over a wide area. At Illeginni Islet, soil containing residual concentrations of beryllium, depleted uranium, and tungsten from prior intercontinental ballistic missile (ICBM) and other flight tests could be scattered over the area (U.S. Air Force 2004, U.S. Air Force 2021, DON 2019b). If necessary for personnel safety, the payload impact site would be wetted with water to stabilize the disturbed soil. Once the site is cleared for safe entry, other test support personnel would conduct an impact assessment of the site, and initiate cleanup and recovery operations. Any visible payload debris would be recovered, as much as practicable. As part of recovery operations, loose soil material may need to be screened in order to retrieve payload debris. The portable sensor equipment brought on island during pre-flight test preparations would also be removed.

At Illeginni Islet, the crater may need to be backfilled and appropriate repairs made to any island structures. In addition, soil and groundwater samples would be taken at Illeginni Islet for testing, as needed, to ensure that concentrations of heavy metals, such as beryllium, uranium (as a surrogate for depleted uranium), and tungsten, do not exceed established UES standards (USASMDC 2021).

While not planned or expected, if a payload were to inadvertently impact outside the island target site in adjacent shallow waters, divers in scuba gear would attempt to recover the debris manually. For an inadvertent impact off Illeginni Islet on the coral 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 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 Navy and USAG-KA representatives, decide on any response measures that may be required (DON 2019b).

2.2 Avoidance, Minimization, and Conservation Measures

Over time and through consultation with NMFS and USFWS on other test program activities, several standard avoidance, minimization, and mitigation measures to minimize the impacts of flight testing on UES protected species and their habitats have been developed. These measures, which would be implemented as part of Navy CPS test program activities at Kwajalein Atoll, are very similar to those implemented for other recent missile test programs with payload impacts at Illeginni Islet (e.g., U.S. Air Force 2021, U.S. Army 2020, DON 2019b, DON 2017a). The following measures would be implemented as part of the Proposed Action at Kwajalein Atoll and would be included in the Document of Environmental Protection for Navy CPS Test Program activities at Kwajalein Atoll:

Marine Mammal and Sea Turtle Monitoring

- During travel to and from payload target sites, including Illeginni Islet, ship personnel would monitor for marine mammals and sea turtles to avoid potential ship strikes. Vessel operators would adjust speed or raft deployment based on the presence of special-status species and on lighting and turbidity conditions.
- A helicopter or fixed-wing aircraft overflight in the vicinity of the KMISS or Illeginni Islet target site would be conducted during the week prior to the test and as close to launch as safely practical to survey for marine mammals and sea turtles. Any sightings or the lack of sightings would be recorded and reported.
- Any marine mammals or sea turtle opportunistic sightings collected during ship travel, overflights, and deployment of sensor rafts in the vicinity of the Illeginni Islet or KMISS target sites would be recorded and reported.
- Pre-flight test monitoring by qualified personnel would be conducted on Illeginni Islet for sea turtles or sea turtle nests. For at least 8 weeks preceding the launch, Illeginni Islet would be surveyed weekly by pre-test personnel for sea turtles, sea turtle nesting activity, and sea turtle nests. If possible, personnel would inspect the area within days of the launch. Sea turtles or sea turtle nest observations near the target site or the lack of observations would be recorded and reported.
- Post-test overflights of the impact area would be conducted to survey for dead or injured cetaceans and sea turtles.
- Although unlikely and unexpected, any dead or injured marine mammals or sea turtles sighted by project personnel would be reported immediately to USASMDC and USAG-KA Environmental Office; USASMDC would as soon as possible, and within 24 hours, inform the RMI Environmental Protection Authority, NMFS, and USFWS. USAG-KA aircraft pilots or vessel operators otherwise operating in the vicinity of the impact and test support areas would also report any opportunistic sightings of dead or injured marine mammals or sea turtles through the aforementioned procedures.
- For all surveys and incidental observations, data would be recorded including location, date, time, species, and number of individuals or reports of no sightings when animals

are not seen on surveys. Observations would be reported to the USAG-KA Environmental Office, the RTS Range Directorate, the Flight Test Operations Director, and USASMDC. USASMDC and the USAG-KA Environmental Office would maintain records of these observations and USASMDC would distribute survey reports to the RMI Environmental Protection Authority, NMFS, and USFWS within 6 months of completion of each fiscal year.

Hazardous Materials Measures

- Vessel and heavy equipment operators would inspect and clean equipment for fuel or fluid leaks prior to use or transport and would not intentionally discharge fuels or waste materials into terrestrial or marine environments.
- Any accidental spills from support equipment operations would be contained and cleaned up and all waste materials would be transported to Kwajalein Islet for proper disposal.
- Response to releases of oil, fuels, and lubricants into the USAKA environment would be in accordance with the Kwajalein Environmental Emergency Plan (UES § 3-6.5.8).
- All equipment and packages/materials shipped from the United States to RTS would be inspected prior to shipment and washed if necessary to prevent the introduction of animals, plants, and seeds.
- Following an Illeginni Islet land-impact test, soil and groundwater samples would be collected at various locations around the payload impact site and samples would be tested for metals (not limited to, but including arsenic, barium, cadmium, chromium, and lead). Testing results exceeding the UES standards would trigger an immediate investigation of the soil on Illeginni Islet, as detailed in the UES § 3-6.5.8. Coordination would be initiated with the Defense Program, USASMDC, RMI Environmental Protection Authority, and the other UES Appropriate Agencies to determine the scope and methods/procedures to be followed during the investigation and any subsequent soil removal or other remediation activities.
- Following completion of a flight test at KMISS, a vessel or aircraft from USAG-KA would inspect the ocean impact area for any floating debris. Any visible debris found floating would be recovered, as much as practicable.

Reef Protection Measures

- To avoid impacts on coral heads in waters near Illeginni Islet, sensor rafts would be located in waters at least 3 m (10 ft) deep.
- When feasible, within 1 day after the land impact test at Illeginni Islet, USAKA RTS environmental staff would survey the islet and the near-shore waters for any injured wildlife, damaged coral, or damage to sensitive habitats (i.e., reef habitat). Any impacts to biological resources would be reported to the UES Appropriate Agencies via USASMDC, with USFWS, RMI Environmental Protection Authority, and NMFS offered the opportunity to inspect the impact area to provide guidance on mitigations.

- 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 NMFS, USFWS, and RMI Environmental Protection Authority would be offered the opportunity 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 RTS representatives, decide on any response measures that may be required.
- In the event of a payload impact that affects the reef, personnel would secure or remove from the water any substrate or coral rubble from the ejecta impact area that may become mobilized by wave action.
- If any man-made debris were to enter the marine environment and divers were 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.

General Measures at Illeginni Islet

- When feasible, within 1 day after the land impact test at Illeginni Islet, USAKA RTS environmental staff would survey the islet and the near-shore waters for any injured wildlife or damage to sensitive habitats (i.e., sea turtle nesting habitat). Any impacts to special-status biological resources would be reported to the UES Appropriate Agencies via USASMDC, with USFWS, RMI Environmental Protection Authority, and NMFS offered the opportunity to inspect the impact area to provide guidance on mitigations.
- Debris recovery and site cleanup would be performed for the land impact. To minimize long-term risks to marine life, all visible project-related man-made debris 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.
- During post-test recovery and cleanup, should personnel observe highly mobile endangered, threatened, or other species requiring consultation moving into the area, work would be delayed until such species are out of harm’s way or leave the area of their own volition.
- Test personnel would be briefed on Best Management Practices and conservation requirements and the requirement to adhere to them during test activities.

2.3 Description of the Action Area

The Action Area for this Biological Assessment is the terminal end of Navy CPS test flights within RMI territory, including the payload target sites at Illeginni Islet and in the KMISS area (**Figures 5** and **6**) which are part of USAKA. Only CPS downrange activities at Kwajalein Atoll are described and analyzed in this Biological Assessment. The potential effects of CPS flight test activities in locations outside of RMI territory on protected species (including those listed as threatened and endangered under the ESA) are described and analyzed in separate documents.

Centrally located within the RMI, USAKA consists of all or portions of 11 out of 93 coral islets that make up Kwajalein Atoll and enclose a large lagoon. Since the late 1950s, USAKA has served as a primary site for flight testing ICBMs, sea-launched ballistic missiles, antiballistic missiles, and hypersonic glide bodies. At USAKA, USAG-KA and RTS support flight test programs by providing tracking, sensing, and other technical and logistical support, typical of everyday operations there. An extensive array of missile tracking radars, optical sensors, and meteorological equipment are located on several of the USAKA islets. Depending on mission requirements, other auxiliary sea-based, aircraft-based, and satellite-based sensors (optical and radar systems) may be involved in tracking missiles and collecting data. Test support is provided primarily by existing Government personnel and contractors based at USAG-KA and is part of ongoing USAG-KA and RTS operations there.

KMISS is part of RTS and is a deep-ocean range 6 to 16 kilometers (3 to 9 nautical miles) east of Gagan Islet (**Figure 5**) with ocean depths ranging from 2,100 to 3,700 m (7,000 to 12,000 ft) (USASMDC 2014). KMISS includes a series of fixed underwater hydrophones, originally installed in 1996, to detect and locate surface impacts of missiles in all weather conditions (USASMDC 2014). The KMISS sensor system was recently refurbished and continues to be used routinely for missile impact scoring for DoD missile test programs (e.g., U.S. Air Force 2020a, U.S. Air Force 2021, U.S. Army 2021, DON 2019a).

Illeginni Islet is one of the 11 Kwajalein Atoll islets leased to the United States for USAG-KA and RTS operations (**Figure 6**). Located on the west-central side of the atoll, Illeginni Islet is 31 uninhabited acres of land area with several buildings (some abandoned), towers, roadways, a helipad, and a dredged harbor area. The small islet has been used as a target testing site by the U.S. military for various hypersonic missile programs since the early 1990s (e.g., U.S. Air Force 2004, U.S. Air Force 2010, U.S. Air Force 2021, USASMDC 2011, DON 2019a). Illeginni Islet has a harbor with a pier used for vessel access and loading and unloading of equipment and also has a helipad on the western end of the islet (**Figure 6**).

3.0 Listed Species and Designated Critical Habitat in the Action Area

This section includes the species listed as consultation species under Section 3-4 of the UES that occur or have the potential to occur in the Kwajalein Atoll portion of the Action Area and may be affected by the Proposed Action (**Table 3**). To determine whether the Proposed Action may affect these species or the habitats on which they depend, each species or habitat was evaluated based on the potential for exposure and response to Proposed Action stressors. No critical habitat has been designated in the RMI; therefore, no designated critical habitat occurs in the Action Area.

Because the Action Area at Kwajalein Atoll is the same for many DoD test programs, a regularly updated document detailing the baseline conditions at sites used for DoD testing at Kwajalein Atoll is maintained by USASMDC contractors (**Appendix A**). This document includes species descriptions for species listed as consultation species in the UES (USASMDC 2021) in the Action Area as well as descriptions of the most recent survey data available for these species at USAKA. Rather than include detailed species descriptions and baseline conditions in this section, the baseline conditions document is provided in **Appendix A**. For each species in **Table 3**, **Appendix A** provides the listing status, a general description, the known distribution, threats to, and population of each species in the Action Area.

Table 3. Species in the Action Area Requiring Consultation under the UES that May Be Affected by the Proposed Action

Scientific Name	Common Name	UES Consultation Species Listing Status [1]			
		ESA	MMPA	RMI Statute	UES 3-4.5.1(a)
Marine Mammals					
Balaenoptera musculus	Blue whale	E	Migratory	1	
Balaenoptera physalus	Fin whale	E	Migratory		
Delphinus delphis	Short-beaked common dolphin			2	
Feresa attenuata	Pygmy killer whale		Resident		
Globicephala macrorhynchus	Short-finned pilot whale		Migratory		
Grampus griseus	Risso's dolphin		Resident		
Kogia breviceps	Pygmy sperm whale		Migratory		
Megaptera novaeangliae	Humpback whale (Western North Pacific DPS) [2]	E [2]	Migratory		
Mesoplodon densirostris	Blainville's beaked whale		Migratory		
Orcinus orca	Killer whale		Resident		
Peponocephala electra	Melon-headed whale		Resident		
Physeter macrocephalus	Sperm whale	E	Resident	1	
Stenella attenuata	Pantropical spotted dolphin			2	
Stenella coeruleoalba	Striped dolphin			2	
Stenella longirostris	Spinner dolphin		Resident	2	
Tursiops truncatus	Bottlenose dolphin		Resident		

Scientific Name	Common Name	UES Consultation Species Listing Status [1]			
		ESA	MMPA	RMI Statute	UES 3-4.5.1(a)
Reptiles					
Chelonia mydas	Green turtle (Central West Pacific DPS)	E		1,3	
Eretmochelys imbricata	Hawksbill turtle	E		3	
Fish					
Alopias superciliosus	Bigeye thresher shark				x
Carcharhinus longimanus	Oceanic whitetip shark	T			
Cheilinus undulatus	Humphead wrasse				x
Mobula alfredi [3]	Reef manta ray [3]				x
Mobula birostris [3]	Oceanic giant manta ray [3]	T			
Sphyrna lewini	Scalloped hammerhead (Indo-West Pacific DPS)	T			
Thunnus orientalis	Pacific bluefin tuna				x
Corals					
Acropora microclados	Strawberry shortcake *Acropora*				x
Acropora polystoma					x
Cyphastrea agassizi	Agassiz's coral				x
Heliopora coerulea	Blue coral				x
Pavona venosa					x
Turbinaria reniformis	Yellow scroll coral				x
Mollusks					
Hippopus hippopus	Giant clam	C			
Rochia nilotica [4]	Top shell snail [4]			3	
Tridacna squamosa	Giant clam	C			

Sources: USASMDC 2021, NOAA 2023a

Notes:

1 UES Consultation Species Listing Status based on Appendix 3-4A of the UES (USASMDC 2021).
RMI Statutes: 1 = Endangered Species Act 1975, Title 8 MIRC Chapter 3; 2 = Marine Mammal Protection Act 1990, Title 33 MIRC Chapter 2; 3 = Fisheries Act 1997, Title 51 MIRC Chapter 2
UES Section 3-4.5.1(a): X = Contained in RMI Environmental Protection Agency letter, 12 March 2015, or RMI Environmental Protection Agency letter, 28 September 2016

2 The DPSs of humpback whales likely in the Action Area (Oceania DPS) are not listed under the ESA; however, there is some uncertainty about which DPS whales in the Action Area belong to (see **Appendix A**).

3 Within the UES the manta rays are listed as consultation species under the names *Manta alfredi* and *Manta birostris*. Most biological authorities currently place both the reef manta ray and the oceanic giant manta ray within the genus *Mobula*.

4 Within RMI legislation *Tectus niloticus* is inclusive of *Trochus maximus*, *Trochus niloticus*, and Tectus maximus. Most biological authorities currently synonymize all of these under the name *Rochia nilotica*.

Abbreviations: C = Species is a candidate for listing under the ESA, DPS = Distinct Population Segment, E = ESA Endangered, ESA = U.S. Endangered Species Act, MMPA = Marine Mammal Protection Act, T = ESA Threatened, UES = United States Army Kwajalein Atoll Environmental Standards (USASMDC 2021 Section 3-4.5.1).

3.1 Marine Mammals

Sixteen cetacean species protected under the UES have the potential to occur in deeper waters of the Action Area (**Table 3**) including at KMISS. Four of these species are listed under the ESA. All marine mammals discussed in this section are also protected under the MMPA (16 U.S.C. § 1361 et seq.). Most of the cetacean species listed in **Table 3** have been observed in the RMI (Miller 2023). For other species such as pygmy killer whale (*Feresa attenuata*), Risso's dolphin (*Grampus griseus*), pygmy sperm whale (*Kogia breviceps*), and Blainville's beaked whale (*Mesoplodon densirostris*), potential presence in the Action Area is based on information regarding life history, including feeding patterns, known distribution, and migration patterns, as well as range distribution form the literature sources (NOAA 2023a, Reeves et al. 2002, Perrin et al. 2002). The dugong (*Dugong dugong*) may have occurred historically at Kwajalein Atoll according to an appendix of the UES. However, because this species has not been reported in the vicinity of the Action Area for many decades, it would not be affected by the Proposed Action and is not included in this Biological Assessment.

Species descriptions of marine mammals in the Action Area (**Table 3**) as well as a summary of threats to cetaceans, including the potential impacts of noise exposure, are included in **Appendix A**.

3.2 Reptiles

The only sea turtle species with the potential to be present in the Kwajalein Atoll portion of the Action area are green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) turtles (**Table 3**). Both of these species are listed under the ESA and are UES consultation species. Species descriptions for these turtles are included in **Appendix A** along with a summary of threats to sea turtles and a summary of sea turtle hearing. These species have the potential to occur in waters of Kwajalein Atoll but also have the potential to haul out or nest on land at Illeginni Islet. While suitable sea turtle nesting and haulout habitat occurs on Illeginni Islet (**Figure 7**), no sea turtle nests or nesting activity has been observed on Illeginni Islet in over 25 years (since 1996) (USFWS 2021, NMFS and USFWS 2012).

3.3 Fishes

The marine environment of the Action Area provides a diversity of fish habitat including many reef habitats typical of atolls in the central Pacific, protected lagoon habitats, and deeper ocean habitats surrounding Kwajalein Atoll. Seven species of fish that require consultation under the UES have the potential to occur in the Action Area (**Table 3**). The bigeye thresher shark (*Alopias superciliosus*), oceanic whitetip shark (*Carcharhinus longimanus*), oceanic giant manta ray (*Mobula birostris*), and Pacific bluefin tuna (*Thunnus orientalis*) are primarily open ocean species and have the potential to occur in deep ocean waters of Kwajalein Atoll, including KMISS. Relatively little is known about scalloped hammerhead sharks (*Sphyrna lewini*), but this species does have an affinity for coastal environments where it is known to give birth to live young. Juvenile scalloped hammerheads are known to occur in relatively shallow nearshore

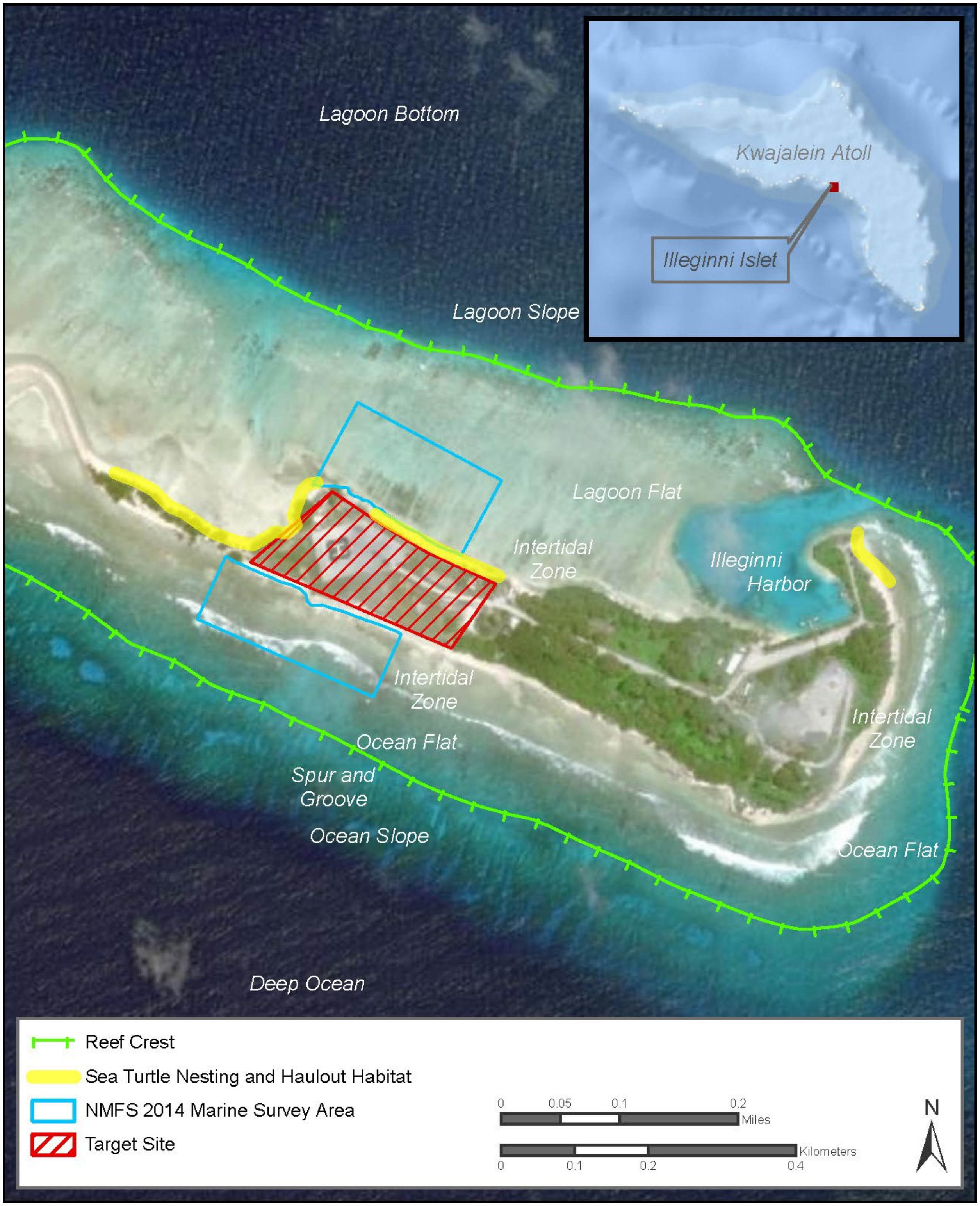

Figure 7. Marine Habitats and Survey Areas at Illeginni Islet, Kwajalein Atoll

waters, and adults are known to occur in deeper coastal waters. This species may be found in both nearshore and deeper ocean waters of Kwajalein Atoll. The reef manta ray (*Mobula alfredi*) is a shallow water species found primarily in or near reef habitats. Reef manta rays have the potential to occur in the deeper waters of Kwajalein Atoll at KMISS but are more likely to be present in waters near Illeginni Islet. The humphead wrasse (*Cheilinus undulatus*) is reef-associated and found in reef habitat throughout Kwajalein Atoll including the waters surrounding Illeginni Islet.

Species descriptions for the UES consultation fishes in the Action Area (**Table 3**) are included in **Appendix A** along with a summary of threats to fish and a summary of fish hearing abilities.

3.4 Corals

The marine environment surrounding Illeginni Islet supports a community of corals that is typical of reef ecosystems in the tropical insular Pacific. In 2014, NMFS surveyed the reef habitats offshore of the payload target site at Illeginni Islet (**Figure 7**) (NMFS-PIRO 2017a). Based on these NMFS surveys (NMFS-PIRO 2017a), six UES consultation coral species (*Acropora microclados*, *Acropora polystoma*, *Cyphastrea agassizi*, *Heliopora coerulea*, *Pavona venosa*, and *Turbinaria reniformis*) occur in reef habitats offshore of the payload target site on Illeginni Islet and have the potential to be subject to the effects of the Proposed Action as adults (**Table 3**). Descriptions of these six UES consultation coral species can be found in **Appendix A** along with a summary of coral characteristics, threats to corals, and coral reproduction in the Action Area. An additional 15 UES consultation species have the potential to occur in the Action Area as larvae (see **Table 4** and **Appendix A**).

Generally, coral cover and diversity near Illeginni Islet are moderate to high on the lagoon reef slopes and around to the southern and western seaward reef crest and slopes, while abundance and diversity appear lower off the seaward northwestern side of the islet. Offshore of the Illeginni Islet target site, deeper ocean-side habitats (up to 4 m or 13 ft) include raised limestone plateaus which are highly colonized by corals separated by deep coral and cobble valleys (NMFS-PIRO 2017a). Shallower ocean-side habitats include areas with high coral colonization as well as an area that is primarily pavement and cobble with small patches of coral (NMFS-PIRO 2017a). Habitats on the lagoon side of the target site have less coral cover, mostly consisting of small scattered coral aggregates with some large patches of *Montipora digitata* (NMFS-PIRO 2017a). Illeginni Harbor has a sandy bottom with dense seagrass beds but supports a diversity of coral species on both the wall and bottom habitats including nine consultation coral species (see Table 5 in **Appendix A**) (NMFS and USFWS 2018).

All shallow-water corals of the Marshall Islands are found throughout much of the insular Pacific and the coral triangle (i.e., the area surrounding Indonesia and the Philippines) (Sakashita and Wolf 2009). No known shallow-water coral species are endemic to the Marshall Islands. Within Kwajalein Atoll, all coral species found at Illeginni Islet during the NMFS and USFWS biennial inventories are found on at least three other Kwajalein Atoll islets (n = 11 islets) (Table 6 in

Appendix A) and at other locations in the Marshall Islands (Beger et al. 2008, Pinca et al. 2002, NMFS and USFWS 2012).

No adults of UES consultation coral species are known to occur in the KMISS portion of the Action Area. Deep-water corals may occur in these areas; however, based on the water depth, corals in these areas would likely be UES coordination species and not consultation species.

Coral Species Not Affected

The Proposed Action has the potential to affect coral species by direct contact from impact debris or ejecta from crater formation on land, by shock waves from impact, or through human activity and equipment operation. These activities would only have the potential to affect adult coral colonies in habitats near the payload target site on and in habitats within up to 91 m (300 ft) of Illeginni Islet.

Only six UES consultation coral species have been recorded as adults in the area of potential effect offshore of Illeginni Islet (**Table 3**). The other 15 UES consultation species with the potential to occur in the Action Area (**Table 4**) are only likely to occur in the Action Area as gametes or larvae. Four of these species, *Acropora tenella*, *Acropora vaughani*, *Leptoseris incrustans*, and *Pavona cactus*, occur on lower reef slopes which occur well below areas that may be affected by proposed CPS activities, and for this reason, adults would not be adversely affected by the Proposed Action.

Two other species are only known to occur in Illeginni Harbor, *Pavona decussata* and *Acropora aspera*, and are not known or expected to be near the potential exposure area where debris deposition or shockwaves might occur. No modifications to Illeginni Harbor would be required for proposed Navy CPS activities. Illeginni Harbor is routinely used for docking of support vessels for ongoing DoD testing activities. The coral species that occur in Illeginni Harbor exist there under the baseline conditions of routine USAG-KA vessel traffic (established over the past decades) and proposed activities would not change those baseline conditions. Therefore, proposed flight test support activities involving vessels would not affect consultation species in Illeginni Harbor.

The other species listed in **Table 4** have either not been recorded near Illeginni Islet or have been recorded at other locations near Illeginni Islet but have not been recorded in the area potentially affected by impact debris or shock waves (NMFS-PIRO 2017a). Adults of the species listed in **Table 4** are not expected to be exposed to stressors related to proposed payload impacts or other flight test support activities and would not be affected by the Proposed Action.

Table 4. Consultation Coral and Mollusk Species Not Affected by the Proposed Action

Scientific Name	Common Name
Corals	
Acanthastrea brevis	Starry cup coral
Acropora aculeus	Bottlebrush *Acropora*
Acropora aspera	Green staghorn coral
Acropora dendrum	
Acropora listeri	
Acropora speciosa	
Acropora tenella	
Acropora vaughani	
Alveopora verrilliana	
Leptoseris incrustans	Swelling coral
Montipora caliculata	
Pavona cactus	
Pavona decussata	Leaf or cactus coral
Turbinaria mesenterina	Vase coral
Turbinaria stellulata	Disc coral
Mollusks	
Pinctada margaritifera	Black-lipped pearl oyster
Tridacna gigas	Giant clam

At various times of the year the gametes (eggs and sperm) and larvae of reef-associated invertebrates may occur in ocean 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 in the Action Area, especially for UES consultation species, are likely to be very low except during peak spawning when density may be high over the reef for a short period of time. Only up to one flight test per year would involve impact on Illeginni Islet and a shoreline payload impact is not planned or expected. There is a small possibility that tests might introduce debris into nearshore reef habitats, and the reef area with the potential to be impacted is a small portion of the reef area at Illeginni Islet and throughout Kwajalein Atoll. Therefore, the Proposed Action would have no effect on gamete or larvae concentrations of UES consultation coral species.

3.5 Mollusks

Five mollusk species that require consultation under the UES have the potential to occur in the Action Area. The Proposed Action has the potential to affect mollusk species by direct contact from impact debris or ejecta from crater formation on land, by shock waves from impact, or through human activity and equipment operation. These activities would only have the potential to affect adult mollusks in habitats offshore of the payload target site on Illeginni Islet.

In 2014, NMFS surveyed the reef habitats offshore of the target site at Illeginni Islet (**Figure 7**) (NMFS-PIRO 2017b). Based on these NMFS surveys (NMFS-PIRO 2017b), only three UES consultation mollusk species (*Hippopus hippopus*, *Rochia nilotica*, and *Tridacna squamosa*) (**Table 3**) are likely to occur in the area offshore of Illeginni Islet where adults would have the potential to be subject to the effects of the Proposed Action. Two additional UES consultation species, *Pinctada margaritifera* and *Tridacna gigas* (**Table 4**), are unlikely to occur in the area of potential effect offshore of Illeginni Islet as adults. Descriptions of these UES consultation mollusk species and their distribution in the Action Area can be found in **Appendix A**.

All of the UES consultation species with the potential to occur in the Action Area are fairly widespread in Kwajalein Atoll. During surveys of Kwajalein Atoll since 2010, all of the species listed in **Table 3** and **Table 4** have been observed in waters offshore of at least 8 of 11 surveyed islets and all have been observed at multiple sites in the mid-atoll corridor (see Table 8 in **Appendix A**).

No UES consultation mollusk species are known to occur in the KMISS deep water payload target site as adults.

Mollusk Species Not Affected

Pinctada margaritifera and *Tridacna gigas* have not been recorded in the area of potential effect offshore of Illeginni Islet and are not likely to occur in the area as adults. Adults of these species are not expected to be exposed to stressors related to the payload impact and would not be affected by the Proposed Action.

The black-lipped pearl oyster (*Pinctada margaritifera*) has been observed on the lagoon-side reef slope during biennial resource surveys at Illeginni Islet (see Table 8 in **Appendix A**). Since *Pinctada margaritifera* is a reef slope dwelling species, it occurs below the areas that have the potential to be affected by Proposed Action payload impacts at Illeginni islet. Therefore, this species would not be affected by direct contact or any other Proposed Action stressors.

The giant clam *Tridacna gigas* has been observed at biennial survey locations at Illeginni Islet and throughout Kwajalein Atoll (see Table 8 in **Appendix A**). This species was observed at all surveyed Kwajalein Atoll islets since 2010 but had a relatively low distribution at these islets; being found at only 22% of surveyed sites (28 of 125). While *Tridacna gigas* was found at 40% of sites (2 of 5) at Illeginni Islet, including at a lagoon reef crest site and in Illeginni Harbor, this species has not been observed in habitats near the proposed payload target site (NMFS-PIRO 2017a and 2017b). No modifications to Illeginni Harbor would be required for proposed Navy CPS activities. Illeginni Harbor is routinely used for docking of support vessels for ongoing DoD testing activities. The mollusk species that occur in Illeginni Harbor exist there under the baseline conditions of routine USAG-KA vessel traffic (established over the past decades) and proposed activities would not change those baseline conditions. Therefore, proposed flight test support activities involving vessels would not affect consultation species in Illeginni Harbor. Since adults of this species are not known to occur in the area potentially affected by direct contact and vessel activity in Illeginni Harbor would have no effect on mollusks, *Tridacna gigas* would not be affected by the Proposed Action.

Larvae of all the mollusk species listed in **Table 3** and **Table 4** have the potential to occur in the Action Area; however, the Proposed Action would not affect larval concentrations at Kwajalein Atoll and would have no effect on these species. Giant clams (*Hippopus* and *Tridacna* species) are synchronous spawners where release of sperm is triggered by the presence of a spawner with ripe eggs (Munro 1993). Due to the limited time frame of gamete viability (viable up to 8 hours in *Tridacna squamosa* but fertilization success decreased within hours of spawning [Neo et al. 2015]), viable gametes are not likely to be found far from adult clams. Giant clam larvae are considered the dispersal phase where ambient currents and larval swimming speed influence long-distance dispersal (Neo et al. 2015). This longer-distance dispersal is limited by the time period during which larvae are able to survive before settlement/recruitment. For most giant clam species, the period from spawning to settlement is approximately 14 days (Ellis 1997, Neo et al. 2015). Black-lipped pearl oysters are also broadcast spawners, producing 40-50 million eggs per female (Thomas et al. 2014). First-stage larvae form within 24 hours of fertilization and the pelagic larval stage lasts for 15 to 30 days before larvae metamorphose and settle to the bottom (Thomas et al. 2014). Top shell snails (*Rochia nilotica*) females release more than 1 million eggs (SPC 2016) and pelagic larvae are free-swimming for at least 3 to 5 days before metamorphosis and subsequent settlement on substrate (SPC 2016). Due to the short time between fertilization and settlement in these mollusk species and their time-limited dispersal capability, the abundance of mollusk larvae (especially viable larvae) is likely extremely low in the Action Area. Since proposed flight tests are discrete events, most flight tests utilizing USAKA would have payload impact in deep ocean waters, and proposed support activities in the marine environment are limited, the Proposed Action would have no effect on gamete or larvae concentrations of UES consultation mollusk species.

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4.0 Effects of the Proposed Action

This section describes how the Proposed Action has the potential to directly or indirectly affect listed species, their habitats, and designated critical habitats. Direct effects are the immediate effects of the Proposed Action on species, their habitats, or designated critical habitat. Indirect effects are effects of the Proposed Action which occur at a later point in time. The following describes the elements of the Proposed Action that may act as stressors on UES consultation species and provides an analysis of the effects of those stressors on those species. No critical habitat has been designated in the RMI; therefore, no designated critical habitat occurs in the Action Area and there would be no effects to critical habitat. Many of the stressors for the Proposed Action at Kwajalein Atoll are of the same type and magnitude as other recent test programs; therefore, portions of the Flight Experiment-2 (FE-2) Biological Assessment (DON 2019b), the Minuteman III Modification Biological Assessment (U.S. Air Force 2015), the Ground Based Strategic Deterrent Biological Assessment (U.S. Air Force 2020b), and the NMFS Biological Opinions on those actions (NMFS 2015a, NMFS 2019, NMFS 2021a) are excerpted and used in this document where relevant.

The Proposed Action has the potential to directly or indirectly affect UES listed species and their habitats due to the following stressors: elevated sound pressure levels; direct contact and shock waves; exposure to hazardous materials; disturbance due to human activity or equipment operation; and vessel traffic. The potential stressors for UES consultation species in the Action Area are described in this section and summarized in **Table 5**. The effects of the Proposed Action stressors are evaluated for each species or for a group of species (i.e., cetaceans) where the effects are expected to be essentially identical for all species within a group.

As stated previously, proposed Navy CPS flight test activities at Kwajalein Atoll are very similar to those of past and ongoing flight test programs conducted by the Navy, Army, and Air Force. For more than 25 years, Kwajalein Atoll has been the terminal location for ICBM and other flight tests. Vehicle impacts from these tests have occurred and continue to occur on and in the vicinity of Illeginni Islet and in ocean waters at KMISS. All U.S. Government activities that occur on USAG-KA and RTS controlled islands, the Kwajalein Mid Atoll Corridor, or elsewhere in the RMI have been subject to regulations in the UES since December 1995 (USASMDC 2021). The proposed Navy CPS flight test activities are consistent with the ongoing RTS mission and are well within the limits of current operations of RTS and USAG-KA.

4.1 Exposure to Elevated Sound Levels

4.1.1 Sources of Elevated Sound Levels

The Proposed Action has the potential to result in elevated sound pressure levels both in the air and underwater. The primary elements of the Proposed Action that would result in elevated noise levels are: (1) sonic booms, (2) impact of the payload, (3) vessel operation, and (4) human activity and equipment operation.

Table 5. Stressors Resulting from Proposed Navy CPS Flight Test Activities at Kwajalein Atoll

Stressors and Stressor Sources	Stressor Summary in Deep Ocean Waters of KMISS	Stressor Summary at Illeginni Islet and in Nearshore Habitats
Frequency of Flight Tests		
Number of Tests	Up to eight flight tests per year between Fiscal Years 2025 and 2035	Up to one test per year with land impact between Fiscal Years 2025 and 2035. Up to 10 total land impact tests. Shoreline or shallow water impact not planned or expected.
Elevated Sound Pressure Levels		
Sonic Booms	Maximum sound pressure up to 175 dB in-water (re 1 μPa) at the surface and 149 dB in-air (re 20 μPa) near the point of impact. Duration 0.08 second for loudest sounds and 0.27 second for weakest sonic boom.	Same as for deep ocean waters.
Payload Impact	Estimated maximum of up to 191 dB in-water (re 1 μPa) at the surface. Duration on the order of a few seconds.	No CPS-specific estimates for terrestrial impact noise. Estimated maximum of 165 dB in-air (re 20 μPa) based on expected ocean impact sound levels. Due to refraction at the air-water interface and attenuation, loud sounds from terrestrial impact are not expected in the marine environments.
Vessel Activity	Range from 150 to 190 dB re 1 μPa. Similar to ongoing vessel activity at USAKA.	Same as for deep ocean waters.
Direct Contact and Shock Waves		
Cratering	No cratering in waters great than 3 m (10 ft) deep.	Payload land impact craters 6–9 m (20–30 ft) in diameter and 2–3 m (7–10 ft) deep.
Ejecta/Debris	No ejecta dispersion in waters over 3 m (10 ft) deep. Payload debris area estimated to be less than land debris dispersion (less than 91 m or 300 ft).	Ejecta may extend as far as 60 to 91 m (200 to 300 ft) from the impact location. Shoreline impact not planned or expected.
Shock Waves	No ground-borne propagation of shock waves strong enough to damage corals in waters deeper than 3 m (10 ft). Effects due to pressure waves in-water are encompassed in “elevated sound pressure level” estimates.	Propagation of ground-borne shock waves strong enough to damage corals up to 37.5 m (123 ft) from the point of impact.
Hazardous Materials		
Chemicals or Debris from Test Components	Potential introduction of payload materials into marine environments. Payload components expected to sink to the ocean floor relatively quickly.	Potential introduction of payload materials into terrestrial and marine environments. All visible test debris would be cleaned up where possible.
Chemicals or Waste from Support Equipment	Potential for accidental spills or leaks from vessels. Avoidance measures would be implemented.	Potential for accidental spills or leaks from support equipment. Avoidance measures would be implemented.

Stressors and Stressor Sources	Stressor Summary in Deep Ocean Waters of KMISS	Stressor Summary at Illeginni Islet and in Nearshore Habitats
Human Activity and Equipment Operation		
Human Activity	Potential for sensor raft deployment and recovery.	On Illeginni Islet: Increased human activity for up to 10 weeks. Equipment placement, cleanup operations, heavy equipment use. Nearshore Waters: Sensor deployment and recovery in waters greater than 3 m (10 ft) deep. Potential manual debris recovery.
Equipment Operation	Potential for helicopter or fixed wing aircraft overflight for pre- and post-test payload impact site inspection.	On Illeginni Islet: Several helicopter trips for personnel and equipment transport. Heavy equipment such as a backhoe or loader for equipment placement and post-test cleanup. Nearshore Waters: Self-stationing sensor raft operation in waters greater than 3 m (10 ft) deep.
Vessel Operation	Several vessel round trips for equipment and personnel transport pre-and post-test. Vessels may be used for raft placement or debris cleanup.	Several vessel round trips to Illeginni Harbor for personnel and equipment transport pre- and post-test. Vessel(s) used to place several self-stationing sensor rafts.

Abbreviations: CPS = Conventional Prompt Strike, dB = decibels, ft = feet, KMISS = Kwajalein Missile Impact Scoring System, m = meter(s), re = referenced to, USAKA = United States Army at Kwajalein Atoll, µPa = micropascal

Sonic Booms

The vehicle would fly at speeds sufficient to generate sonic booms from close to launch and extending to impact in Kwajalein Atoll. Sonic booms create elevated pressure levels both in the air and underwater. No model estimates are available for sonic boom footprints resulting from Navy CPS flight, but similar to other recent flight tests (DON 2019b, DON and U.S. Army 2022), sonic booms are expected to average 130 decibels (dB) in-water (referenced to 1 micropascal [re 1 µPa]) at the surface for most of the vehicle flight and last no more than 270 milliseconds. Maximum sound levels from sonic booms for vehicle flight are expected to be 135 dB re 1 µPa (DON 2019b). Sonic booms generated by the payload near impact may be up to 175 dB re 1 µPa near the impact point and last approximately 75 milliseconds (DON 2019b).

Payload Impact Noise

Impact of the payload at the terminal end of the flight would result in elevated sound levels in-air and underwater. No Navy CPS-specific model estimates of noise levels are available for payload impact; therefore, the peak noise levels estimated for other similar test payloads are used as a bounding case for CPS flight tests. Estimated sound levels for impact of the FE-2 and Joint Flight Campaign program payloads (DON 2019b, DON and U.S. Army 2022) are used as a bounding case for Navy CPS payload impact. Sound pressure levels for impact of payloads using a similar amount of high explosive as those in the proposed payloads were 140 dB in-air (re 20 µPa) at 18 m (59 ft) from impact. Therefore, sound pressures from payload impact are expected to be less than 191 dB in-water (re 1 µPa) at the ocean surface at the payload impact point and would last no more than a few seconds. The sound pressures would decrease with water depth and distance from the point of payload impact. Using a point source attenuation model with spherical spreading coefficient, sound pressures would attenuate to 186 dB re 1 μPa at 1.8 m (6 ft) from payload splashdown, 160 dB re 1 μPa at 35.5 m (116 ft), and 150 dB re 1 μPa at 112 m (367 ft).

Vessel Noise

Vessels would be used to move equipment and personnel to Illeginni Islet and to deploy sensor rafts. Vessel activity would include several vessel round trips within Kwajalein Atoll, most likely from Kwajalein Islet to the target site. NMFS estimates that large vessels can create sounds ranging from 170–190 dB (re 1 μPa) and sounds from smaller vessels would range from 150–170 dB (re 1 μPa) (NMFS 2019).

Human Activity and Equipment Operation

Acoustic effects associated with post-test human activity and equipment operations would be consistent with any other land or sea activity that uses mechanized equipment and would primarily be in terrestrial habitats centered on the payload impact location.

4.1.2 Effects of Elevated Sound Levels

Noise has the potential to affect the behavior and hearing sensitivity of marine mammals and fish. 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 on the frequency and intensity of the sound as well as on the hearing ability of the animal and its distance from the noise source. The species considered in this document have varying hearing abilities and thresholds for effects, which have been detailed in several documents including the FE-2 Biological Assessment (DON 2019b), NMFS Biological Opinion for FE-2 (NMFS 2019), NMFS Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (NOAA 2018), and in **Appendix A**. The detailed descriptions of general sound characteristics, justification for thresholds for effect in consultation organisms, and analysis methodology used in these documents is incorporated by reference and noise effect thresholds in marine environments are summarized in **Table 6**.

In general, a sound level that is sufficient to cause physical injury to auditory receptors is a sound that exceeds an organism's permanent threshold shift (PTS) level. The extent of physical injury depends on the received sound pressure level 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 permanent physical injury but loud enough to result in temporary hearing alteration. Sound levels above the TTS threshold have the potential to temporarily impair an animal's ability to communicate, navigate, forage, and detect predators. Another common effect of elevated sound levels is behavioral modification. For marine mammals, behavioral responses may include changes in surfacing, breathing patterns, dive duration, vocalization, feeding, travel, and group composition but tend to be highly variable (NRC 2005, Gomez et al. 2016). Marine mammal behavioral responses to anthropogenic sounds depend on many factors including the received levels of sound, an animals functional hearing group, the source of the sound, environmental factors, and on the individual animal exposed (Erbe et al. 2018, Southall et al. 2007, NRC 2005, Gomez et al. 2016). Realized behavioral responses can vary from minor temporary reactions like altering vocalization or small movements (Erbe et al. 2018, NRC 2005), to larger responses such as longer-term abandonment of normal behaviors or habitat use. Some studies divide behavioral response into severity groups which can be generalized as minor/brief responses (i.e., brief to prolonged orientation response or responses unlikely to affect vital rates), moderate effect potential (i.e., higher potential to affect vital rates, foraging, reproduction, or survival), and high effect potential (i.e., likely to affect vital rates, foraging, reproduction, or survival) (Southall et al. 2007, Miller et al. 2012, Gomez et al. 2016). Sounds that have a moderate to high behavioral effect potential might have a biologically significant effect on animals as they are more likely to keep an animal from growing, surviving, or reproducing (NRC 2005, Erbe et al. 2018).

Table 6. Maximum Underwater Radial Distance to Elevated Sound Pressure Level Effect Thresholds for UES Consultation Species from Ocean Payload Impact

Species Group	Effect Category	Threshold Criterion (re 1 μPa)	Radial Distance from Payload Impact Point	Area Around Impact Point
Low Frequency Cetaceans (*Balaenoptera* and *Megaptera* whales)	PTS (non-lethal injury)	219 dB_{peak}	-	-
	TTS	213 dB_{peak}	-	-
Mid Frequency Cetaceans (*Delphinus*, *Grampus*, *Stenella*, and *Tursiops* dolphins; *Feresa*, *Globicephala*, *Mesoplodon*, *Orcinus*, *Peponocephala*, and *Physeter* whales)	PTS (non-lethal injury)	230 dB_{peak}	-	-
	TTS	224 dB_{peak}	-	-
High Frequency Cetaceans (*Kogia* whales)	PTS (non-lethal injury)	202 dB_{peak}	-	-
	TTS	196 dB_{peak}	-	-
All Cetaceans	Behavioral Disturbance	160 dB_{peak}	35.5 m (116 ft)	3,955 m^2 (4,730 yd^2)
Sea Turtles [1]	Mortality/ Mortal Injury	237 dB_{peak}	-	-
	PTS (non-lethal injury)	230 dB_{peak}	-	-
	TTS	224 dB_{peak}	-	-
	Behavioral Disturbance	160 dB_{peak}	35.5 m (116 ft)	3,955 m^2 (4,730 yd^2)
Fish [2]	Mortality/ Mortal Injury	229 dB_{peak}	-	-
	TTS	186 dB SEL_{cum} re 1 μPa^2-s	1.8 m (6 ft)	10 m^2 (12 yd^2)
	Behavioral Disturbance	150 dB_{RMS}	112 m (367 ft)	0.04 km^2 (0.02 mi^2)

Sources: DON 2019b, NMFS 2019, NOAA 2018, Finneran and Jenkins 2012, Popper et al. 2014

Notes: All sound pressures in this table are in dB SPLpeak re 1 μPa unless indicated.

1 The PTS threshold listed for sea turtles is based on the non-lethal injury threshold in Finneran and Jenkins 2012.

2 The PTS threshold for fish with swim bladders is based on the mortality/mortal injury threshold in NMFS 2015a and Popper et al. 2014. Thresholds in fish are not specific to auditory injury.

Abbreviations: μPa = micropascals, dB = decibels, ft = feet, km = kilometers, m = meters, mi = miles, PTS = Permanent Threshold Shift, SEL = Sound Exposure Level, RMS = root mean squared, SPL = Sound Pressure Level, TTS = Temporary Threshold Shift, yd = yards, "-" = sound pressures would not exceed threshold criterion

For each marine functional hearing group, the range to potential effect was calculated for Proposed Action noise sources where the maximum expected sound pressure exceeded injury or behavioral effect thresholds. The distance to potential effect from CPS payload splashdown is detailed in **Table 6** for each functional hearing group. Range to potential effect was calculated using a point source attenuation model. The complete methodology for estimating the range to potential effect thresholds for wildlife is detailed in the FE-2 Biological Assessment (DON 2019b) and is incorporated here by reference.

Corals and mollusks can perceive sounds (Vermeij et al. 2010), but much less than other invertebrates more specialized to produce and sense sounds (e.g., crabs and shrimp). While there is some evidence that long-term or very intense sounds may induce stress effects on invertebrates or mask biologically relevant sounds used by invertebrates (DON 2015), research on the effects of sound on invertebrate species is limited. Based on the expected intensity and the short-duration of sounds associated with the Proposed Action, elevated noise levels are not expected to have any effect on UES consultation corals and mollusks and they are not considered further in this section.

Effects of Sonic Booms

At its loudest (175 dB in-water), the sonic boom at Kwajalein Atoll would not exceed permanent injury thresholds for consultation organisms and would be below the temporary hearing effect thresholds (TTS) as well. The maximum noise levels for sonic booms may exceed the behavioral disturbance threshold for consultation organisms near the surface. Sonic boom sounds would dissipate rapidly with depth in the ocean but animals near the surface may be exposed to sound sounds loud enough to cause temporary behavioral disturbance. The sonic boom footprint for sounds above 160 dB re 1 μPa would likely cover a large area around the flight path; however, the sound would last less than 0.3 seconds. Because of the expected sound intensity loss at the air-water interface, the rapid attenuation of the sound in water, and the short duration of the sound, the low intensity sonic boom noise is expected to have insignificant effects on UES-listed cetaceans, sea turtles, and fish in the Action Area. As NMFS concluded in their biological opinions for other recent flight tests, “at most, an exposed individual may experience temporary behavioral disturbance in the form of slight changes in swimming direction or speed, feeding, or socializing, that would have no measurable effect on the animal's fitness, and [animals] would return to normal within moments of the exposure. Therefore, [...] exposure [to sonic boom noise] is expected to have insignificant effects” on consultation species (NMFS 2015a).

Effects of Payload Impact Noise

For payload impacts in KMISS, sound pressure levels may peak at up to 191 dB re 1 μPa at impact and would last no more than a couple of seconds. Using a spherical spreading model for deep ocean waters (detailed in U.S. Air Force 2015, NMFS 2015a, DON 2019b, NMFS 2019), the range to pressure effect thresholds from payload impact was calculated for UES consultation species functional hearing groups (**Table 6**). This is a simplified and conservative approach, as it does not account for differential sound attenuation due to ocean conditions such as water depth, temperature, salinity, or stratification, and likely represents the maximum area where pressures would be above respective effect thresholds.

The sound pressures from payload impact would not exceed the PTS threshold for any animal group. Payload impact sounds would not exceed the temporary injury threshold (TTS) for any marine mammal group of for sea turtles. Impact noise may exceed the TTS threshold for fish but only very close to the impact point (within 1.8 m or 6 ft) (**Table 6**). Payload impact on land is not expected to produce sound pressures above permanent or temporary effect thresholds in nearshore marine habitats at Illeginni Islet.

Density data are not available for UES consultation fish species in deep ocean waters of Kwajalein Atoll. However, if maximum density data for these species in other areas of the central Pacific Ocean (detailed in DON 2019b) are used, the number of expected TTS exposures for any fish species is substantially less than one. For example, around Guam, reef manta rays have maximum density estimates of 0.03 per square kilometer (Martin et al. 2016) and the maximum density of bigeye thresher sharks in the Pacific Ocean is 1 per square kilometer (Fu et al. 2016). These densities are likely on the very upper end of density for any consultation fish species at Kwajalein Atoll. Using a maximum density of 1 individual per square kilometer, the estimated number of exposures to TTS would be only 0.04 individuals for each KMISS payload impact. Even if summed across the maximum of eight tests per year, the number of individuals that might be exposed to pressures high enough to cause TTS is still estimated to be substantially less than one per year for any fish species.

The distance within which UES consultation species have the potential to be exposed to sound pressures above behavioral disturbance thresholds would be approximately 35.5 m (116 ft) for cetaceans and sea turtles and 112 m (367 ft) for fish. However, based on the area where payload impact sound pressures might be above the behavioral disturbance threshold and the estimated maximum densities of marine mammals and sea turtles in the deep waters of Kwajalein Atoll (see **Section 4.2.2** and **Table 7**), it is unlikely that any individuals would be exposed to sounds above the behavioral disturbance threshold. For the marine mammal with the highest expected density (spinner dolphins), the estimated number of exposures per test is 0.0003 which corresponds to a 1 in 3,800 chance of exposure. Even if summed across all possible tests with impact at KMISS (8 per year over 10 years), the number of exposures is substantially less than one (maximum 0.02 animal exposures) for all marine mammals and sea turtle species.

If any marine mammals or sea turtles were exposed to sounds above the behavioral disturbance threshold, some individuals may respond to the payload impact noise with behavioral modification. However, as concluded by NMFS for similar flight tests (NMFS 2015a, NMFS 2019, NMFS 2021a, NMFS 2021b), any effects of this single impulsive noise are expected to “be limited to a temporary behavioral modification in the form of slight changes in swimming direction or speed, feeding, or socializing, that would have no measurable effect on the animal's fitness, and would return to normal within moments of the exposure.” Therefore, exposure to elevated sound pressures from payload impact in deep ocean waters is expected to have insignificant effects on UES consultation cetaceans, sea turtles, and fish in the Action Area.

Effects of Vessel Noise

Noise from vessel operation would likely range from 150 to 190 dB re 1 μPa depending on the vessel type (NMFS 2019). Vessels would be moving and sounds would be continuous. While some marine mammals, sea turtles, or fish might be exposed to sounds loud enough to cause behavioral disturbance, the low intensity noise would at most cause temporary disturbance, such as changes in swimming direction or speed, feeding, or socializing, that would have no measurable effect on the individual fitness (NMFS 2019). Animals would be expected to return to normal behaviors after the vessel passed and the noise is expected to have insignificant effects on UES-listed cetaceans, sea turtles, and fish in the Action Area.

Effects of Human Activity and Equipment Operation Noise

Pre-test and post-test human activity and equipment operation are primarily planned for terrestrial areas at Illeginni Islet. Because of the substantial loss of noise intensity at the air-water interface, little if any increase in noise would occur in the marine environment as a result of these activities. If nesting or hauled-out sea turtles were present on Illeginni Islet, noises from human activity and equipment operations might disturb individuals. However, no sea turtle nesting or haul-out activity has been observed on Illeginni Islet in over 20 years and effects are discountable.

If debris were to enter nearshore waters (less than 30 m or 100 ft deep), debris would be manually recovered and would involve heavy equipment if necessary. Noise generated by human activity and equipment operation in the marine environment would have the potential to cause behavioral disturbance to UES-listed animals. Behavioral disturbance would likely be limited to temporary behavioral modification such as leaving the area of human activity and equipment operation or cessation of feeding activity. Cleanup activities would likely last no more than a couple of weeks. Animals would be expected to return to normal distributions and behaviors after cessation of the noise producing activities and are not likely to be adversely affected by noise produced by human activity and equipment operation.

Elevated sound levels may affect but are not likely to adversely affect all UES consultation species in the Action Area. All potential effects of proposed activities on UES consultation species would be insignificant or discountable.

4.2 Exposure to Direct Contact or Shock Waves

4.2.1 Sources of Direct Contact and Shock Waves

The Proposed Action would result in impact of CPS payloads either on land at Illeginni Islet or in deeper ocean waters of KMISS. Up to eight payload impacts per year could occur at the KMISS target site. Up to one payload impact per year could occur at the Illeginni Islet land target site.

In the deep ocean waters of KMISS, the CPS payload would impact the ocean at high velocity. In addition to posing a direct contact risk, the payload impact would generate underwater shock/sound waves. These in-water pressures are discussed and evaluated in **Section 4.1**, *Exposure to Elevated Noise Levels*. Payload impact in these deep ocean waters would not result in ground-borne shock waves strong enough to injure corals or other organisms. Therefore, this section only evaluates the potential for direct contact risk from the payload or payload debris at the KMISS target site. As for other test programs with a similar payload (U.S. Army 2020, DON 2019b), it is assumed that payload debris might occur up to 91 m (300 ft) from the payload impact point. Therefore, a direct contact area of 26,016 square meters (m^2; 31,115 square yards [yd^2]) was used as a conservative direct contact area to account for any fragmentation of the payload upon impact.

At Illeginni Islet, impact of the payload would directly impact terrestrial habitats and would have the potential to directly contact organisms on land. The force of payload land impact land would result in crater formation and would likely result in ejecta and/or shock waves radiating out from the point of impact. The assumptions for CPS cratering and shock waves are based on payload impacts from previous flight test programs that had payload impacts on Illeginni Islet. As for other recent hypersonic flight tests, empirical evidence from Minuteman III payload impact cratering and shock waves are used as estimates for the Proposed Action. Craters from Minuteman III payload land impacts have been documented to be 6 to 9 m (20 to 30 ft) in diameter and 2 to 3 m (7 to 10 ft) deep (U.S. Air Force 2015).

Upon impact, crater formation would result in natural substrate (i.e., soil and coral rubble) being ejected around the rim of the crater. For Minuteman III, ejecta resulting from crater formations was estimated to extend no more than 60 to 91 m (200 to 300 ft) from the impact location (U.S. Air Force 2015, DON 2019b). Based on observations from Minuteman III and other payload testing at Illeginni Islet, most of the payload materials and substrate ejecta would remain close to the edge of the crater and the density of ejecta would be expected to decrease with distance from the impact point (U.S. Air Force 2015). The payload target site on Illeginni Islet includes only terrestrial areas. A shoreline payload impact is unplanned and unexpected for the Proposed Action but a payload land impact near the shoreline could result in the dispersal of soil and rubble onto the shallow nearshore reef flat (U.S. Air Force 2015).

Since a nearshore or shoreline strike is not expected, most of the ejected debris would fall on land. However, since the exact impact location and distribution of ejecta is unknown, these analyses assume a worst-case scenario of a shoreline payload impact where the ejected debris could enter the nearshore marine environment, similar to the approach used for the analyses of effects for other recent flight test programs (U.S. Air Force 2020b, U.S. Army 2020, DON 2019b). Although the exact shape of the potential debris field is unknown, the seaward portion of such an area is conceptually illustrated as a rough semi-circle on the lagoon and ocean sides of Illeginni Islet with a radius of 91 m (300 ft) (**Figure 8**). Based on the worst-case scenario, ejected debris has the potential to occur in a 13,008 m^2 (15,557 yd^2) area.

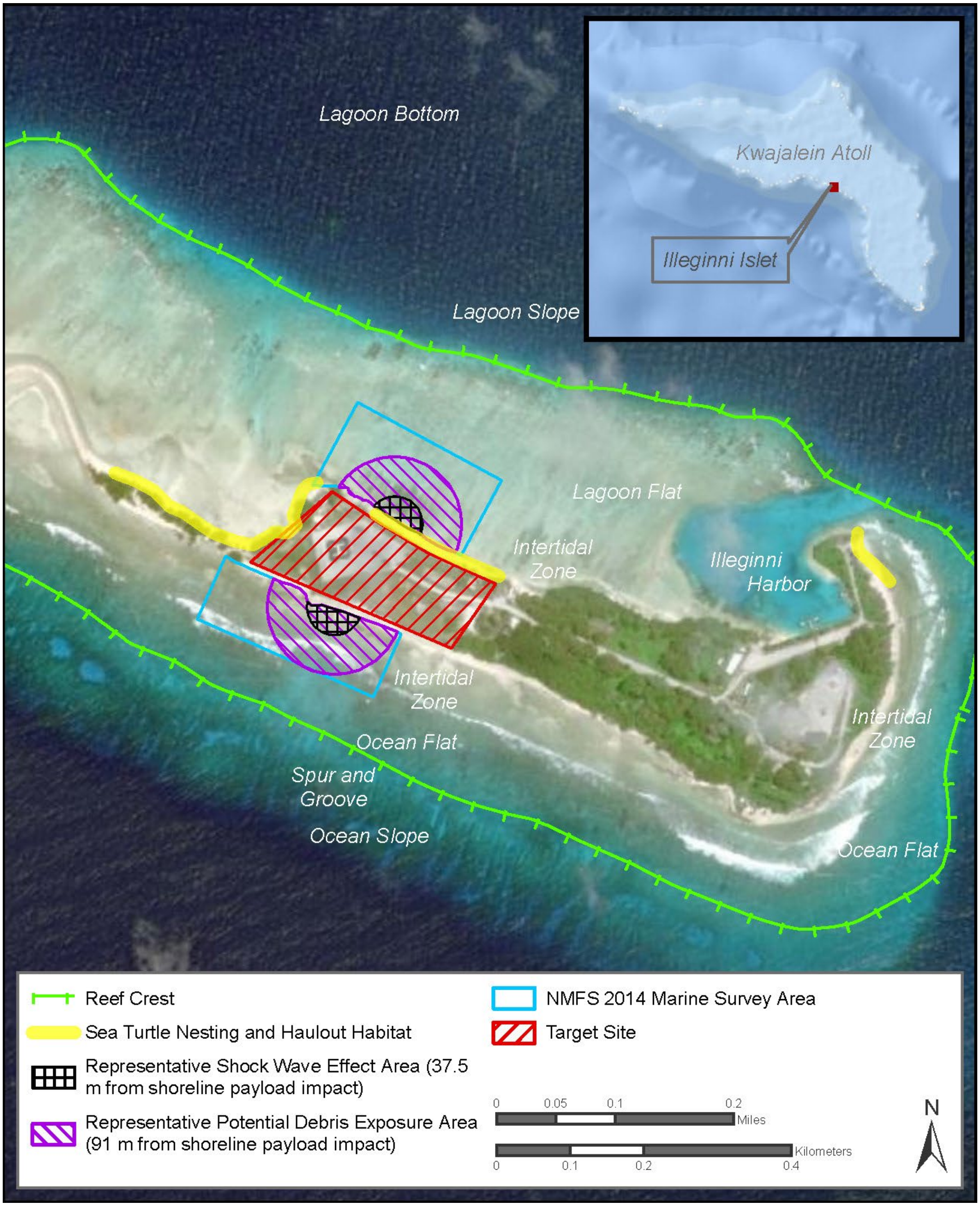

Figure 8. Estimated Maximum Direct Contact and Shock Wave Areas at Illeginni Islet

For Minuteman III tests, shock waves resulting from payload impact were estimated to be strong enough to damage corals out as far as 37.5 m (123 ft) from the point of impact (U.S. Air Force 2015). If impact occurred on the shoreline, shock waves would propagate into the submerged seafloor (U.S. Air Force 2015). No shoreline impact is planned or expected for CPS testing; however, is assumed that shock waves strong enough to damage corals might propagate up to 37.5 m (123 ft) into the marine environment (**Figure 8**).

4.2.2 Effects of Direct Contact and Shock Waves

Effects of Direct Contact at KMISS

The payload or payload debris would enter marine habitats and has the potential to directly contact marine organisms. For marine mammals and sea turtles with the potential to occur in the deep ocean waters near Kwajalein Atoll the number of exposures to direct contact was calculated based on the best available estimates of species density in the region (DON 2019b) and on a direct contact area of 91 m (300 ft) to account for payload fragmentation. The estimated number of exposures to direct contact was based on methodology used for other test programs (DON 2019a) where the expected number of animals exposed to direct contact is calculated using the direct contact area and estimated maximum seasonal density for species in the Action Area.

The best available density data for marine mammals and sea turtles in the Action Area comes from Navy marine species density databases for naval operating areas in the central Pacific, including for the Hawai'i-Southern California Training and Testing Study Area (DON 2017b) and the Mariana Islands Training and Testing Study Area (DON 2018) (**Table 7**). If maximum density data for UES consultation species in other areas of the central Pacific are used, the number of individuals which may be exposed to direct contact would be substantially less than one for all species (**Table 7**). For a single flight test, the estimated maximum number of animal exposures is 0.002 for the species with the highest density, spinner dolphins. This corresponds to a 1 in 590 chance of contacting a spinner dolphin during a single test with payload impact at KMISS. Exposure estimates are likely overestimates because they are based on maximum density estimates for other areas in the central Pacific and do not account for differences in seasonal distribution but rather assume the maximum seasonal density for the entire year.

Even if the maximum number of eight flight tests per year over 10 years is assumed, the estimated number of animal exposures is less than one individual for all species (**Table 7**) for the life of the program. Therefore, the effects of direct contact from vehicle components on consultation cetaceans, sea turtles, and fish in deep water areas are discountable.

While density data are not available for most UES consultation fish species in the Action Area, if maximum densities for reef manta rays and bigeye thresher sharks from other locations in the central Pacific described in **Section 4.1.2** are used, the estimated number of exposures for these fish species is still substantially less than one per test. All fish species in the Action Area at KMISS are likely to have very low densities, patchy distributions, and in many cases seasonal occurrence. Given the small direct contact area and the low density and patchy distribution of UES consultation fish species in the Action Area, it is very unlikely that these fish would be subject to direct contact from payload impact. Overall, no direct contact of UES consultation species is expected at KMISS, and the effects would be discountable.

Table 7. Estimated Maximum Number of Marine Mammal and Sea Turtle Exposures to Direct Contact from Navy CPS Payload Impact at the KMISS Target Site

Scientific Name	Common Name	Estimated Density in Offshore Waters (per km^2)	Estimated Number of Exposures per Test	Estimated Number of Exposures over 10 years (assuming 8 tests per year)
Marine Mammals				
Balaenoptera acutorostrata	Minke whale	0.0042	1.10E-04	8.80E-03
Balaenoptera borealis	Sei whale	0.0003	7.54E-06	6.04E-04
Balaenoptera musculus	Blue whale	0.0001	1.30E-06	1.04E-04
Balaenoptera physalus	Fin whale	0.0001	1.56E-06	1.25E-04
Delphinus delphis	Short-beaked common dolphin[1]	-	-	-
Feresa attenuata	Pygmy killer whale	0.0044	1.14E-04	9.16E-03
Globicephala macrorhynchus	Short-finned pilot whale	0.0144	3.76E-04	3.01E-02
Grampus griseus	Risso's dolphin	0.0047	1.23E-04	9.87E-03
Kogia breviceps	Pygmy sperm whale	0.0029	7.57E-05	6.06E-03
Megaptera novaeangliae	Humpback whale	0.0211	5.49E-04	4.39E-02
Mesoplodon densirostris	Blainville's beaked whale	0.0009	2.24E-05	1.79E-03
Orcinus orca	Killer whale	0.0001	2.34E-06	1.87E-04
Peponocephala electra	Melon-headed whale	0.0043	1.11E-04	8.91E-03
Physeter macrocephalus	Sperm whale	0.0096	2.49E-04	1.99E-02
Stenella attenuata	Pantropical spotted dolphin	0.0226	5.88E-04	4.70E-02
Stenella coeruleoalba	Striped dolphin	0.0150	3.89E-04	3.11E-02
Stenella longirostris	Spinner dolphin	0.0660	1.72E-03	1.37E-01
Tursiops truncatus	Bottlenose dolphin	0.0315	8.21E-04	6.57E-02
Sea Turtles				
Chelonia mydas	Green turtle	0.0043	1.12E-04	8.95E-03
Enetmochelys imbricata	Hawksbill turtle	0.0043	1.12E-04	8.95E-03

Notes:
[1] This species did not have density coverage in the Navy's Marine Species Density Database.
Abbreviations: km^2 = square kilometers, "-" = no data available

Effects of Direct Contact at Illeginni Islet

For up to one flight test per year, a payload may impact on land at Illeginni Islet. The Navy CPS payload would directly impact terrestrial habitats and would have the potential to directly contact consultation organisms. Payload impact on land may also result in ejecta and shock waves radiating out from the point of impact. Only terrestrial and nearshore marine areas are at risk from direct contact and shock waves due to payload impact. No UES consultation cetaceans or deep-water fish species would be in the area of potential direct contact for land-impact tests. Therefore, there would be no effect of direct contact on cetaceans or deeper-water fish species.

No UES consultation species would be at risk from crater formation; however, the potential exists for shoreline and nearshore reef-associated species to be at risk from debris being ejected from the crater and by shock waves radiating out from the point of impact.

Direct Contact in Terrestrial Habitats. While sea turtles hauled out or nesting on land and sea turtle nests have the potential to be adversely affected if struck by a piece of debris ejected during crater formation, no sea turtle nesting activity has been recorded on Illeginni Islet in over 25 years. Therefore, it is considered extremely unlikely that sea turtles would be in terrestrial habitats on Illeginni Islet and it is discountable that sea turtles would be adversely affected by direct contact or shock waves. As an additional avoidance measure, Illeginni Islet would be surveyed for sea turtle nesting and haul-out activity prior to the flight tests as described in **Section 2.2**, *Avoidance, Minimization, and Conservation Measures*.

Direct Contact in Nearshore Marine Habitats. Corals, mollusks, humphead wrasses, and sea turtles have the potential to be adversely affected if struck by a piece of debris ejected during crater formation. Larger pieces of debris could crack or break parts of coral colonies or injure individual mollusks or fish.

As discussed in **Section 4.2.1**, empirical observations after payload impact on Illeginni Islet for previous tests found that most of the test debris was contained within or near the crater rim (U.S. Air Force 2015) and the density of falling material ejected during crater formation decreases with distance from the impact point (DON 2017a). The exact dispersion of test payload debris and ejecta is unknown but it is assumed that the primary ejecta debris would be natural substrate (crushed coral) ejected from the crater. As a worst-case scenario, it is assumed that that half of the ejecta might enter the marine environment in the event of a shoreline impact. Based on these assumptions and on the maximum estimated size of the crater, ejecta debris might cover a maximum, non-contiguous area of 1,950 m^2 (2,332 yd^2). This is the total surface area that the natural debris might cover, but the ejected debris would be in pieces and dispersed across an area as far as 91 m (300 ft) from the point of impact, with debris density decreasing as distance from the impact point increases.

Since debris may disperse as far as 91 m (300 ft) from the point of impact, the marine area of potential direct contact is approximately 13,008 m^2 (15,557 yd^2) in a half circle extending out from the shoreline (**Figure 8**). Within this potential direct contact area, only a portion of the area is suitable habitat for UES consultation species. Based on the 2014 NMFS surveys of the area offshore of the land target site and the best professional judgment of NMFS survey divers, approximately 80% of the lagoon-side survey area (**Figure 8**) and 75% of the ocean-side survey area are considered potentially viable habitat for consultation coral, mollusk, and reef-associated fish species (NMFS 2019). Using these estimates of suitable habitat and assuming the ejecta would only cover approximately 1,950 m^2 (2,332 yd^2) on only one side of the islet for a given test (i.e., either on the lagoon or ocean sides of the islet); the area of lagoon-side and ocean-side suitable habitat which may be impacted by debris for each test was calculated (**Table 8**). Using these percentages of suitable habitat likely results in an overestimate of the area of potential effect because habitat suitability for consultation species is lowest along the water's edge (where debris is more likely to occur) and with the exception of sandy patches, suitable habitat typically increases with distance from shore (NMFS 2019), while the concentration of ejected debris would decrease with distance from shore.

Table 8. Estimated Marine Areas with the Potential to be Impacted by Ejecta Debris and Shock Waves from a Shoreline Impact

Parameter	Ocean Side	Lagoon Side
Total marine area of potentially ejecta debris exposure (91 m from point of impact)	13,008 m^2 (15,557 yd^2)	13,008 m^2 (15,557 yd^2)
Percent suitable habitat in NMFS survey area	75 percent	80 percent
Estimated area of suitable habitat within the potential debris exposure area	9,756 m^2 (11,668 yd^2)	10,406 m^2 (12,445 yd^2)
Expected debris impact area for a single shoreline payload impact (within potential debris exposure area)	1,950 m^2 (2,332 yd^2)	1,950 m^2 (2,332 yd^2)
Estimated area of suitable habitat potentially impacted by ejecta debris for a single test	1,463 m^2 (1,750 yd^2)	1,560 m^2 (1,866 yd^2)
Expected shock wave area for a single shoreline payload impact	2,209 m^2 (2,642 yd^2)	2,209 m^2 (2,642 yd^2)
Estimated area of suitable habitat potentially impacted by shock waves for a single test	1,657 m^2 (1,982 yd^2)	1,767 m^2 (2,113 yd^2)

Abbreviations: m^2 = square meters, NMFS = National Marine Fisheries Service, yd^2 = square yards

Based on the estimated area of suitable habitat that ejecta might cover in the marine environment and the density of coral colonies and mollusks reported by NMFS in 2017 (NMFS-PIRO 2017a, 2017b), the number of potential coral and mollusk exposures to direct contact was calculated (**Table 9**). For an ocean-side shoreline impact, an average of two coral colonies and one mollusk might be exposed to direct contact (**Table 9**). An average of 253 coral colonies and five mollusks might be exposed to direct contact for a lagoon-side shoreline impact. If it is assumed that each potential test involving land impacts would have a shoreline impact (an unplanned worst-case scenario) and that either each test would impact a different marine area or that coral and mollusk densities would fully recover in the time between tests, an estimated 2,530 UES consultation coral colonies and 50 individual mollusks might be exposed to direct contact from debris (**Table 9**) based on mean densities in the area.

As described by NMFS in their 2019 Biological Opinion for the FE-2 action, the response of corals to exposure to ejecta and ground-borne shock waves would depend on the scale and intensity of the exposure as well as on the morphology of the coral (NMFS 2019). Plate forming corals such as *Acropora microclados* are more easily broken than large massive or encrusting forms such as *Pavona venosa* (NMFS 2019). *Heliopora coerulea* colony growth forms are highly variable depending on habitat (Sakashita and Wolf 2009). Not all corals exposed to debris would be damaged, but the most likely realized effects would be broken branches or plates or damaged soft tissue. Based on the expected dispersion pattern of the debris and lack of suitable coral habitat near the shoreline, complete pulverization of coral colonies is not likely.

Table 9. Estimated Numbers of Consultation Coral Colonies and Individual Mollusks and Fish Potentially Exposed to Debris and Shock Waves Generated by a Shoreline Payload Impact

Species	Ocean Side Single Test				Lagoon Side Single Test				Estimated Number of Colonies or Individuals Exposed for All Tests Involving Land Impact[1]
	Mean Colonies or Individuals (per m²)	99% UCL (per m²)	Number of Colonies or Individuals affected by Debris (mean to UCL)	Number of Colonies or Individuals affected by Shock Waves (mean to UCL)	Mean Colonies or Individuals (per m²)	99% UCL (per m²)	Number of Colonies or Individuals affected by Debris (mean to UCL)	Number of Colonies or Individuals affected by Shock Waves (mean to UCL)	
Corals									
Acropora microclados	0.0004	0.0017	1 to 3	1 to 3	-	-	-	-	20 to 60
Acropora polystoma	≤0.0004	0.0017	1 to 3	1 to 3	-	-	-	-	20 to 60
Cyphastrea agassizi	-	-	-	-	0.0003	0.0013	1 to 2	1 to 2	20 to 40
Heliopora coerulea	-	-	-	-	0.16	0.45	250 to 702	283 to 795	5,330 to 14,970
Pavona venosa	-	-	-	-	0.0003	0.0013	1 to 2	1 to 2	20 to 40
Turbinaria reniformis	-	-	-	-	≤0.0003	0.0013	1 to 2	1 to 2	20 to 40
Coral Subtotal			**2 to 6**	**2 to 6**			**253 to 708**	**286 to 801**	**5,390 to 15,156**
Mollusks									
Hippopus hippopus	0.0003	0.0015	1 to 2	0	0.002	0.006	3 to 9	0	30 to 90
Rochia nilotica	-	-	-	-	0.00006	0.0003	1 to 1	0	10 to 10
Tridacna squamosa	-	-	-	-	0.0002	0.0011	1 to 2	0	10 to 20
Mollusk Subtotal			**1 to 2**	**0**			**5 to 12**	**0**	**50 to 120**
Fish									
Cheilinus undulatus – adults[2]	0.0008	N/A	1	0	N/A	-	-	-	10
Cheilinus undulatus – juveniles[2]	-	N/A	-	-	N/A	0.0096	15	0	150
Fish Subtotal			**1 adult**	**0**			**15 juveniles**		**10 adults and 150 juveniles**

Notes: The coral and mollusk species in this table were observed during a 2014 survey of reef areas offshore of the Illeginni Islet target site (NMFS-PIRO 2017a and 2017b).
[1] The estimated number of colonies or individuals exposed for the maximum number of Navy CPS tests with land impact (one per year over 10 years) was calculated based on the mean and 99% UCL number of colonies or individuals exposed during a single test multiplied by ten possible land-impact tests over the life of the program.
[2] The density of humphead wrasse in the Action Area is based on the total number recorded by NMFS in 2008 (NMFS-PIRO 2017a) and does not represent a mean.
Abbreviations: N/A = not applicable, m^2 = square meter, UCL = upper confidence limit, "-" = species or life stage not known to occur in this portion of the Action Area

Partial fracturing of a coral colony skeleton and contact from debris would injure the soft, living tissues of those portions of the colony. Coral have the potential to regrow after damage but regrowth and stress could still have a negative impact on growth rate, reproduction, and disease susceptibility (NMFS 2019). The break could expose the coral to threats from algae or sponge growth infection by diseases that may prevent regrowth (NMFS 2019). As detailed by NMFS (2019), since these corals are colonial organisms with hundreds to thousands of genetically-identical interconnected polyps, affecting some polyps of a colony does not necessarily constitute harm to the individual (defined as a colony) as the colony can continue to exist even if the colony is damaged.

Smaller, sand-like particles would remain close to the point of impact and resulting crater. Since the worst-case scenario would be a shoreline impact, sand-like debris would only occur in areas very near the shore where corals do not occur or density is very low. Therefore, corals and mollusks are not likely to be buried by or have their soft tissues scoured by large amounts of small payload ejecta.

The estimates for the number of coral colonies or individual mollusks exposed to direct contact are considered maximum estimates of effects for the following reasons:

- Shoreline payload impacts are not planned; therefore, the amount of debris entering the water would decrease as payload impact distance from shore increased.
- Exposure calculations assume that each test involving payload land impact (up to one per year over 10 years) would result in a shoreline impact and that all tests would result in impact debris in a different marine location, which is highly unlikely to occur.
- Exposure calculations assume that debris would be distributed across the entire area with potential for ejecta debris when in reality debris would be dispersed outward from the payload impact point with decreasing debris density as distance increases.
- Ejected debris would be most likely near the water’s edge where habitat suitability for consultation corals is lowest (NMFS 2019). Therefore, calculations based on suitable habitat for the whole survey area are likely overestimates of potential effect for these species.
- NMFS has indicated that the distribution and density reports likely overestimated the number of coral and mollusk species that may be within the area of potential effect at Illeginni Islet (NMFS 2019). Therefore, calculations based on these density data are likely overestimates of potential effect.
- Coral exposure to shock waves or ejecta from payload impact would probably be limited to cracks and/or loss of branches (as opposed to pulverizing the entire colony). Any cracking or loss of branches would likely injure or destroy soft tissue; however, it would not necessarily result in mortality of or substantial stress to the colony.

Humphead wrasses have the potential to be injured if exposed to direct contact from debris; however, several factors make this unlikely. No humphead wrasse were observed in the 2014 surveys of the areas offshore of the Illeginni Islet target site. This highly mobile species has been recorded in nearby habitats where up to 8 adult and 100 juvenile humphead wrasses were projected to be in the ocean-side and lagoon-side (respectively) areas of potential effect for previous missile testing at Illeginni (NMFS-PIRO 2017a). However, humphead wrasses are generally not found at the surface (NMFS 2019) where they would be most vulnerable to effects from direct contact. These fish are most commonly found in waters a few meters to at least 60 m (200 ft) deep (NMFS 2019) and any debris would rapidly lose velocity upon entering the water. In addition, NMFS stated that the humphead wrasses observed near Illeginni Islet have been observed beyond the reef crest around 91 m (300 ft) from the shoreline (NMFS 2019). It is unlikely that any humphead wrasse would be contacted by ejecta. Any effects from debris entering the water would likely be limited to temporary behavioral responses and fish would be expected to return to normal behaviors within moments of exposure. While considered unlikely, a maximum number of humphead wrasse that might be affected by debris entering the water can be calculated similar to the methodology used for corals and mollusks as a conservative approach. If the 8 adult and 100 juvenile humphead wrasse estimated by NMFS (NMFS-PIRO 2017a) to be in the potential direct contact area were distributed evenly across suitable reef habitat in the area, the density of fish would be 0.0008 per m^2 ocean side and 0.0096 per m^2 lagoon side (**Table 9**). Based on the worst-case scenario, up to 1 adult or 15 juvenile humphead wrasse might be affected by direct contact from a single test (**Table 9**).

Sea turtles are very unlikely to be in marine areas where ejecta might land. Green and hawksbill turtles may occur infrequently around Illeginni Islet, but they would occur in low numbers and are typically found in waters near the reef edge, which is over 150 m (490 ft) from the shore (NMFS 2019). Even if turtles were in waters closer to the shore where they might be exposed to ejecta sinking to the bottom, the ejecta would be fairly slow moving after entering the water and any effects would be likely be limited to temporary behavioral disturbance. Sea turtle behavior would return to normal within moments of exposure with no measurable fitness effects (NMFS 2019). As with debris in terrestrial areas, ejecta in the marine environment would have insignificant effects on sea turtles.

Shock Waves in Nearshore Marine Habitats. Shock waves have the potential to crack or fragment corals depending on the intensity of the shock wave and the morphology of the coral. For previous tests, shock waves resulting from payload impact that were strong enough to damage corals were estimated to extend as far as 37.5 m (123 ft) from the point of impact if on the shoreline (DON 2019b). No shoreline impact is planned for the Navy CPS tests. Therefore, for nominal tests, shock waves intense enough to damage corals would not propagate that far into the marine environment and would be less intense in the marine environment. If the worst-case scenario of a shoreline payload impact is considered, coral colonies might be exposed to shock waves propagating through the marine substrate. As discussed above, habitat suitability for consultation species is lowest along the water’s edge (where shock waves would be most intense) and typically increases with distance from shore (NMFS 2019).

As described by NMFS in their 2019 Biological Opinion for the FE-2 action, the response of corals to exposure to ejecta and ground-borne shock waves would depend on the morphology of the coral with plate forming corals being more easily broken than large massive or encrusting forms (NMFS 2019). The UES consultation coral species which would be most sensitive to shock waves would be those with branching or corymbose colonies including *Acropora microclados* and *Acropora polystoma*, and the plate-like *Turbinaria reniformis*. *Cyphastrea agassizi* and *Pavona venosa*, massive-type corals, would be least affected by shock waves.

If shock waves strong enough to damage corals might extend out 37.5 m (123 ft) from impact, shock waves might occur in approximately 2,209 m^2 (2,642 yd^2) of nearshore marine areas. In the event of a shoreline payload impact, it is likely that some coral colonies would be affected, but the most likely realized effects would be cracks in the colony or broken branches or plates. As discussed for direct contact above, fracturing or broken branches would injure the soft tissue near the break but affecting some polyps of a colony does not necessarily constitute harm to the individual as the colony can continue to exist even if the colony is damaged.

The maximum debris exposure and potential shock wave exposure areas overlap (**Figure 8**); however, since the area of overlap with the debris impact area is unknown, the effects of shock waves in the entire potential shock wave area are evaluated as a worst-case scenario. Within the potential shock wave area, the expected amount of suitable habitat was calculated based on NMFS estimates of suitable habitat in the 2014 survey area (**Table 8**). Based on the density of UES consultation corals and area of suitable habitat where shock waves might be strong enough to damage corals, the expected number of coral colony exposures was calculated for each species (**Table 9**). For the worst-case scenario of a shoreline strike, an average of 286 coral colonies might be affected by ground-borne shock waves. Since the area of overlap with the debris impact area is unknown, the number of coral colonies potentially affected by shock waves was added to those potentially affected by debris when determining the overall number of coral colonies which might be affected. This likely leads to an overestimation of effect because the two areas would likely overlap to a great extent since the concentration of debris would be greatest closer to shore.

Exposure to intense ground-borne shock waves could injure the soft tissues of mollusks but the range of onset of significant injuries is likely much less than that estimated for corals (NMFS 2019). Since top shell snails are anchored to the substrate by their muscular foot, the muscular foot would somewhat isolate the snail's shell and soft tissues from vibration and damage (NMFS 2019). Giant clams are anchored to the substrate; therefore, ground-borne vibrations would travel through the clam's shell and soft tissues (NMFS 2019). Since the range to potential shock wave effects for mollusks is less than for corals, shock waves are not likely to be strong enough to injure these species. Therefore, shock waves are expected to have insignificant effects on UES consultation mollusks.

Humphead wrasses have the potential to be injured by concussive shock waves; however, several factors make this highly unlikely for the Proposed Action. The shock waves would propagate primarily through the substrate, and it can be assumed that little of the pressure intensity would be transferred to the water. Therefore, the range of onset of significant injuries to fish from shock waves is likely substantially less than for corals (NMFS 2019). In addition, NMFS stated that the humphead wrasses observed near Illeginni Islet have been observed beyond the reef crest around 91 m (300 ft) from the shoreline (NMFS 2019). As with elevated noise levels discussed in **Section 4.1.2**, any realized effects of shock waves on nearshore fish, including the humphead wrasse, would likely be limited to temporary behavioral responses. Fish would be expected to return to normal behaviors within moments of exposure to shock wave pressures and the shock waves are expected to have insignificant effects on UES-listed fish in the Action Area.

Direct contact and shock waves may affect, and in the event of a shoreline strike, are likely to adversely affect six UES consultation coral species (*Acropora microclados*, *Acropora polystoma*, *Cyphastrea agassizi*, *Heliopora coerulea*, *Pavona cactus*, and *Turbinaria reniformis*), three UES consultation mollusk species (*Hippopus hippopus*, *Rochia nilotica*, and *Tridacna squamosa*), and the humphead wrasse. An estimated maximum of 15,156 coral colonies, 120 mollusks, 10 adult humphead wrasse, and 150 juvenile humphead wrasse might be adversely affected over the 10 years of Navy CPS flight testing (**Table 9**).

Direct contact and shock waves may affect but are not likely to adversely affect sea turtles on land or in nearshore environments as the effects on sea turtles would be discountable or insignificant.

4.3 Exposure to Hazardous Materials

4.3.1 Sources of Hazardous Materials

The Proposed Action has the potential to introduce hazardous materials into the Action Area. Impact of the payload would have the potential to introduce propellants, battery acids, and heavy metals into the terrestrial or marine environment at the payload impact site. The test payloads would contain varying quantities of hazardous materials; potentially including batteries, explosives, asbestos, tungsten, and other heavy metals (detailed in **Table 2**).

Hazardous Materials at KMISS

Following a payload impact in KMISS waters, fragmentation of the payload would disperse any onboard hazardous materials in water around the impact point. Most payload components would sink relatively quickly to the ocean floor and would not be recovered in waters greater than 30 m (100 ft) deep. Some residual hazardous chemicals are likely to be introduced in the marine environment; however, the area affected by the dissolution of chemicals would be relatively small because of the size of the payload components and the minimal amount of residual materials they would contain. Any chemicals introduced to the water column would be quickly diluted and dispersed by wave action, ocean currents, and the large volume of water.

Test components have the potential to pose a temporary ingestion risk to marine wildlife. However, all debris is expected to sink to the ocean bottom where depths reach thousands of feet and where most UES-listed species and their prey do not occur. While no residual debris is expected on the surface or in the water column, a recovery team would inspect the payload impact site after the test flight to recover and remove any visible debris present on the ocean surface.

Hazardous Materials at Illeginni Islet

Following a payload impact on land, fragmentation of the payload would disperse any of the residual onboard hazardous materials up to 91 m (300 ft) from the impact point. The majority of the payload fragments and materials would be expected to remain close to the impact point in terrestrial habitats. As described for debris and ejecta in **Section 4.2.1**, most of the payload materials would remain close to the edge of the crater and the density of debris would be expected to decrease with distance from the impact point (U.S. Air Force 2015). Only in the unplanned and unexpected event of a shoreline impact would debris be expected to enter marine habitats (see **Figure 8** for worst-case scenario extent of payload debris).

During post-test clean-up activities, attempts would be made to recover all visible man-made test debris. The impact crater and ejecta immediately surrounding the crater may be excavated and screened to remove payload debris. 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. 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 in the United States. Only trace amounts of hazardous materials would be expected to remain in terrestrial areas after the test. Few, if any, hazardous materials would be expected to enter the nearshore marine environment for a nominal test. Any materials that entered the nearshore marine environment would be quickly diluted and dispersed by the large volume of ocean water and wave action.

Up to 454 kilograms (1,000 pounds) of tungsten alloy would be contained on the payload. Most of the tungsten is expected to be cleaned up during recovery operations. However, it is possible that a small (but unknown) amount of tungsten alloy would remain in terrestrial habitats at Illeginni Islet.

Several avoidance, minimization, and mitigation measures would be in place to reduce the potential for effects due to hazardous materials (listed in **Section 2.2**) including post-test debris and waste cleanup, vessel and equipment inspections, spill response procedures, and post-test soil and groundwater sampling for hazardous materials.

Due to concerns over hazardous materials accumulation at Illeginni Islet from past and ongoing DoD missile testing and the potential for harmful concentrations of hazardous chemicals in soil, groundwater, and marine systems, soil and groundwater testing has been conducted after several recent flight tests for other programs. Illeginni Islet soil and groundwater studies have measured pre- and post-flight test quantities of a number of materials at the target site including uranium, beryllium, and tungsten (DON 2023). Results of these studies are detailed in the Navy CPS Flight Tests Environmental Assessment/Overseas Environmental Assessment (Section 3.2.2.4.4 and Section 3.2.2.5.4 in DON 2023). In summary, Illeginni Islet soil and groundwater beryllium and uranium levels remained below all UES compliance goals and U.S. Environmental Protection Agency screening levels between 2005 and 2020 and were below the limit of quantification (categorized at undetectable) for most samples (DON 2023). Similarly, tungsten was categorized as undetected in soil samples in the most recent study (RGNext 2020). However, in a 2019 study, soil tungsten levels were above the U.S. Environmental Protection Agency screening level for resident soil to groundwater (DON 2019a) but were below screening levels for residential and industrial soils. Sampled levels of tungsten in Illeginni Islet groundwater have been variable across years and sampling locations. Reported tungsten levels in groundwater samples from the past two studies (2019 and 2020) were above the U.S. Environmental Protection Agency regional screening level of 16 micrograms per liter (DON 2019a, RGNext 2020). Pre-flight test groundwater samples have had tungsten concentrations as high as 990 micrograms per liter (approximately 1 part per million) and post-flight test concentrations have been as high as 1,200 micrograms per liter (approximately 1.2 parts per million) (DON 2019a, RGNext 2020). The 2019 pre-flight test ground water study showed tungsten concentrations at 650 micrograms per liter, while post-flight test post-flight test concentrations were reported at 1,200 micrograms per liter (DON 2019a). The 2020 pre-flight test ground water study showed tungsten concentrations at 990 micrograms per liter, while post-flight concentrations were reported at 63 micrograms per liter (RGNext 2020).

4.3.2 Effects of Hazardous Materials

Terrestrial and marine wildlife have the potential to be affected by hazardous materials if materials are present in quantities or concentrations high enough to harm individuals and if wildlife come into contact with or ingest these materials.

Of notable concern at Illeginni Islet and in nearshore habitats, is tungsten. While some studies have concluded that residual tungsten may dissolve and move through soil or groundwater, the potential effects of residual tungsten on biotic communities is largely unknown (DON 2019b). Under certain environmental conditions, tungsten may dissolve and some forms of tungsten (depending on soil conditions) can move through soil (Dermatas et al. 2004). 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 Islet are primarily well-drained and composed of calcareous sand poor in organic materials with a few carbonate fragments; therefore, residual tungsten is likely to mobilize into groundwater, as evidence by the historical soil and groundwater testing results (see **Section 4.3.1**). The potential effects of residual tungsten on wildlife and habitats are less clear. There is some evidence 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). Some forms of tungsten such as sodium metatungstate have been shown to be toxic to animals such as guppies, daphnia, redworms, algae, and plants at concentrations higher than 420 milligrams per liter (approximately 420 parts per million) (Strigul et al. 2010). However, other forms of tungsten such as sodium tungstate are very low toxicity chemicals which are not likely to be found in toxic concentrations in natural aquatic environments (Strigul et al. 2010). While the effects of tungsten remaining in the soil or groundwater at Illeginni Islet are largely unknown, the target site is largely a disturbed area where there would not likely be environmental effects which would meaningfully alter terrestrial habitats.

Also of concern is the potential for tungsten to migrate into marine environments where it would have the potential to affect marine UES listed species. In a recent laboratory study of the effects of tungsten on corals, adult and larval coral were exposed to tungsten concentrations between 100 parts per billion and 100 parts per million for up to 30 days (Wilkins et al. 2021). No acute toxicity of corals was observed; however, some corals exhibited sublethal responses such as lightening (bleaching) and tissue loss (Wilkins et al. 2021). While the authors posited that the metabolic effects of tungsten at these concentrations would likely result in reduced reproductive success over time, they also found that corals would recover from tungsten exposure over time (Wilkins et al. 2021). While tungsten may be a stressor to corals and other marine animals, the effects would depend on concentration of tungsten in the marine environment and the length of exposure. Some studies have estimated that tungsten is present in marine environments globally at concentrations of 0.001 parts per million (1 part per billion) (Shanware and Phadtare 2014); however, the background concentrations of tungsten and the form of tungsten found in Illeginni Islet reef habitats or elsewhere in Kwajalein Atoll is unavailable. It is not known at this time how much DoD payload testing (including for proposed flight tests) might contribute to marine tungsten concentrations or, if testing were to increase tungsten concentrations, the length of time tungsten levels might be elevated after a test. It is also not clear what tungsten levels in the marine environment would result in adverse effects to UES listed organisms.

Currently, no quantification of the likelihood of proposed flight test hazardous materials and wastes (including tungsten) affecting UES consultation species is possible. Instead, these analyses rely on a qualitative analysis approach based on the best available information about species distributions over time (based on NMFS and USFWS biennial surveys) and the relative potential for animal exposure to materials in concentrations high enough to cause harm or meaningfully modify habitats.

For all species considered in this Biological Assessment, exposure to hazardous materials as a result of the Proposed Action would have discountable or insignificant effects. Several avoidance and minimization measures would be in place as part of the Proposed Action to minimize the potential for hazardous material to affect biological resources (**Section 2.2**). Considering the planned cleanup of man-made materials, the very small quantities of hazardous materials expected to be introduced into terrestrial and marine habitats, and the dilution and mixing capabilities of the ocean and lagoon waters, materials released during payload impact are not expected to be present in sufficient quantities or concentrations high enough to adversely affect any consultation cetacean, fish, sea turtle, or invertebrate in the Action Area. At KMISS, test debris would sink to the ocean bottom where most ESA-listed animals and their prey species would not occur. While ingestion of debris is a possibility for other protected cetacean, sea turtle, and fish species, it is extremely unlikely these marine organisms would be co-located with debris, and it is considered discountable that any ESA-listed would come into contact with or ingest test debris. The effects of hazardous materials on UES consultation species would be insignificant.

Hazardous materials and debris may affect but are not likely to adversely affect all UES consultation species in the Action Area. All potential effects of hazardous materials resulting from proposed activities on UES consultation species would be insignificant or discountable.

4.4 Human Activity and Equipment Operation

4.4.1 Human Activity and Equipment Operation Stressors

Both pre-flight preparations and post-flight cleanup activities may result in elevated levels of human activity in terrestrial and marine environments for several weeks.

Human activity and equipment operation in marine environments at Kwajalein Atoll would only involve vessel traffic to and from payload target sites and use of sensor rafts. KMISS optical and electronic sensors and system support equipment are already in place on Gagan Islet and in the offshore ocean waters. For nominal missions, payloads that impact in deep ocean waters of KMISS would not be recovered and no post-test cleanup or recovery activities are anticipated to be required for flight tests in the KMISS portion of the Action Area.

Elevated levels of human activity are expected for several weeks at Illeginni Islet. During this period, several vessel round-trips are likely. Helicopters would also be used to transport equipment and personnel to Illeginni Islet. Most of the human activity and equipment operation related to the Proposed Action would take place in terrestrial environments at Illeginni Islet. Personnel and equipment would be used for preparation of the target site including equipment placement in terrestrial areas. Post-flight cleanup would involve recovery of all visible man-made test debris, as practicable, and would include personnel and equipment use in terrestrial habitats. Man-made debris would be removed from the impact crater and it would be filled with surrounding substrate that was ejected from the crater. These post-test activities may include use of heavy equipment such as a backhoe or grader.

In the vicinity of Illeginni Islet, human activity in marine areas would involve pre-test deployment and post-test recovery of sensory rafts. Sensor rafts with onboard optical or acoustic sensors would be deployed by landing craft utility in the lagoon or ocean waters in waters no less than 3 m (10 ft) deep.

Post-test human activity in marine areas near Illeginni Islet would likely only involve vessel traffic to and from Illeginni Islet and collection of sensor rafts. Use of heavy equipment in the nearshore marine environment is not expected since shallow water and reef habitats would not be targeted. However, if test debris enters the nearshore marine environment, including the reef flat, test personnel may manually recover debris. Human activity in the nearshore marine environment would be limited to the area near the payload land impact where debris entered the water. In the event of an unexpected shoreline or reef-flat payload impact, several measures and procedures would be in place (**Section 2.2**) to guide post-test activities in order to avoid impacts to consultation organisms. 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.

4.4.2 Effects of Human Activity and Equipment Operation

Most of the human activities and equipment operation related to the Proposed Action would take place in terrestrial environments. The only UES consultation organisms with the potential to be affected by human activity and equipment operation on Illeginni Islet are hauled out or nesting sea turtles. Several mitigation measures would be in place as part of the Proposed Action to minimize the chance of affecting sea turtles, including sea turtle nest and activity searches of suitable habitat at Illeginni Islet leading up to the test. As discussed in **Section 3.2**, no sea turtle nests or nesting activity has been observed on Illeginni in over 25 years. Sea turtle nest pits (unidentified species) were last found on Illeginni Islet in 1996, on the northern tip of the islet. Therefore, it is considered discountable that any sea turtles or sea turtle nests would be exposed to human activity and equipment operation in terrestrial habitats.

Planned human activity and equipment operation in marine areas would only involve vessel traffic to and from the payload target site and use of sensor rafts. No debris recovery or other cleanup activities are expected to be required in shallow nearshore waters at Illeginni Islet. In the event that debris entered the nearshore marine environment, several measures would be in place to protect reef habitats and consultation species (**Section 2.2**). During planned test activities, nearshore reef-associated species including corals and mollusks would not be affected by human activity and equipment operation. For other motile cetacean, sea turtle, and fish species, response to Proposed Action human activity and equipment operation, if any, would likely be limited to short-term behavioral reactions such as avoidance behavior. This type of response is not expected to have any measurable effect on fitness of individuals and animals would be expected to return to normal behaviors within minutes of cessation of proposed activity. Human activity and equipment operation is expected to have insignificant effects on UES-listed cetaceans, sea turtles, and fish in the Action Area.

Human activity and equipment operation would either have no effect on or may affect but is not likely to adversely affect all UES consultation species in the Action Area. All potential effects of human activity and equipment operation resulting from proposed activities on UES consultation species would be insignificant.

4.5 Vessel Traffic

4.5.1 Sources of Vessel Traffic

The Proposed Action has the potential to increase ocean-going vessel traffic in Kwajalein Atoll for several weeks. Pre-test activities would include several vessel round-trips to and from Illeginni Islet for personnel and equipment transport. All vessels transporting personnel and equipment to Illeginni Islet would use Illeginni Harbor. Sensor rafts would be deployed from a vessel near the target sites. Post-test recovery efforts would also result in increased vessel traffic to Illeginni Islet. Vessels would be used to transport heavy equipment (such as backhoe or grader) and personnel for manual cleanup of debris, backfilling of any craters, and instrument recovery. Deployed sensor rafts would also be recovered by a vessel. The scope and magnitude of the vessel activity associated with the Proposed Action would be within the envelope of normal USAG-KA and RTS vessel operations at Illeginni Islet and USAKA more broadly.

4.5.2 Effects of Vessel Traffic

Effects of Vessel Strike

Consultation 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, such as cetaceans and sea turtles that must surface to breathe air, are at risk of being struck by vessels or their propellers. Several measures would be in place to reduce the chances of a cetacean or sea turtle being struck by a vessel (**Section 2.2**), including the requirement that vessel operators watch for and avoid marine protected species where possible based on ocean conditions. Based on the expected low density of cetaceans and sea turtles in the Action Area and implementation of avoidance measures, the risk of vessel strike for these species is considered discountable.

It is also discountable that vessels would strike UES consultation fish in the Action Area. The fish species listed in **Table 3** are agile animals capable of avoiding oncoming vessels and are only infrequently found near the ocean surface since they do not need to surface to breathe (NMFS 2019). It is discountable that any UES-listed fish would be struck by a project-related vessel.

The Proposed Action would involve no anchoring (vessels would use Illeginni Harbor); therefore, vessels and anchors would not contact the substrate and would have no effect on UES consultation invertebrates.

Effects of Vessel Activity in Illeginni Harbor

UES consultation corals and mollusks have the potential to be affected by turbidity and sedimentation as vessels use Illeginni Harbor. No modifications to Illeginni Harbor would be required for proposed Navy CPS activities. Illeginni Harbor is routinely used for docking of support vessels for ongoing DoD testing activities. Ten UES consultation coral species and four consultation mollusk species are known to occur in Illeginni Harbor (see Table 5 in **Appendix A**). The coral and mollusk species that occur in Illeginni Harbor exist there under the baseline conditions of routine USAG-KA and RTS vessel traffic (established over the past decades) and proposed activities would not change those baseline conditions. Therefore, proposed flight test support activities involving vessels would have no effect on consultation species in Illeginni Harbor.

Vessel traffic would have no effect on UES consultation corals or mollusks in the Action Area. Vessel traffic may affect but is not likely to adversely affect UES consultation cetacean, sea turtle, and fish species in the Action Area as all effects would be discountable.

5.0 Cumulative Effects

Cumulative effects include the effects of future actions that are reasonably certain to occur in the Action Area. Future federal actions that are unrelated to the Proposed Action are not considered in the cumulative effects section of this Biological Assessment as they require their own separate consultation pursuant to Section 3-4 of the UES. No specific non-federal actions have been identified in the Action Area; however, there are several general categories of activities or global trends that may impact biological resources in the Action Area. Therefore, the analysis of cumulative effects for the Proposed Action considers the effects of the Navy CPS flight test activities at Kwajalein Atoll and the general types of activities summarized in **Table 10**.

Table 10. Future Actions and Other Environmental Considerations Identified for Cumulative Effects Analysis

#	Future Action or Consideration	Location in Action Area
1	Commercial and Recreational Fishing	Kwajalein Atoll
2	Subsistence and Artisanal Fishing	Kwajalein Atoll
3	Vessel Traffic	Kwajalein Atoll
4	Ocean Pollution and Marine Debris	Kwajalein Atoll
5	Climate Change and Ocean Acidification	Kwajalein Atoll

5.1 Future Actions and Environmental Considerations

5.1.1 Commercial and Recreational Fishing

Commercial and recreational fishing is prevalent throughout the Pacific including the ocean waters of the Action Area. Fishing can adversely affect not only fish but an abundance of other organisms through overfishing, bycatch, entanglement, and habitat destruction. While commercial and recreational fishing are economically important across the globe, the impacts of fishing on biological resources have been and continue to be significant. Overfishing of targeted species has been documented as a primary cause of population declines in many at-risk species (NOAA 2023a). While overfishing of many U.S. fish stocks has decreased in recent years (NOAA 2022a), overfishing globally has continued to increase with more than a third of the fish stocks around the world considered overfished in 2019 (FAO 2022). Overfishing can deplete spawning stocks, thereby reducing a population's ability to replenish itself (NOAA 2022a). Commercial and recreational fishing also impact non-target species through bycatch. Non-target organisms such as fish, invertebrates, marine mammals, sea turtles, and sea birds can all be subject to bycatch (FAO 2022). Bycatch has been cited as a significant factor in population declines of many species protected under the ESA, MMPA, and UES (NOAA 2023a). Due to overharvest and bycatch, oceanic whitetip shark populations have decreased approximately 90% from 1996 to 2009 (Defenders of Wildlife 2015) and Pacific bluefin tuna populations have decreased to approximately 2.6% of their estimated unfished biomass (Center for Biological Diversity 2016).

Lost fishing equipment can also threaten marine organisms when individuals become entangled in or ingest such debris (NOAA 2023b, NOAA 2023c). Entanglement in marine debris has been an increasing global problem that results in the deaths of hundreds of thousands of marine mammals and sea turtles every year (NOAA 2023b).

Commercial and recreational fishing can also modify ocean habitats and community dynamics within marine ecosystems. Fishing has the potential to negatively impact biodiversity, change community structure, and impact ecosystem functions (FAO 2022) by removing predator species, by removing prey species, or by introducing discarded waste or bycatch and thereby changing food availability for other species. Fishing can also physically alter marine habitats when fishing gear, propellers, and anchors contact the seafloor, especially in deep offshore as well as shallower reef, sandbank, and seagrass areas (Perry et al. 2022). Fishing with gear such as bottom trawls, dredges, handlines, and longlines have all been shown to cause habitat damage (Perry et al. 2022), especially activities that involve equipment being towed along the bottom to capture groundfish, shrimp, and mollusks.

In the RMI, marine fisheries have two distinct areas, offshore and coastal (FAO 2023). Coastal fishing is primarily for subsistence purposes and for sale in local and export markets (discussed in **Section 5.1.2**). Offshore fisheries consist of commercial longlining, purse seining, and pole-and-line fishing and are focused on tuna (FAO 2023). The annual catch from RMI purse-seine vessels in 2014 was 79,562 metric tons, of which 18% was taken within the RMI Exclusive Economic Zone (FAO 2023). Foreign offshore fleets operating within RMI waters caught over 51,000 metric tons of fish in 2014 with over 90% of the catch consisting of tuna (FAO 2023). Analyses indicate that the RMI bigeye tuna stock is in an overfished state (FAO 2023). One UES-listed fish species, the Oceanic white tipped shark, has been recorded in RMI offshore fisheries catch data and consisted of 5% of the non-tuna take in 2009 (Vianna et al. 2020). The two most important non-food fisheries in the RMI are for aquarium fish (mostly from Majuro lagoon and outer reef) and the top shell snail (FAO 2023). A national fisheries policy was approved by the government of the RMI in 1977 to increase fisheries within sustainable limits and to strengthen the capability of the nation to manage its fisheries resources (FAO 2023), and the Marshall Islands Marine Resources Authority was established to manage marine resources and their sustainable development. As part of fisheries management in the Marshall Islands, the Marshall Islands Marine Resources Authority participates in fisheries observer programs, has a shiprider program that allows marine enforcement personnel to ride on U.S. vessels in the Marshall Islands Exclusive Economic Zone, and participates in several regional and international fisheries forums and agreements (FAO 2023).

5.1.2 Subsistence and Artisanal Fishing

Subsistence and artisanal fishing are very important in the RMI, especially in the outer atolls and more remote islets where it provides residents with their primary source of animal protein (FAO 2023). Citizens of the RMI use diverse fishing methods including spearing, hand-lining, trolling, gill-netting, and cast netting (FAO 2023). Some subsistence fishing is conducted via paddling or sailing canoes, while most artisanal fishing is conducted from small craft (4.5 to 6 m [15 to 20 ft]) with outboard motors (FAO 2023). Imported food has gained importance in the RMI since the 1960s, but the consumption of fish remains substantial and critically important to the outer islands (FAO 2023). Almost all artisanal catches in the RMI are marketed locally for food (FAO 2023) but part of the fisheries catch in the RMI includes non-food commodities such as mollusks, aquarium fish, and corals. Exports from the coastal commercial fisheries are primarily aquarium fish and coral for U.S. markets and top shell snails for button factories in Asia and Europe (FAO 2023). Between 1950 and 1990, harvests from artisanal and subsistence fishing increased from 1,100 metric tons per year then stabilized at around 4,500 metric tons per year after 1990 (FAO 2023, Vianna et al. 2020). Subsistence and artisanal catches in the RMI are typically composed of approximately 75% finfishes and 25% invertebrates (Vianna et al. 2020). Predominant fish species include humpback red snapper (*Lutjanus gibbus*) and humpnose big-eye bream (*Monotaxis grandoculis*), each accounting for around 5% of the catch (Vianna et al. 2020). Invertebrates also make up a substantial portion of the subsistence and artisanal catch with giant clams (*Tridacna maxima*, *Hippopus hippopus*, and *Tridacna squamosa*) making up 35% of the invertebrate catch (Vianna et al. 2020). Top shell snails are generally exported rather than consumed locally and make up between 0.25 metric tons and 9 metric tons of the annual artisanal catch (Vianna et al. 2020). Marshall Islands Marine Resource Authority is responsible for coastal fisheries management in the Marshall Islands including a prohibition on taking top-shell snails except during a short open season (FAO 2023).

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. Sea turtles continue to be harvested for subsistence purposes in the RMI, but the taking is restricted to in-water subsistence harvest of hawksbills greater than 68.5-centimeter (27-inch) carapace length and green turtles over 86 centimeters (34 inches) in length (Kabua and Edwards 2010).

The Marshall Islands Marine Resource Authority manages and regulates fishing in the RMI under the Marshall Islands Marine Resources Act of 1997. As part of this Act, the Marine Resource Authority determines the total level of fishing and allocation of fishing rights, develops fishery management plants, protects species, establishes fisheries exclusion zones, limits the taking of sea turtles and other protected species, and regulates fishing gear, among other responsibilities (FAO 2023).

5.1.3 Vessel Traffic

Vessel traffic may impact biological resources by vessels striking marine mammals and sea turtles, introduction of non-native species, emissions, and creation of underwater noise. Global commercial and recreational vessel traffic continues to increase with the global commercial fleet growing approximately 3 to 4% per year over the past 10 years (United Nations 2022, Schoeman et al. 2020). As discussed in **Sections 5.1.1** and **5.1.2**, commercial, recreational, and subsistence fishing is prevalent in the RMI waters and is associated with vessel traffic in the Action Area. Other vessel traffic in the Action Area may include both local and international commercial cargo vessels and passenger cargo vessels. The RMI Port Authority has forecasted that annual cargo volumes to the port of Majuro will likely double from 2013 levels by 2033 (RMIPA 2014) and existing World Bank port data indicate that Marshall Islands container port traffic increased an average of 14% per year between 2010 and 2019 (based on 20-foot equivalent units). At Kwajalein Atoll, the majority of vessel traffic is local vessel traffic, such as recreational sailing, diving and fishing boats, and patrol boats. Ferries and personal transport taxis are used to transport RMI citizens and USAG-KA or RTS employees between islets within Kwajalein Atoll. Larger supply container ships transport materials and supplies to USAKA about every 2 weeks, and fuel barges are also in the area periodically.

Vessel collisions have been documented for at least 75 marine species globally, including smaller whales, dolphins, porpoises, sea turtles, sharks, and other fish (Schoeman et al. 2020). The list of species with documented vessel collisions includes all of the UES consultation cetaceans and sea turtle species listed in **Table 3** except for melon-headed whales (Schoeman et al. 2020, Winkler et al. 2020). Over time, vessel collisions might have population-level consequences for species through contribution to the cumulative mortality rates (Schoeman et al. 2020). Vessel collision risk is generally highest in areas with higher vessel and/or animal density but depends on vessel types, vessel speeds, and the natural history of each species (e.g., relative time spent at the surface) (Schoeman et al. 2020). Global reports of cetacean ship strikes increased up to a peak in 2007 but declined somewhat in the early 2010s (Winkler et al. 2020). Vessel collision reports in the western central Pacific major fishing area, which includes Kwajalein Atoll, have accounted for approximately 3% of total global ship strike reports (Winkler et al. 2020).

5.1.4 Ocean Pollution and Marine Debris

Ocean pollution is the introduction of non-normal and harmful contaminants into the marine ecosystem. Ocean pollution includes marine debris which is defined as any persistent solid material that is intentionally or unintentionally disposed of or abandoned into the marine environment (NOAA 2023b). Ocean pollution has and will continue to have serious impacts on marine organisms and marine ecosystems. Common ocean pollutants include toxic compounds such as metals, pesticides, and other organic chemicals; excess nutrients from fertilizers and sewage; detergents; oil; plastics; and other solids. Pollutants enter oceans from non-point sources (i.e., storm water runoff from watersheds), point sources (i.e., wastewater treatment plant discharges), other land-based sources (i.e., windblown debris), spills, dumping, vessels, and atmospheric deposition.

One of the main ocean pollution concerns in the Pacific Ocean, including the waters of Kwajalein Atoll, is marine debris. Marine debris includes any persistent solid material that is intentionally or unintentionally disposed of or abandoned into the marine environment (NOAA 2023b). Common types of marine debris include various forms of plastic and abandoned fishing gear, as well as clothing, metal, glass, and abandoned and derelict vessels (NOAA 2023b). Marine debris degrades marine habitat quality and poses ingestion and entanglement risks to marine life and birds (NOAA 2023b). Marine debris is an increasing problem with an estimated 23 million metric tons of plastic waste entering aquatic ecosystems in 2016 (NOAA 2023b). Debris that sinks to the seafloor is a concern for ingestion and entanglement by fish, invertebrates, sea turtles, marine mammals, and marine vegetation and may contribute to marine habitat degradation, contributing to coral reef and deep water habitat damage (NOAA 2023b).

Plastic marine debris is a major concern because it degrades slowly and many plastics float, allowing the debris to be transported by currents throughout the oceans. In the North Pacific, currents create subtropical gyres which act to accumulate floating plastic marine debris including an eastern and a western “Garbage Patch” (NOAA 2023b). These large debris accumulation areas are not found in the central Pacific due to the equatorial currents and countercurrents, although marine debris is still carried in these currents. South of the equator, debris accumulation is also occurring in the South Pacific Gyre, where microplastics are distributed across the South Pacific both vertically and horizontally in the water column. Because plastics do not break down the same way as many other materials, plastics often break up into smaller and smaller pieces, called microplastics, when exposed to the sun, salt water, and wave action (NOAA 2023b). Microplastics and the chemicals in plastics can harm animals by causing reproductive, digestive, immune, and other health effects (NOAA 2023b). Fish, marine mammals, and birds can mistakenly consume plastic debris, especially microplastics, which contain elevated levels of toxins instead of their prey (NOAA 2023b). Some studies have shown that approximately 32% of sea turtles and 40% of seabirds have ingested plastics and that 56% of all marine mammal species have been found to ingest debris (NOAA 2023b).

It is likely that the impacts of ocean pollution and marine debris will continue to increase as the amount of debris in the oceans increases and as animal encounters with debris increase.

5.1.5 Climate Change and Ocean Acidification

Climate change is a notable concern in the RMI as the impacts of climate change are more pronounced in this island nation. Kwajalein Atoll is a large coral atoll with extensive nearshore reefs surrounding islets of the atoll and within the mid-atoll corridor. The islets of Kwajalein Atoll are an average of 1.8 m (6 ft) above sea level and a total land area of just over 16 square kilometers (6 square miles). Climate change has the potential to have substantial impacts on terrestrial and marine ecosystems and may contribute to cumulative environmental effects at Kwajalein Atoll. According to recent reports by the International Panel on Climate Change, factors projected to be of the most concern to the Pacific Islands before 2050 include mean air temperature, atmospheric carbon dioxide at the surface, ocean acidity, relative sea level, marine heatwaves, coastal flooding, coastal erosion, heavy precipitation and pluvial (rain) flood, and extreme heat (IPCC 2021).

Globally, ocean ecosystems and marine resources are already being affected by climate change and the related issue of ocean acidification. These effects are expected to increase in coming years. Global sea level has been rising over the past century and the rate has increased in the most recent decades. Sea level has risen approximately 21 to 24 centimeters (8 to 9 inches) since 1880 and further increases are expected even if significant reductions in greenhouse gas emissions are made (NOAA 2022b). Increasing levels of atmospheric carbon dioxide (CO_2) is one of the most serious problems affecting physical, chemical, and biological properties of oceans (Griffis and Howard 2013). The present atmospheric CO_2 concentrations are higher than they have been at any time in recorded history and reached new record highs in 2022 (NOAA 2023e). Anthropogenic release of CO_2 from fossil fuel combustion is considered the largest contributor to global climate change and has resulted in a 43% increase in atmospheric concentrations of greenhouse gases since 1850 (USEIA 2022). While there are some projections that U.S. energy-related emissions will decrease slightly by 2050 (2% lower than 2021 levels), world CO_2 emissions are projected to continue to increase (USEIA 2022, NOAA 2023e). The two primary direct consequences of increased atmospheric CO_2 in marine ecosystems are increased ocean temperatures and higher acidity (Griffis and Howard 2013).

Air temperature and ocean surface temperatures are strongly correlated as atmospheric heat is absorbed by ocean waters (Griffis and Howard 2013). Data has shown that as atmospheric CO_2 and other greenhouse gas concentrations have increased, air temperatures have increased and so have ocean temperatures (Griffis and Howard 2013). Increasing ocean temperatures have the potential to affect marine organisms and ecosystems in several ways. In addition to the physical change of temperature, ocean temperature change can lead to changes in ice volume, sea level, ocean circulation, available oxygen, and salinity (Griffis and Howard 2013). Research has shown that average temperature of the upper 700 m (2,297 ft) of ocean water increased by 0.2 degrees Celsius (ºC; 0.4 degrees Fahrenheit [ºF]) between 1961 and 2003 and arctic sea ice volume shrank by 75% over a decade (Griffis and Howard 2013). The global mean surface temperature in 2022 was 0.86 ºC (1.55 ºF) warmer than the 20th century average and 1.06 ºC (1.90 ºF) warmer than the pre-industrial period (1880-1900) (NOAA 2023d). The 10 warmest years on record have all occurred since 2010 (NOAA 2023d). Based on modeling, it is predicted that air temperatures and ocean temperatures will continue to increase over the next several decades (NOAA 2023d, IPCC 2021). While some variations in local temperature change are expected, ocean temperatures are expected to change globally and subsequently affect biological resources throughout the world's oceans.

Ocean acidification is one of the major changes in ocean chemistry as a result of increasing atmospheric CO_2 levels. Ocean acidification is the decrease in the pH of oceans associated with the uptake of atmospheric CO_2 and related chemical reactions (Griffis and Howard 2013). Ocean surface pH has declined globally over the last 40 years and present-day pH values are lower than they have been for at least 26,000 years (IPCC 2021). Corals and a variety of other marine organisms require calcium carbonate to build exoskeletons; however, ocean acidification drives down the availability of calcium carbonate in ocean waters (Brierley and Kingsford 2009, IPCC 2021). Increased acidification is also thought to adversely affect coral fertilization, larval settlement, zooxanthellae acquisition rates, and stress levels affecting growth rates (Brainard et al. 2011). Ocean acidification is expected to increase in the coming decades (IPCC 2021) and the effects of acidification and associated reductions in the saturation state of calcium carbonate are expected to continue or intensify.

Trends in the RMI are consistent with global patterns of warming and sea level rise. At Kwajalein, maximum temperatures increased at a rate of 0.20 ºC (0.36 ºF) per decade between 1960 and 2011 (PCCSP 2011) and mean air temperatures have increased 1 to 2 ºC (2 to 4 ºF) in the RMI since the 1950s (The Nature Conservancy n.d., World Bank Group 2021). Based on climate modeling for the RMI and across the Pacific, temperatures are projected to increase between 0.6 and 4 ºC (1 and 7 ºF) by 2090 (World Bank Group 2021). Sea level in the RMI rose approximately 0.8 centimeters (0.3 inches) per year between 1993 and 2011 (PCCSP 2011) with tide gauge data indicating a rise of approximately 13 to 15 centimeters (5 to 6 inches) between 1968 and 2015 (The Nature Conservancy n.d.). Sea levels are expected to rise at least 0.5 centimeters (0.2 inches) per year with global mean sea level rise estimated in the range of 0.4 to 0.7 m (1.4 to 2.4 ft) by 2100 (World Bank Group 2021). Ocean acidification has been slowly increasing in Marshall Islands' waters since the 18th century (PCCSP 2011). Ocean acidification and ocean temperatures are expected to continue to rise in the next several decades (IPCC 2021, Australian Bureau of Meteorology 2014).

Coral bleaching is a threat to coral reef ecosystems that directly relates to increases in ocean temperatures. The dinoflagellate algae (zooxanthellae) which are tissue-borne symbionts of many coral species, are particularly sensitive to increasing ocean temperatures and this can lead to bleaching events (Brierley and Kingsford 2009, Marshall and Schuttenburg 2006). Coral bleaching occurs when the colorful zooxanthellae are expelled from stressed coral hosts (Marshall and Schuttenburg 2006). Loss of zooxanthellae also reduces the nutritional advantage that healthy corals receive symbiotically from the by-products of photosynthesis. Many local stressors may cause coral bleaching including disease, sedimentation, pollutants, and changes in salinity; however, a growing body of evidence indicates that the large-scale bleaching events observed in recent decades are closely associated with globally increasing sea temperatures (Eakin et al. 2018, Marshall and Schuttenburg 2006, Beger et al. 2008). Even if corals survive bleaching events and repopulate their tissues with zooxanthellae; growth, reproduction, and resistance to disease may be reduced in corals subject to bleaching (Marshall and Schuttenburg 2006). Projections of global ocean temperature increases over the next several decades suggest that mass bleaching events are likely to be more frequent in the future (Marshall and Schuttenburg 2006). Increases in frequency and severity of mass bleaching events are likely to decrease coral cover and lower coral biodiversity (Marshall and Schuttenburg 2006). These changes in coral abundance and diversity would likely alter the available habitat and food for other reef-associated species and subsequently community structure of these coral reefs (Marshall and Schuttenburg 2006).

The Proposed Action would not meaningfully contribute to global GHG emissions or climate change but the potential impacts of climate change in conjunction with proposed activities and other past, present, and reasonably foreseeable actions are considered in this section.

5.2 Cumulative Effects

Consequences of cumulative impacts on marine animals can manifest as any combination of loss of prey resources, behavioral disturbances from various human activities (such as vessel activity or military ordnance activities), acoustic disturbances, an increased chance of physical strikes or contact, or decreased resilience following disturbance (e.g., delayed or lack of recovery from induced stress or physiological changes back to a natural state).

Marine mammals, sea turtles, and fish have the potential to be impacted by the cumulative effects from commercial and recreational fishing, subsistence and artisanal fishing, vessel traffic, ocean pollution, and climate change. Almost all of the marine mammals, sea turtles, and fish considered in this Biological Assessment are at direct risk from commercial fishing bycatch, vessel strike, and entanglement in or ingestion of marine debris. These considerations may also impact these animals indirectly through changes in prey availability. The effects of climate change and ocean acidification are likely to primarily impact marine mammals, sea turtles, and fish by changing prey availability and habitat suitability. Sea turtle nesting and reproduction may also be affected by climate change as nesting sites may be inundated due to rising seas and as their eggs depend on temperature conditions for proper development. All of these impact considerations are expected to continue in the foreseeable future and may have adverse impacts on marine mammal populations.

Based on analyses in **Section 4.0**, marine mammals, sea turtles, and most fish species are not likely to be adversely affected by Proposed Action activities in the Action Area. All effects of the Proposed Action on marine mammals, sea turtles, and all fish except the humphead wrasse would be discountable or insignificant. The Proposed Action would generate marine debris and vessel traffic but no additive or interactive effects with other future actions or environmental considerations have been identified that would contribute to or increase cumulative effects on these animals.

The corals, mollusks, and reef-associated fish considered in this Biological Assessment have the potential to be impacted by cumulative effects from commercial and recreational fishing, subsistence and artisanal fishing, vessel traffic, ocean pollution and marine debris, and climate change and ocean acidification. Commercial and recreational fishing affect corals and mollusks through targeted fishing, bycatch, and habitat alteration. Subsistence and artisanal fishing in the RMI likely affect populations of UES consultation species, especially top shell snails and giant clams, and contribute to cumulative effects on these species. Some fishing methods or marine debris created from abandoned fishing equipment can damage corals in reefs. Lost or abandoned traps, nets, and lines from fisheries can damage corals in reefs. The main effect of vessel traffic on coral and mollusks is the effect of cavitation on larvae. Cavitation from vessels traveling through an area could lead to decreased fertilization, larval deformities, or even larval death (NMFS 2015b). Studies have provided evidence that larvae subject to highly turbulent water may die or have abnormal development (NMFS 2015b). As with other organisms, corals and mollusks can become entangled in or inadvertently ingest particles of marine debris.

Coral reef systems such as those found near Illeginni Islet are among the most diverse ecosystems on the planet. Coral reefs may be threatened by the physical, chemical, and biological changes in ocean waters associated with climate change and ocean acidification (Brierley and Kingsford 2009, Beger et al. 2008). Climate change is a global phenomenon and widespread coral bleaching events have been recorded throughout the Tropical Pacific (Eakin et al. 2018), including multiple coral bleaching events that have occurred at USAKA between 2012 and 2018 (NMFS and USFWS 2021, NMFS and USFWS 2018). During the most recent biological inventories at Illeginni Islet (NMFS and USFWS 2018), evidence of coral bleaching was observed in lagoon flat, lagoon slope, ocean flat, and ocean slope habitats offshore of the target site. NMFS has stated that coral bleaching events in the RMI are likely to increase in frequency because ocean waters are expected to reach severe coral bleaching temperatures annually within the next 20 years (NMFS and USFWS 2021). Many coral species are integral components in coral reef ecosystems, providing physical structure and productivity and any cumulative effects on these reef building corals would result in changes to the reef habitat and would affect other reef-associated species.

Illeginni Islet has been the terminal target site for DoD missile testing for the past several decades. In the past, NMFS has noted effects on the reefs offshore of the Illeginni target site due to both payload impacts and post-test cleanup activities. Some degradation of lagoon flat and crest habitats has been noted in past inventories offshore of the Illeginni targets site (NMFS and USFWS 2018), but how much of this could be attributed to ongoing missile testing vs other environmental considerations or natural processes cannot be determined given existing data. Even though flight testing is ongoing, NMFS and USFWS noted in their most recent inventory that there was no evidence of anthropogenic impacts in lagoon slope or ocean slope habitats other than those associated with warm water bleaching events (NMFS and USFWS 2018). In the ocean flat area, it was noted that even though metal debris associated with previous testing was present, the area did not appear degraded in 2016 (NMFS and USFWS 2018). It is likely that past and ongoing DoD testing at Illeginni Islet has contributed and will continue to contribute to cumulative effects on corals and coral reef habitats to some degree.

All of these environmental considerations which have contributed to cumulative effects on UES consultation corals, mollusks, and reef-associated fish are expected to continue in the foreseeable future and may have adverse impacts on populations of these species.

Based on analyses in **Section 4.0**, proposed activities may affect and are likely to adversely affect several species of corals and mollusks and humphead wrasse. Adults of six coral and three mollusk species have the potential to be damaged by direct contact or shock waves and these species may be adversely affected by the Proposed Action. It should be noted that these effects would only be realized in the unplanned and unexpected event of a shoreline or reef flat payload impact. Based on this worst-case scenario, the Proposed Action has the potential to affect a number of corals and mollusks but would not change the regional relative population density, distribution, or recovery ability of these species. As part of ongoing DoD testing at RTS, the Proposed Action has the potential to contribute incrementally to cumulative effects on reef-associated species. However, proposed testing is quantitatively and qualitatively within the envelope of past and ongoing DoD testing at Illeginni Islet and is not expected to have substantial interactive or additive effects that would significantly contribute to cumulative effects on these species.

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6.0 Conclusions

Based on analyses of all of the potential stressors in the Action Area, the Navy has determined that the Proposed Action would have "no effect" on 15 coral species (*Acanthastrea brevis*, *Acropora aculeus*, *A. aspera*, *A. dendrum*, *A. listeri*, *A. speciosa*, *A. tenella*, *A. vaughani*, *Alveopora verrilliana*, *Leptoseris incrustans*, *Montipora caliculata*, *Pavona cactus*, *P. decussata*, *Turbinaria mesenterina*, and *T. stellulata*) and two mollusk species (*Pinctada margaritifera* and *Tridacna gigas*) listed as consultation species under the UES (**Table 4**). These species are not known to occur in the portion of the Action Area where they might be exposed to stressors resulting from the Proposed Action.

The Navy has determined that the Proposed Action "may affect but is not likely to adversely affect" 16 cetacean species, two sea turtle species, and six fish species listed as consultation species under the UES in the Action Area (**Table 11**). The species that may be but are not likely to be adversely affected by the Proposed Action include the cetaceans *Balaenoptera musculus*, *B. physalus*, *Delphinus delphis*, *Feresa attenuata*, *Globicephala macrorhynchus*, *Grampus griseus*, *Kogia breviceps*, the Western North Pacific Distinct Population Segment (DPS) of *Megaptera novaeangliae*, *Mesoplodon densirostris*, *Orcinus orca*, *Peponocephala electra*, *Physeter macrocephalus*, *Stenella attenuata*, *S. coeruleoalba*, *S. longirostris*, and *Tursiops truncatus*; the Central West Pacific DPS of green turtle (*Chelonia mydas*); the hawksbill turtle (*Eretmochelys imbricata*); and the fish *Alopias superciliosus*, *Carcharhinus longimanus*, *Mobula alfredi*, *M. birostris*, *Sphyrna lewini*, and *Thunnus orientalis*. Based on the analysis in **Section 4.0** and summarized in **Table 11,** all effects of the Proposed Action on these species would be insignificant or discountable.

The Navy has determined that the Proposed Action "may affect and is likely to adversely affect" six coral species, three mollusk species, and the humphead wrasse (**Table 11**). The species likely to be adversely affected by the Proposed Action are the corals *Acropora microclados*, *A. polystoma*, *Cyphastrea agassizi*, *Heliopora coerulea*, *Pavona cactus*, and *Turbinaria reniformis*; the mollusks *Hippopus hippopus*, *Rochia nilotica*, and *Tridacna squamosa*; and the fish *Cheilinus undulatus*. Based on the analysis presented in **Section 4.2.2**, the Proposed Action may adversely affect up to 15,156 coral colonies, 120 individual mollusks, and 10 adult and 150 juvenile humphead wrasse (**Table 12**).

There is no designated critical habitat for any listed species in the Action Area.

Table 11. Effect Determinations for UES Consultation Species that may be Affected by the Proposed Action.

Scientific Name	Common Name	Deep ocean waters of KMISS and Kwajalein Atoll					Illeginni Islet and nearshore habitats				
		Elevated Sound	Direct Contact	Hazard. Materials	Human Activity	Vessel Strike	Elevated Sound	Direct Contact	Hazard. Materials	Human Activity	Vessel Strike
Cetaceans											
Balaenoptera musculus	Blue whale	◎	◎	◎	◎	◎	–	–	–	–	–
Balaenoptera physalus	Fin whale	◎	◎	◎	◎	◎	–	–	–	–	–
Delphinus delphis	Short-beaked common dolphin	◎	◎	◎	◎	◎	–	–	–	–	–
Feresa attenuata	Pygmy killer whale	◎	◎	◎	◎	◎	–	–	–	–	–
Globicephala macrorhynchus	Short-finned pilot whale	◎	◎	◎	◎	◎	–	–	–	–	–
Grampus griseus	Risso's dolphin	◎	◎	◎	◎	◎	–	–	–	–	–
Kogia breviceps	Pygmy sperm whale	◎	◎	◎	◎	◎	–	–	–	–	–
Megaptera novaeangliae	Humpback whale (Western North Pacific DPS)	◎	◎	◎	◎	◎	–	–	–	–	–
Mesoplodon densirostris	Blainville's beaked whale	◎	◎	◎	◎	◎	–	–	–	–	–
Orcinus orca	Killer whale	◎	◎	◎	◎	◎	–	–	–	–	–
Peponocephala electra	Melon-headed whale	◎	◎	◎	◎	◎	–	–	–	–	–
Physeter macrocephalus	Sperm whale	◎	◎	◎	◎	◎	–	–	–	–	–
Stenella attenuata	Pantropical spotted dolphin	◎	◎	◎	◎	◎	–	–	–	–	–
Stenella coeruleoalba	Striped dolphin	◎	◎	◎	◎	◎	–	–	–	–	–
Stenella longirostris	Spinner dolphin	◎	◎	◎	◎	◎	–	–	–	–	–
Tursiops truncatus	Bottlenose dolphin	◎	◎	◎	◎	◎	–	–	–	–	–
Sea Turtles											
Chelonia mydas	Green turtle (Central West Pacific DPS)	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
Eretmochelys imbricata	Hawksbill turtle	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎

Scientific Name	Common Name	Deep ocean waters of KMISS and Kwajalein Atoll					Illeginni Islet and nearshore habitats				
		Elevated Sound	Direct Contact	Hazard. Materials	Human Activity	Vessel Strike	Elevated Sound	Direct Contact	Hazard. Materials	Human Activity	Vessel Strike
Fish											
Alopias superciliosus	Bigeye thresher shark	◎	◎	◎	◎	◎	–	–	–	–	–
Carcharhinus longimanus	Oceanic whitetip shark	◎	◎	◎	◎	◎	–	–	–	–	–
Cheilinus undulatus	Humphead wrasse	–	–	–	–	–	◎	●	◎	◎	◎
Mobula alfredi	Reef manta ray	◎	◎	◎	◎	◎	◎	○	◎	◎	◎
Mobula birostris	Oceanic giant manta ray	◎	◎	◎	◎	◎	◎	○	◎	◎	◎
Sphyrna lewini	Scalloped hammerhead (Indo-West Pacific DPS)	◎	◎	◎	◎	◎	◎	○	◎	◎	◎
Thunnus orientalis	Pacific bluefin tuna	◎	◎	◎	◎	◎	–	–	–	–	–
Corals											
Acropora microclados		–	–	–	–	–	○	●	◎	◎	○
Acropora polystoma		–	–	–	–	–	○	●	◎	◎	○
Cyphastrea agassizi	Agassiz's coral	–	–	–	–	–	○	●	◎	◎	○
Heliopora coerulea	Blue coral	–	–	–	–	–	○	●	◎	◎	○
Pavona cactus		–	–	–	–	–	○	●	◎	◎	○
Turbinaria reniformis		–	–	–	–	–	○	●	◎	◎	○
Mollusks											
Hippopus hippopus	Giant clam	–	–	–	–	–	○	●	◎	◎	○
Rochia nilotica	Top shell snail	–	–	–	–	–	○	●	◎	◎	○
Tridacna squamosa	Giant clam	–	–	–	–	–	○	●	◎	◎	○

● = may affect and likely to adversely affect, ◎ = may affect but not likely to adversely affect, ○ = no effect, "-" not known to be present in this portion of the Action Area
Abbreviations: DPS = distinct population segment, KMISS = Kwajalein Missile Impact Scoring System

Table 12. Estimated Total Number of Consultation Coral Colonies, Individual Mollusks, and Individual Fish Potentially Adversely Affected by Proposed Navy CPS Activities

Species	Estimated Total Number of Colonies or Individuals That May be Adversely Affected[1]
Corals	
Acropora microclados	60
Acropora polystoma	60
Cyphastrea agassizi	40
Heliopora coerulea	14,970
Pavona venosa	40
Turbinaria reniformis	40
Coral Subtotal	**15,156**
Mollusks	
Hippopus hippopus	90
Tectus niloticus	10
Tridacna squamosa	20
Mollusk Subtotal	**120**
Fish	
Cheilinus undulatus - adults	10
Cheilinus undulatus - juveniles	150
Fish Subtotal	**10 adults and 150 juveniles**

Note:
[1] The estimated total number of coral colonies or individual mollusks that may be adversely affected for all potential tests with land impact (up to one per year over 10 years) was calculated based on the 99% upper confidence limit density of colonies or individuals potentially exposed to direct contact from both debris and shock waves for each test multiplied by ten.

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Baseline Conditions of UES Consultation Species and Habitats at DoD Test Locations in Kwajalein Atoll

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Baseline Conditions of UES Consultation Species and Habitats at DoD Test Locations in Kwajalein Atoll

November 2023 Revised Version

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Acronyms and Abbreviations

μPa	micropascal(s)
C	Celsius
CBD	Center for Biological Diversity
cm	centimeter(s)
dB	decibel(s)
DoD	Department of Defense
DPS	Distinct Population Segment
ESA	Endangered Species Act
F	Fahrenheit
ft	feet
ft^3	cubic feet
Hz	hertz
IUCN	International Union for the Conservation of Nature and Natural Resources
kHz	kilohertz
KMISS	Kwajalein Missile Impact Scoring System
lb	pounds
m	meter(s)
mi	mile(s)
MMPA	Marine Mammal Protection Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
PIRO	Pacific Islands Regional Office
RMI	Republic of the Marshall Islands
RTS	Ronald Reagan Ballistic Missile Defense Test Site
SEL	Sound Exposure Level
SPC	The Pacific Community
U.S.	United States
UES	United States Army Kwajalein Atoll Environmental Standards
USAF	United States Air Force
USAG-KA	United States Army Garrison – Kwajalein Atoll
USASMDC	United States Army Space and Missile Defense Command
USFWS	United States Fish and Wildlife Service

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1.0 Scope and Purpose

1.1 Introduction

This document was prepared to describe the baseline conditions for species listed as consultation species under Section 3-4 of the *Environmental Standards and Procedures for U.S. Army Kwajalein Atoll (USAKA) Activities in the Republic of the Marshall Islands, 16th Edition* (USASMDC 2021; hereafter referred to as the USAKA Environmental Standards or UES) at select United States (U.S.) Department of Defense (DoD) test locations in Kwajalein Atoll. This document is maintained and updated by KFS, LLC to support the evaluation of the effects of various DoD test programs on UES consultation species and to support consultation with the National Marine Fisheries Service (NMFS) and United States Fish and Wildlife Service (USFWS) where required.

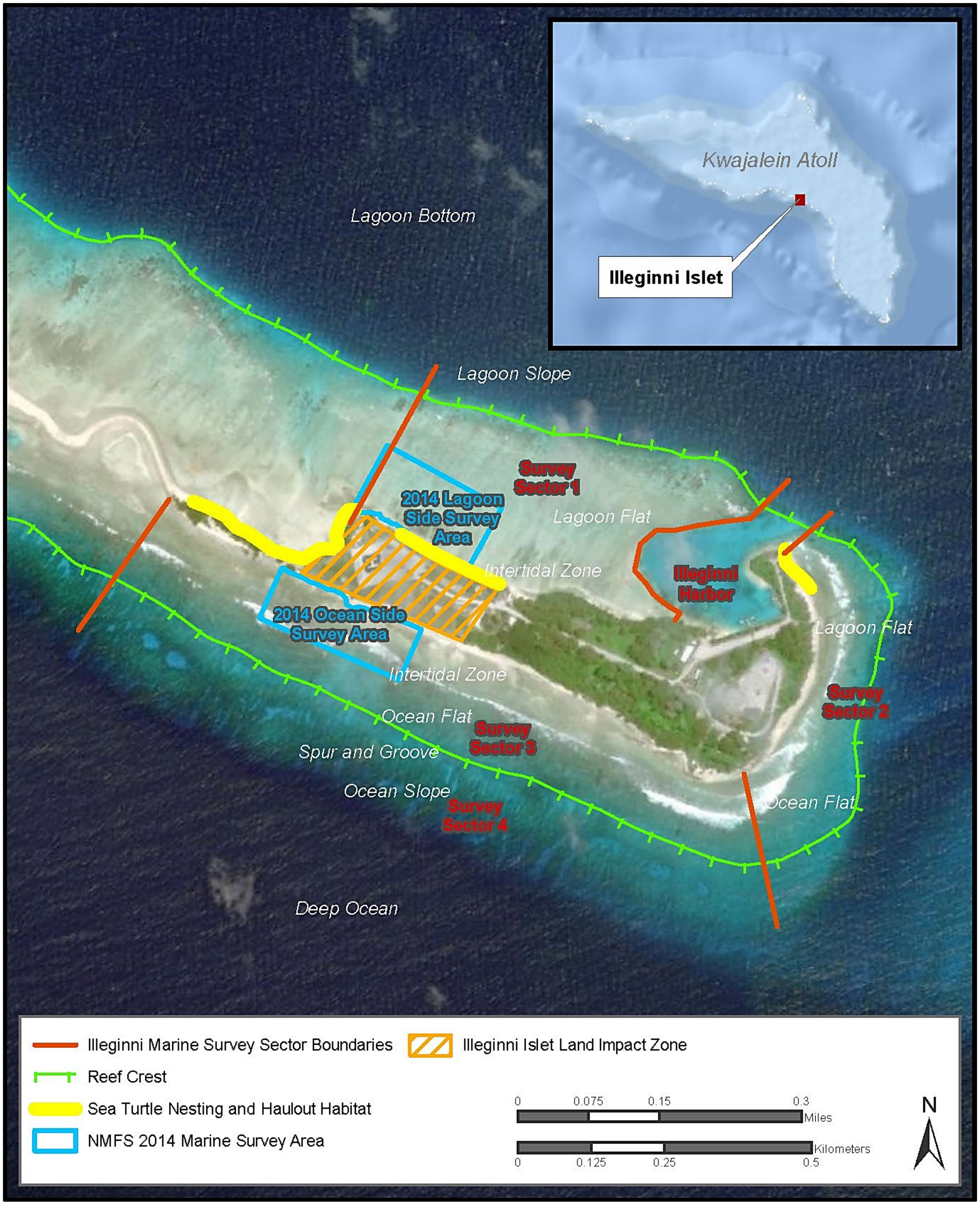
1.2 Locations Considered

The locations considered in this document include select DoD testing locations that are on the U.S. Army Garrison-Kwajalein Atoll (USAG-KA) and Ronald Reagan Ballistic Missile Defense Test Site (RTS) controlled islands and the Mid-Atoll Corridor, as well as all other deep-water sites within the Republic of the Marshall Islands (RMI) at Kwajalein Atoll. Locations considered in this document include:

- Terrestrial areas of Illeginni Islet, focused on the test program impact zone on the western end of the islet (**Figure 1**);
- Nearshore marine areas of Illeginni Islet with focus on areas adjacent to the terrestrial impact zone on Illeginni Islet (**Figure 1**); and
- Three offshore, deep-water test impact zones (**Figure 2**);
    - the Kwajalein Missile Impact Scoring System (KMISS) impact zone,
    - the Southwest Deep Ocean Impact zone southwest of Kwajalein Atoll, and
    - the impact zone in the vicinity (southwest) of Illeginni Islet.

Testing activities at Kwajalein Atoll may include activities outside of these locations; however, the primary stressors related to test program activities are either within or centered on these missile or payload impact zones.

Illeginni Islet. Illeginni Islet is on the western side of Kwajalein Atoll and has been the site of DoD testing for several decades, including missile and payload impact testing. The USAG-KA/RTS test impact zone on Illeginni Islet is an area approximately 137 meters (m) (450 feet [ft]) by 290 m (950 ft) on the non-forested, northwest end of the islet (**Figure 1**). The only UES consultation species with the potential to use terrestrial habitats at Illeginni Islet are green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) sea turtles.



Data Sources: NMFS-PIRO 2017a, NMFS-PIRO 2017b, NMFS and USFWS 2018

Figure 1. Terrestrial Impact Zone, Marine Survey Areas, and Habitats at Illeginni Islet

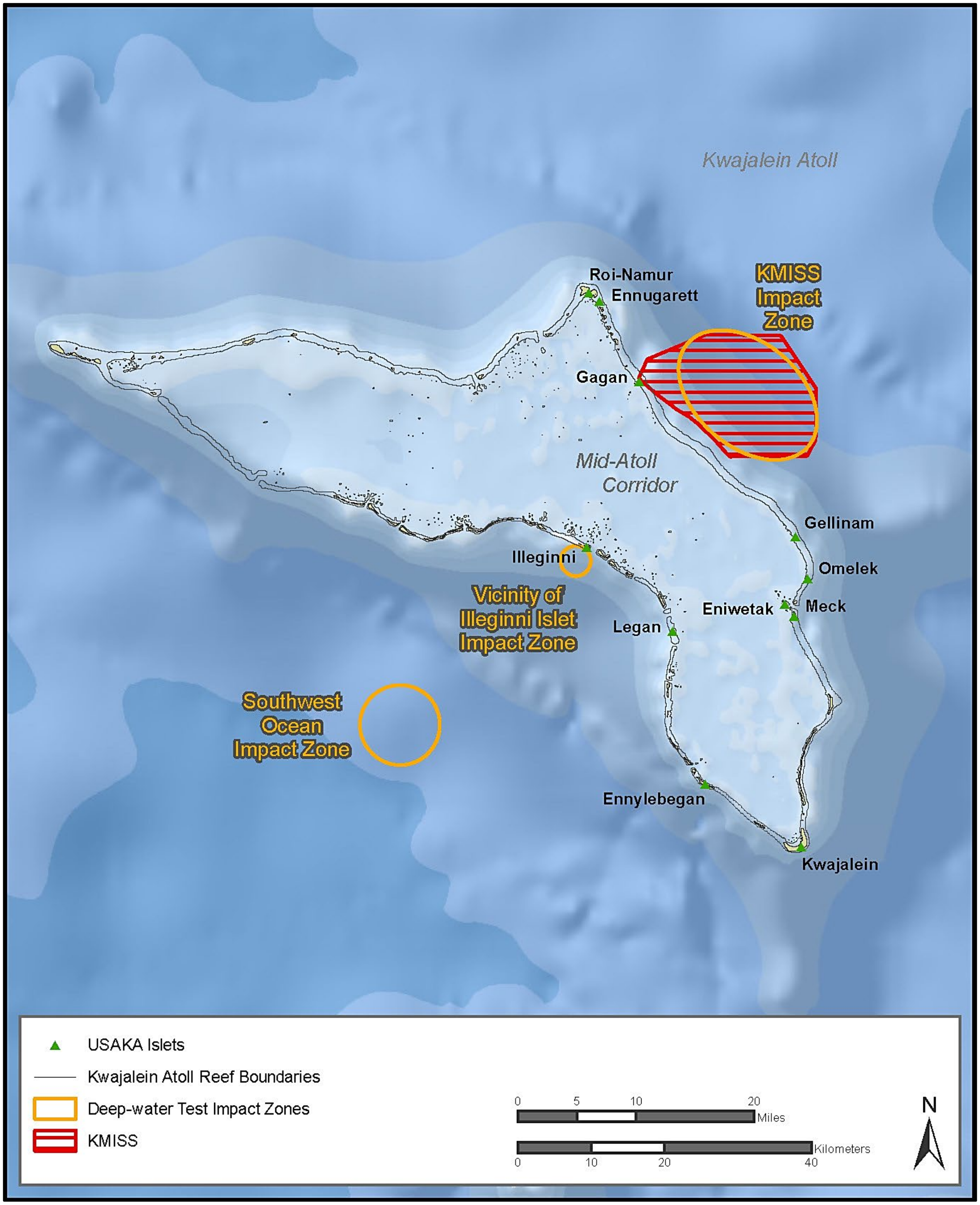


Figure 2. Deep Water Impact Zones for Testing at Kwajalein Atoll.

Illeginni Islet Nearshore Marine Areas. Marine habitats of the neritic zone around Illeginni Islet include both lagoon-side and ocean-side reef flats, crests, and slopes with diverse communities of organisms as well as areas of pavement and cobbles (**Figure 1**). These habitats support a number of reef-associated corals, mollusks, and fish that are listed as consultation species under Section 3-4 of the UES. Human activity and vessel operation resulting from testing activities have the potential to occur in several nearshore marine areas at Illeginni Islet, including Illeginni Harbor. While the presence of UES consultation species in nearshore areas surrounding all of Illeginni Islet is discussed in this document, the document focuses on UES consultation species likely to occur in the habitats offshore of the terrestrial impact zone on the western end of Illeginni Islet as these species have the most potential to be affected by DoD testing activities.

In accordance with requirements specified in the UES, USAG-KA conducts a natural resource baseline survey of USAG-KA controlled islets and associated marine habitats every 2 years to identify and inventory protected or important biological resources (USASMDC 2021). USFWS and NMFS personnel have been conducting these biennial biological resource inventories since 1996 to support USAG-KA requirements. The last marine survey at USAKA islets occurred in 2016. In addition to biennial resources surveys, NMFS surveyed the reef habitats offshore of the test impact zone at Illeginni Islet (**Figure 1**) in 2014 (NMFS-PIRO 2017a). NMFS estimated that these surveys covered all of the reef habitat area potentially affected by payload impact testing on the lagoon side and 99% of the reef area on the ocean side (NMFS-PIRO 2017a and NMFS-PIRO 2017b). These data are still considered the best available information for coral and mollusk species presence and density offshore of the terrestrial impact zone at Illeginni Islet.

Offshore Test Sites. The KMISS is a system of sensors east of Gagan Islet at Kwajalein Atoll (**Figure 2**). The waters of the KMISS area where payload impacts are conducted are deep-water areas with ocean depth ranging from approximately 2,100 to 3,700 m (7,000 to 12,000 ft. The waters southwest of Kwajalein Atoll and southwest of Illeginni Islet, often referred to as the “Vicinity of Illeginni Islet” site, are also deep-water, open ocean areas. A wide variety of pelagic and benthic habitats occur in deep-water habitats of Kwajalein Atoll and these habitats support a diversity of marine life. Many special status marine species have the potential to occur in these areas, including cetacean, sea turtle, and fish species protected under the UES (USASMDC 2021). Distribution and abundance data in RMI waters are largely lacking for these species. Some species are migratory species which are present in RMI waters seasonally and some others are observed only rarely in the RMI.

2.0 UES Consultation Species in the Study Area

2.1 Marine Mammals

Sixteen cetacean species protected under the UES have the potential to occur in the waters of Kwajalein Atoll (**Table 1**), four of which are listed under the Endangered Species Act (ESA). All marine mammals discussed in this section are also protected under the Marine Mammal Protection Act (MMPA) (16 United States Code § 1361 et seq.). The marine mammal species listed in **Table 1** have the potential to occur in the deep-water test sites considered in this document but would not occur in the shallow nearshore waters near the Illeginni Islet impact zone. Most of the cetacean species listed in **Table 1** have been observed in the RMI (Miller 2023a) and are likely to occur in the deep-water DoD test sites such as KMISS and southwest of Illeginni Islet. For other species such as pygmy killer whale (*Feresa attenuata*), Risso's dolphin (*Grampus griseus*), pygmy sperm whale (*Kogia breviceps*), and Blainville's beaked whale (*Mesoplodon densirostris*), potential presence in the waters of Kwajalein Atoll is based on information regarding life history, including feeding patterns, known distribution, and migration patterns, as well as range distribution from literature sources (NOAA 2023a, Reeves et al. 2002, Perrin et al. 2002). The dugong (*Dugong dugong*) may have occurred historically at Kwajalein Atoll according to an appendix of the UES. However, this species has not been reported in Kwajalein Atoll for many decades.

Summary of Threats to Cetaceans. Potential threats to cetacean species in the Pacific Ocean 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, parasites and diseases, and changing sea surface temperatures due to global climate change (NOAA 2023a). These threats are not particular to ESA or UES listed species, but the death of an individual may have a greater impact on populations with low numbers.

Noise Exposure and Cetaceans. 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. Anthropogenic sounds are becoming more prevalent in marine environments and can have a broad range of effects on marine mammals (Gomez et al. 2016).

Table 1. Marine Mammal Species Requiring Consultation under the UES that have the Potential to Occur in Kwajalein Atoll Waters.

Scientific Name	Common Name	UES Consultation Species Listing Status[1]		
		ESA	MMPA	RMI Statute
Balaenoptera musculus	Blue whale	E	Migratory	1
Balaenoptera physalus	Fin whale	E	Migratory	
Delphinus delphis	Short-beaked common dolphin			2
Feresa attenuata	Pygmy killer whale		Resident	
Globicephala macrorhynchus	Short-finned pilot whale		Migratory	
Grampus griseus	Risso's dolphin		Resident	
Kogia breviceps	Pygmy sperm whale		Migratory	
Megaptera novaeangliae	Humpback whale (Western North Pacific DPS)[2]	E[(2)]	Migratory	
Mesoplodon densirostris	Blainville's beaked whale		Migratory	
Orcinus orca	Killer whale		Resident	
Peponocephala electra	Melon-headed whale		Resident	
Physeter macrocephalus	Sperm whale	E	Resident	1
Stenella attenuata	Pantropical spotted dolphin			2
Stenella coeruleoalba	Striped dolphin			2
Stenella longirostris	Spinner dolphin		Resident	2
Tursiops truncatus	Bottlenose dolphin		Resident	

Sources: USASMDC 2021, NOAA 2023a

Notes:

1 UES Consultation Species Listing Status based on Appendix 3-4A of the UES (USASMDC 2021).
RMI Statutes: 1 = Endangered Species Act 1975, Title 8 MIRC [Mariana Islands Range Complex] Chapter 3; 2 = Marine Mammal Protection Act 1990, Title 33 MIRC Chapter 2

2 The DPSs of humpback whales likely in Kwajalein Atoll Waters (Oceania DPS) are not listed under the ESA; however, there is some uncertainty about which DPS whales in the area belong to.

Abbreviations: DPS = Distinct Population Segment, E = ESA Endangered, ESA = U.S. Endangered Species Act, MMPA = Marine Mammal Protection Act, RMI = Republic of the Marshall Islands; UES = United States Army Kwajalein Atoll Environmental Standards (USASMDC 2021 Section 3-4.5.1).

Measurements for sound pressure levels in air are generally referenced to (re) 20 micropascals (μPa), and underwater sound levels are standardized to 1 μPa at 1 m (3.3 ft). In the waters of Kwajalein Atoll, 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 decibels (dB) re 1 μPa. A passing supertanker can generate up to 190 dB re 1 μPa of low frequency sound.

There is evidence that loud underwater noise can be lethal, physically damaging, or disruptive to cetaceans (Erbe et al. 2018). Cetaceans have been observed altering their vocalizations in the presence of underwater anthropogenic noises and avoiding some underwater sounds, even vacating feeding or mating grounds, changing migratory routes, or suspending feeding (Erbe et al. 2018). Certain cetaceans are affected by elevated noise levels more than others. The beaked whales (Ziphiidae) and other deep diving species seem to be particularly susceptible to acoustic damage and anthropogenic noise has been linked to strandings in some species (Ellis and Mead 2017, Erbe et al. 2018).

2.1.1 Blue Whale (Balaenoptera musculus)

Species Description. Blue whales are listed as endangered throughout their range under the ESA and as depleted under the MMPA. Blue whales have been recorded at lengths up to 34 m (110 ft), and adults generally weigh 80-150 metric tons (176,000 to 330,000 pounds [lb]) (Sears 2002). This species is a type of baleen whale, which preys almost exclusively on various types of zooplankton, especially krill (Bannister 2002). While blue whales sometimes surface feed, these whales more often lunge feed by diving at least 100 m (330 ft) for 8-15 minutes (Sears 2002). Like other Balaenopterids, blue whales belong to the low-frequency functional hearing group, with hearing ranging from 7 hertz (Hz) to 22 kilohertz (kHz) (Southall et al. 2007). Blue whales breed and calve in late fall through winter (Sears 2002).

Distribution. Blue whales inhabit all oceans of the world and while they are sometimes found in coastal waters, they are predominantly found offshore (Sears 2002). Blue whales in U.S. waters of the North Pacific are divided into two management stocks: the eastern Pacific management stock and the central Pacific management stock. The central Pacific management stock migrates seasonally between summer feeding grounds in the north-central Pacific and wintering areas in lower latitudes of the western and central Pacific including Hawai`i (NOAA 2022a). Blue whales are most often observed alone or with one to two individuals but can be found in groups of 50 or more in very productive areas (Sears 2002). Calving occurs in winter (Sears 2002) and likely in tropical and subtropical waters (Jefferson et al. 2008).

Threats. Widespread whaling over the last century is believed to have decreased the population to approximately 1% of its pre-whaling population size (Sirovic et al. 2004). Blue whales are susceptible to the same potential threats that are generally applicable to all cetacean species known to occur in the waters of Kwajalein Atoll. There are no known threats at Kwajalein Atoll that are specific only to blue whales; however, due to the small population size, vessel strikes, fisheries interactions, ocean noise, habitat degradation, pollution, and climate change (NOAA 2023a) are all significant threats for this species.

Populations at Kwajalein Atoll. The blue whale range includes the deep ocean waters of the RMI. Blue whales have been sighted in areas surrounding the RMI (Miller 2023a). Blue whales have been recorded in Tonga and may breed in these areas, migrating from feeding waters off New Zealand (Balcazar et al. 2015). There is no available information on the abundance of blue whales in the RMI.

2.1.2 Fin Whale (Balaenoptera physalus)

Species Description. Fin whales are listed as endangered throughout their range under the ESA and depleted under the MMPA. The fin whale, which is a baleen whale, is the second largest whale species (Jefferson et al. 2008) reaching lengths in the northern hemisphere of 23 and 21 m (74 and 69 ft) for females and males respectively (Aguilar 2002). This species uses a variety of habitats and is highly adaptable, typically following prey off the continental shelf (Azzellino et al. 2008, Panigada et al. 2008). Fin whales feed on krill and other planktonic crustaceans, schooling fish, and small squid, consuming up to one ton of prey per day in the summer (Aguilar 2002). Most fin whales migrate through pelagic waters from arctic feeding areas in the summer to tropical breeding and calving areas in the winter (NOAA 2023a). Fin whales in the northern hemisphere mate and calve December through February (Aguilar 2002). In terms of functional hearing capability, fin whales belong to the low-frequency group, with hearing ranging from 7 Hz to 22 kHz (Southall et al. 2007).

Distribution. The fin whale is found in all the world's oceans (Jefferson et al. 2008). This whale inhabits deep, offshore waters in temperate to polar latitudes, and less often in tropical latitudes (NOAA 2023a, Reeves et al. 2002). Fin whales are also often seen close to shore after periodic patterns of upwelling and the resultant increase in the density of krill upon which they feed (Azzellino et al. 2008). There are three recognized stocks of fin whales in U.S. waters of the north Pacific: the Hawai`i stock, the California/Oregon/ Washington stock, and the Alaska stock (NOAA 2022a).

Threats. Fin whales are susceptible to the same potential threats that are generally applicable to all cetacean species known to occur in the waters of Kwajalein Atoll. Major threats for this species include vessel strikes, entanglement, and ocean noise which can interrupt normal behavior and diving (NOAA 2023a).

Populations at Kwajalein Atoll. Little or no information is available regarding the population of fin whales in the RMI. These whales do occur in the central and western Pacific Ocean, including in the RMI (Miller 2023a).

2.1.3 Short-beaked Common Dolphin (Delphinus delphis)

Species Description. These small, 2 m (6 ft) long dolphins are usually found in large social groups of hundreds of individuals composed of smaller (20–30 dolphins) subunits (Perrin 2002a, NOAA 2023a). Short-beaked common dolphins are often active at the surface and are capable of diving to at least 200 m (650 ft) to feed on fish (NOAA 2023a). Common dolphins are often found near underwater features such as ridges, continental shelves, and seamounts with abundant prey (NOAA 2023a). In the eastern tropical Pacific, calving takes place all year but may be more seasonal in populations at higher latitudes (NOAA 2023a). Functional hearing for the short-beaked common dolphin is estimated to occur between approximately 150 Hz and 160 kHz, placing them among the group of cetaceans that can hear mid-frequency sounds (Southall et al. 2007).

Distribution. This relatively common species prefers warm tropical to cool tropical waters from about 60°N to 50°S in habitats with upwelling (Perrin 2002a). Although short-beaked common dolphins primarily occur in deep waters beyond the edge of the continental shelf, they do come into continental shelf waters during some seasons (Jefferson et al. 2008) in areas where waters are 200 to 2,000 m (650 to 6,500 ft) deep (NOAA 2023a). Cañadas and Hammond (2008) observed that groups of short-beaked common dolphins with calves and groups that were feeding preferred more coastal waters. The short-beaked common dolphin is not considered to be a truly migratory species, although seasonal shifts which vary with ocean conditions have been documented in the eastern Pacific (Perrin 2002a). In the north Pacific, short-beaked common dolphins are found primarily off the coast of North America, north of the Hawaiian Islands, and near Japan south to New Zealand (Perrin 2002a, NOAA 2023a).

Threats. Short-beaked common dolphins are susceptible to the same potential threats that are generally applicable to all cetacean species known to occur in the waters of Kwajalein Atoll.

Populations at Kwajalein Atoll. The short-beaked common dolphin has been documented in the central and western Pacific Ocean in the Cook Islands, Fiji, and in the deep ocean areas of the RMI (Miller 2023a). This species has the potential to occur in deep ocean areas of Kwajalein Atoll and near Illeginni Islet.

2.1.4 Pygmy Killer Whale (Feresa attenuata)

Species Description. Pygmy killer whales are protected under the MMPA and are not listed under the ESA. The average length of pygmy killer whale specimens is 2.3 m (7.6 ft) (Donahue and Perryman 2002). Reproductive and life history information is almost completely lacking for this species; however, they usually occur in groups of 12 to 50 individuals and feed primarily on squids and fishes (NOAA 2023a, Donahue and Perryman 2002). While no empirical data on hearing ability for this species are available, functional hearing is estimated to occur between approximately 150 Hz and 160 kHz, placing them among the group of cetaceans that can hear mid-frequency sounds (Southall et al. 2007).

Distribution. The pygmy killer whale has been observed in deeper tropical and subtropical waters around the globe (NOAA 2023a, Donahue and Perryman 2002). The open ocean range of the pygmy killer whale generally extends along the equatorial regions from 40°N to 35°N (NOAA 2023a). In the Pacific, pygmy killer whales are known to occur in the eastern tropical Pacific, the waters around Hawai`i, and near Japan (Donahue and Perryman 2002). Around the main Hawaiian Islands, pygmy killer whales were seen at an average distance of 401 m (1,315 ft) from shore in a habitat use study (Baird et al. 2013). Migrations or seasonal movements of this type of toothed whale are not known.

Threats. Pygmy killer whales are susceptible to the same potential threats that are generally applicable to all cetacean species known to occur in the waters of Kwajalein Atoll.

Populations at Kwajalein Atoll. There are no documented pygmy killer whale occurrences in the deep ocean areas of the RMI (Miller 2023a). In the Pacific Islands region, there have been documented occurrences are in French Polynesia, Guam, the Northern Mariana Islands, New Caledonia, and Tonga (Miller 2023a).

2.1.5 Short-finned Pilot Whale (*Globicephala macrorhynchus*)

Species Description. The short-finned pilot whale is a 1.9 to 7.2 m (6.2 to 23.6 ft) long delphinid (Bernard and Reilly 1999). These whales occur in groups of 5 to 50 animals (Bernard and Reilly 1999) and feed primarily on squid, octopus, and fish in waters 305 m (1,000 ft) deep or more (NOAA 2023a). Short-finned pilot whales near Japan had a peak breeding season in April and May and birth of calves in July and August; however, a small number of births were recorded year-round (Bernard and Reilly 1999). The region of best hearing for pilot whales is believed to be between 11.2 and 50 kHz with relatively poor high frequency hearing, compared with other odontocete species and auditory thresholds as low as 50 dB re 1 μPa (Pacini et al. 2010). Pilot whales are in the mid-frequency cetaceans functional hearing group (Southall et al. 2007).

Distribution. The short-finned pilot whale is widely distributed throughout most tropical and warm temperate waters of the world (Bernard and Reilly 1999). The distribution of this species varies seasonally and is likely related to the seasonal abundance of squid (Olson and Reilly 2002). This species occurs in deep offshore areas, waters over the continental shelf break, in slope waters, and in areas of high topographic relief (Olson and Reilly 2002). In the northern Pacific, short-finned pilot whales likely occur throughout tropical and warm temperate waters and have been recorded as far north as Alaska (Bernard and Reilly 1999). There are two recognized management stocks in U.S. waters of the Pacific: the west coast and the Hawai`i stocks.

Threats. Short-finned pilot whales are susceptible to the same potential threats that are generally applicable to all cetacean species known to occur in the waters of Kwajalein Atoll. Current predominant threats to short-finned pilot whales include entanglement in fishing gear, hunting, and vessels strikes (NOAA 2023a).

Populations at Kwajalein Atoll. There have been documented occurrences of the short-finned pilot whale in the central and western Pacific Ocean and in the deep ocean areas of the RMI (Miller 2023a). On 6 May 2006, eight short-finned pilot whales were reported near Illeginni Islet (USAF 2015). There are no abundance estimates available for the deep ocean areas of the RMI.

2.1.6 Risso’s Dolphin (*Grampus griseus*)

Species Description. Risso’s dolphins are blunt-headed delphinids up to 4.1 m (13.5 ft) long (Kruse et al. 1999). These gregarious dolphins may form groups of several hundred individuals comprised of smaller subgroups (Kruse et al. 1999). Risso’s dolphins are believed to feed primarily on cephalopods at night (Kruse et al. 1999). During typical surfacing sequences, these dolphins surface every 7 seconds; however, individuals may remain submerged on dives as long as 30 minutes (Kruse et al. 1999). Risso’s dolphins breed and calve year-round (NOAA

2023a), but there may be a peak in calving during the winter months (Baird 2002). Nachtigall et al. (1995) measured hearing in an adult Risso's dolphin in a natural setting and found that adult hearing ranged from 4 to 64 kHz with thresholds as low as 63.7 dB at 8 kHz (Kruse et al. 1999). Risso's dolphins are among the group of cetaceans that are categorized as mid-frequency cetaceans (Southall et al. 2007).

Distribution. Risso's dolphins occur in temperate, subtropical, and tropical waters throughout the world (NOAA 2023a) from between 60°N and 60°S (Kruse et al. 1999). These dolphins are most commonly found seaward of the continental slope in waters that are generally greater than 1,000 m (3,300 ft) (NOAA 2023a) and are known to frequent seamounts and other areas with steep bottom topography (Kruse et al. 1999). These dolphins are commonly found in waters between 15 and 20 degrees Celsius (°C, or 59 and 68 degrees Fahrenheit [°F]) and are not known to occur in waters below 10°C (50°F) (Baird 2002). Risso's dolphins are known to have seasonal shifts in abundance in some portions of their range which may be due to shifting prey abundance, but in some portions of their range there is evidence that abundance remains relatively constant throughout the year (Kruse et al. 1999). While Risso's dolphins are primarily sighted in deep offshore waters, dolphins in U.S. exclusive economic zone waters are divided into two stocks: the Hawaiian stock and the California/Oregon/Washington stock (NOAA 2022a).

Threats. Risso's dolphins are susceptible to the same potential threats that are generally applicable to all cetacean species known to occur in the waters of Kwajalein Atoll. Some of the major threats to these dolphins include entanglement in fishing gear, hunting, ocean noise, and contaminants that bioaccumulate in their prey (NOAA 2023a).

Populations at Kwajalein Atoll. There are documented occurrences of Risso's dolphins in the central and western Pacific Ocean including in the Cook Islands, French Polynesia, Guam, the Northern Mariana Islands, Papua New Guinea, and Samoa (Miller 2023a). There are no documented occurrences in the RMI but based on the distribution of this species in the Central Pacific, this species has the potential to occur at Kwajalein Atoll.

2.1.7 Pygmy Sperm Whale (Kogia breviceps)

Species Description. Pygmy sperm whales reach lengths of 3.8 m (12.5 ft) and weigh up to 450 kilograms (kg; 990 lb) (McAlpine 2002). Pygmy sperm whales are considered to be a deep-diving species, based on stomach contents and long dive durations (McAlpine 2002). Pygmy sperm whales are a type of toothed whale, which feeds on mid- to deep-water cephalopods and, less often, on deep-sea fish and crustaceans (Beatson 2007, West et al. 2009). Pygmy sperm whales may occur individually or in small groups of up to about six animals (Caldwell and Caldwell 1989). An auditory brainstem response study completed on a stranded pygmy sperm whale indicated best hearing sensitivity between 90 and 150 kHz (Ridgway and Carder 2001). Functional hearing is estimated to occur between approximately 200 Hz and 180 kHz, placing them among the group of cetaceans that can hear high-frequency sounds (Southall et al. 2007).

Distribution. Pygmy sperm whales occur in tropical, subtropical, and temperate waters worldwide (McAlpine 2002). Based on prey analysis, these whales are thought to inhabit waters along the continental shelf and slope in the epipelagic and mesopelagic zones and may be found in deeper waters than dwarf sperm whales (*Kogia sima*) (McAlpine 2002). The pygmy sperm whale may frequent more temperate habitats than dwarf sperm whales, but little is known about possible seasonality of distribution or migrations for this species (McAlpine 2002).

Threats. Pygmy sperm whales are susceptible to the same potential threats that are generally applicable to all cetacean species known to occur in the waters of Kwajalein Atoll. These whales may be especially susceptible to threats such as entanglement, hunting, vessel strike, ingestion of marine debris, and ocean noise (NOAA 2023a).

Populations at Kwajalein Atoll. *Kogia* sp. whales have been documented in waters of many central Pacific islands including French Polynesia, Guam, the Northern Mariana Islands, and Samoa, but there are no documented occurrences or abundance estimates in the deep ocean areas of the RMI (Miller 2023a). Based on the distribution of pygmy sperm whales in the Central Pacific, this species has the potential to occur at Kwajalein Atoll.

2.1.8 Humpback Whale (Megaptera novaeangliae)

Species Description. Humpback whales are currently divided into 14 distinct population segments (DPSs) recognized by National Oceanic and Atmospheric Administration Fisheries (81 FR 62259-62320 [11 October 2016]). The Mexico DPS is listed as threatened under the ESA; four DPSs are listed as endangered under the ESA; and the remaining nine DPSs are not listed under the ESA (81 FR 62259 [11 October 2016]). In the western and central Pacific, there are three humpback whale DPSs: the Hawai`i DPS (not listed), the Oceania DPS (not listed), and the Western North Pacific DPS (endangered). Humpback whales in the waters of Kwajalein Atoll are likely from the Oceania DPS; however, there is the potential for some mixing between the populations throughout the Pacific (Calambokidis et al. 2001). All populations of humpback whale are considered depleted under the MMPA. Humpbacks are baleen whales, which typically feed on krill and small schooling fish in coastal or shelf waters (Clapham 2002). These 14 to 17 m (46 to 56 ft) long whales are generally highly migratory, wintering on calving grounds in the tropics and migrating up to 8,000 kilometers (km; 5,000 miles [mi]) to feeding grounds in mid- or high-latitude waters (Clapham 2002). Humpbacks spend most of their time in the upper 4 m (13 ft) of the water column on the feeding grounds (Dietz et al. 2002). When diving, these whales dive for up to 15 minutes to depths up to 400 m (1,312 ft) (Dietz et al. 2002).

In terms of functional hearing capability, humpback whales are considered low-frequency cetaceans, which have hearing ranges from 7 Hz to 22 kHz (Southall et al. 2007). Houser et al. (2001) produced a predicted humpback whale audiogram using a mathematical model based on the internal structure of the ear. Estimated sensitivity was from 700 Hz to 10 kHz, with maximum relative sensitivity between 2 and 6 kHz (Houser et al. 2001).

Distribution. The humpback whale is found throughout the North Pacific with several populations divided by low-latitude breeding areas (NOAA 2022a). These whales are typically found during the summer on high latitude feeding grounds and during the winter in the tropics and subtropics around islands, over shallow banks, and along continental coasts, where calving occurs (Clapham 2002). Most humpback whale sightings are in nearshore and continental shelf waters; however, humpback whales frequently travel through deep oceanic waters during migration (Calambokidis et al. 2001). On breeding grounds, females with calves occur in significantly shallower waters than other groups of whales, and breeding adults use deeper more offshore waters (Ersts and Rosenbaum 2003, Smultea 1994).

Threats. Humpback whales are susceptible to the same potential threats that are generally applicable to all cetacean species known to occur in the waters of Kwajalein Atoll. As an endangered species, any threats to humpback whales are particularly significant including threats from vessel strike, entanglement in fishing gear, vessel-based harassment, habitat modification, and ocean noise (NOAA 2023a).

Populations at Kwajalein Atoll. There are historical records of humpback whale sightings in the RMI (Miller 2023a). There is no available information on the abundance of humpback whales in the deep ocean areas of the RMI. Oceania humpback whale populations are estimated to number 3,827 (coefficient of variation=0.12) individuals; however, the population appears to be subdivided with relatively little known about the movements and feeding areas for these whales (Bettridge et al. 2015).

2.1.9 Blainville's Beaked Whale (Mesoplodon densirostris)

Species Description. Blainville's beaked whales reach 4.7 m (15 ft) long (Pitman 2002) and weigh 816 to 1,043 kg (1,800 to 2,300 lb) (NOAA 2023a). As in other beaked whale species, Blainville's beaked whales appear to feed on squid and some fish in deep waters (Pitman 2002). Little is known about the movements or behavior or beaked whales. These whales are known to dive from 20 to over 45 minutes at a time (Pitman 2002, NOAA 2023a). An audiogram of a Blainville's beaked whale revealed the range of best hearing was 40 to 50 kHz for this species with thresholds as low at 48.9 dB (Pacini et al. 2011). Beaked whales are part of the mid-frequency cetaceans functional hearing group with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007).

Distribution. Blainville's beaked whales are one of the most widely distributed of the distinctive toothed whales in the *Mesoplodon* genus and are found throughout the world in tropical, sub-tropical, and warm temperate waters (MacLeod et al. 2006). These whales are known to occur along the California coast, Hawai`i, and in the Eastern Tropical Pacific and some research indicates they are found mostly offshore in deeper waters (MacLeod and Mitchell 2006). In a 2013 habitat use study around the main Hawaiian Islands, Blainville's beaked whales had a bimodal pattern of sighting by water depth with peak encounter rates between 500 and 1,500 m (1,640-4,921 ft) deep and between 3,500 and 4,000 m (11,483-13,123 ft) deep (Baird et al. 2013). It is unknown whether this species makes specific migrations.

Threats. Blainville's beaked whales are susceptible to the same potential threats that are generally applicable to all cetacean species known to occur in the waters of Kwajalein Atoll.

Populations at Kwajalein Atoll. There are documented occurrences of Blainville's beaked whales in a number of island chains in the central and western Pacific, but there are no documented occurrences or abundance estimates in the RMI (Miller 2023a). Based on their occurrence in the central Pacific and the best information on their range, Blainville's beaked whales have the potential to occur in deeper waters of Kwajalein Atoll.

2.1.10 Killer Whale (Orcinus orca)

Species Description. Killer whales are considered depleted under the MMPA and potential populations in the waters of Kwajalein Atoll are not listed under the ESA. These highly social animals occur most commonly in groups from 2 to 15 animals (NOAA 2023a). These whales feed on a variety of prey including marine mammals, fish, cephalopods, sea turtles, and sea birds (Ford 2009). Killer whales forage either individually, in small groups, or cooperatively depending on the whale population and prey type (Ford 2009). Killer whales may calve in any month of the year, but most births are in October–March (Ford 2009). Recent behavioral audiograms of killer whales indicated hearing between 600 Hz and 114 kHz with best hearing at 34 kHz with a 49 dB re 1 μPa threshold (Branstetter et al. 2017). Another study using behavioral and auditory evoked potential audiograms of two captive killer whales indicate that they can hear sounds ranging from 1 to 120 kHz (best hearing ranging from 18 to 42 kHz), with most sensitivity at 20 kHz and a detection threshold of 36 dB re 1 μPa (Szymanski et al. 1999). The full range of functional hearing is estimated to occur between approximately 150 Hz and 160 kHz, placing them among the group of cetaceans that can hear mid-frequency sounds (Southall et al. 2007).

Distribution. Killer whales are found in all oceans of the world and are most common in coastal temperate waters (Ford 2009). Eight killer whale stocks are recognized in the Pacific U.S. exclusive economic zone (NOAA 2022a). Although considered one species, killer whales are broken down into different "ecotypes" that are distinguished by distinct social and foraging behaviors and other ecological traits (Ford 2009). In the North Pacific, these distinct forms are known as resident, transient, and offshore ecotypes (NOAA 2022a, NOAA 2023a).

Killer whales are found in all marine habitats, from the coastal zone (including most bays and inshore channels) to deep oceanic basins and from equatorial regions to the polar pack ice zones of both hemispheres (Dahlheim and Heyning 1999). Although killer whales are also found in tropical waters and the open ocean, they are most abundant in coastal habitats at high latitudes (Dahlheim and Heyning 1999). In most areas of their range, killer whales do not show movement patterns that would be classified as traditional migrations. However, some populations exhibit seasonal shifts in density, likely in response to prey availability (Ford 2009).

Threats. Killer whales are susceptible to the same potential threats that are generally applicable to all cetacean species known to occur in the waters of Kwajalein Atoll. Major threats for this species include food depletion from overfishing and habitat loss, contaminants, oil spills, disturbance from vessels, and ocean noise (NOAA 2023a).

Populations at Kwajalein Atoll. There have been documented occurrences of killer whales in the central and western Pacific, including in the RMI (Miller 2023a). Among the documented occurrences, three killer whales were sighted 4.73 km (2.94 mi) off of the coast of South Pass in April 2007 (USAF 2015). There is no available information on the abundance of killer whales in the RMI.

2.1.11 Melon-headed Whale (Peponocephala electra)

Species Description. Melon-headed whales reach lengths of 2.7 m (8.9 ft) (Perryman 2002). These whales are often found in large groups, sometimes in mixed aggregations with Fraser's dolphins or spinner dolphins (Perryman 2002). Most of the fish and squid families eaten by this toothed whale species consist of mid-water forms found in waters up to 1,500 m (4,920 ft) deep, suggesting that feeding takes place deep in the water column (Jefferson and Barros 1997). Melon-headed whales feed primarily on squid but have also been known to eat small fish and shrimp (Perryman 2002). Whether calving is significantly seasonal is unclear, but some evidence suggests a peak in July and August (Jefferson and Barros 1997). While no empirical data on hearing ability for this species are available, functional hearing is estimated to occur between approximately 150 Hz and 160 kHz, placing them among the group of cetaceans that can hear mid-frequency sounds (Southall et al. 2007).

Distribution. Melon-headed whales are found worldwide in tropical and subtropical waters with extralimital observations at higher latitudes with incursion of warm water currents (Perryman 2002). Melon-headed whales are most often found in offshore, deep waters but sometimes move close to shore in areas with deeper water (Perryman 2002). Brownell et al. (2009) found that melon-headed whales near oceanic islands rested near shore during the day and fed in deeper waters at night. This species is not known to migrate. In a 2013 habitat use study around the main Hawaiian Islands (Baird et al. 2013), melon-headed whales were observed throughout the year and in waters with a wide range of depths.

Threats. Melon-headed whales are susceptible to the same potential threats that are generally applicable to all cetacean species known to occur in the waters of Kwajalein Atoll. Major threats to melon-headed whales include entanglement in fishing gear, pollution, and ocean noise (NOAA 2023a).

Populations at Kwajalein Atoll. There have been documented occurrences of melon-headed whales in the central and western Pacific including in the deep ocean areas of the RMI (Miller 2023a). There was a sighting of five whales 4.8 km (3 mi) off the coast of Kwajalein on 23 October 2005 (USAF 2015). There are no abundance estimates available for the RMI.

Mass strandings (those of three or more animals) of melon-headed whales were reviewed in Brownell et al. (2009). Of the 29 documented mass strandings of this species, 5 have occurred in the Pacific islands, and one of these was in the Marshall Islands in 1990, at Kwajalein Atoll (others in Hilo, Hawai`i in 1841; Palmyra Atoll sometime before 1964; Malékoula Island, Vanuatu in 1972; and Hanalei Bay, Kauai in 2004). This indicates that some individuals of this species are at least occasionally in Kwajalein Atoll waters. The events at Palmyra and Kwajalein atolls were unusual because the stranding occurred inside the atoll's lagoons, and only a small number of animals were involved.

2.1.12 Sperm Whale (Physeter macrocephalus)

Species Description. Sperm whales have been endangered since 1970 under the precursor to the ESA and are listed as depleted under the MMPA. Sperm whales are largest of the toothed whales, reaching lengths of 16 m (52 ft) (Whitehead 2002). Females inhabit deeper waters (greater than 1,000 m [3,280 ft]) at latitudes below 40° and are highly social (Whitehead 2002). Female sperm whales spend most of their lives in family units of about 12 females with communal defense and care of young (Whitehead 2002). Male sperm whales may be found at higher latitudes but are more likely to be observed in productive waters such as those along the edges of continental shelves (Whitehead 2002). Sperm whales are deep divers, feeding primarily on squid and other cephalopods as well as on bottom-dwelling fish and invertebrates (Whitehead 2002, Davis et al. 2007). These large whales spend most of their time in deep waters where their prey are found (NOAA 2023a).

Direct measures of sperm whale hearing showed responses to pulses ranging from 2.5 to 60 kHz and highest sensitivity to frequencies between 5 and 20 kHz (Ridgway and Carder 2001). Reactions to anthropogenic (man-made) sounds can provide indirect evidence of hearing capability, and several studies have noted changes seen in sperm whale behavior in conjunction with these sounds. For example, sperm whales have been observed to frequently stop echolocating in the presence of underwater pulses made by echosounders and submarine sonar (Watkins and Schevill 1977). In exposure experiments of pulsed and continuous active sonars generating sounds in the 1 to 10 kHz range, less than half of sperm whales responded to sounds, but behavioral changes in some whales were observed to be severe enough to potentially impact vital rates at sound exposure levels of 137 to 181 dB re 1 μPa^2 (Curé et al. 2021). Thode et al. (2007) observed that the acoustic signal from a fishing vessel's rapidly spinning propeller (110 dB re 1 μPa^2 between 250 Hz and 1.0 kHz) interrupted sperm whale acoustic activity and resulted in the animals converging on the vessel. Sperm whales are in the mid-frequency cetacean functional hearing group with an estimated full range of functional hearing between approximately 150 Hz and 160 kHz (Southall et al. 2007).

Distribution. Sperm whales are divided into three stocks in the Pacific U.S. exclusive economic zone: (1) the Hawaiian stock, (2) the California, Oregon, and Washington stock, and (3) the Alaskan stock. Sperm whales show a strong preference for deep waters (Rice 1989, Whitehead 2003). Adult females are generally found far from land at latitudes less than 40° and in waters 1,000 m (3,280 ft) or deeper (Whitehead 2002). Although adult males are more likely to be observed in deeper, productive waters (Whitehead 2002), in some areas adult males frequent waters with bottom depths less than 100 m (330 ft) and as shallow as 40 m (130 ft) (Romero et al. 2001). In a habitat use study around the main Hawaiian Islands, sperm whales were observed most frequently in waters greater than 3,000 m (9,842 ft) deep (Baird et al. 2013). Female sperm whales and young are typically found far from land (Whitehead 2002). Typically, sperm whale concentrations occur in areas with high biomass of deep-water prey which are generally near drop-offs such as the edges of continental shelves (Whitehead 2002). Sperm whales are somewhat migratory depending on their location, gender, and prey abundance (NOAA 2023a). General shifts occur during the summer for feeding and breeding, while in some tropical areas, sperm whales appear to be largely resident (Rice 1989, Whitehead 2003, Whitehead et al. 2008).

Threats. Sperm whales are susceptible to the same potential threats that are generally applicable to all cetacean species known to occur in the waters of Kwajalein Atoll. Major threats to sperm whales include vessel strike, entanglement in fishing gear, ocean noise, ingestion of marine debris, contaminants, and habitat and food availability changes resulting from climate change (NOAA 2023a).

Populations at Kwajalein Atoll. Sperm whales have been documented in many of the island chains in the central and western Pacific, including the RMI (Miller 2023a). In April 2009, four individuals with calves were reported in the open ocean area surrounding Kwajalein Atoll (9° 00.27' N, 167° 01.30' W), 4.8 km (3 mi) off Legan Islet. These whales were observed breaching, lobtailing, diving, and resting (USAF 2015). There have been documented occurrences of sperm whales in the Illeginni Islet area of Kwajalein Atoll as well. In 2000, a pod of approximately 12 sperm whales was seen a few miles southeast of Illeginni Islet. On August 5, 2006, two whales were sighted between Legan and Illeginni Islet (USAF 2015). In April 2009, an estimated four sperm whales were sighted a few miles southeast of Illeginni (USAF 2015).

An acoustic study performed off of the coast of Kwajalein Atoll in 2007 reported almost continuous detection of sperm whale sounds during the study. This study concluded that sperm whales are highly active in the area during March, May, and September (USAF 2015). There is no available information on the abundance of sperm whales in the RMI.

2.1.13 Pantropical Spotted Dolphin (Stenella attenuata)

Species Description. Adult pantropical spotted dolphins are 1.7 to 2.6 m (5.5 to 8.4 ft) long and weigh up to 119 kg (262 lb) (Perrin 2002b). Pantropical spotted dolphins prey on near-surface fish, squid, and crustaceans and on some benthic species (Perrin 2002b). Results from various tracking and food habit studies suggest that pantropical spotted dolphins in the eastern tropical Pacific and off Hawai`i feed primarily at night on surface and mid-water species (Baird et al. 2001, Robertson and Chivers 1997). Pantropical spotted dolphins are known to breed year-round and occur in groups of several hundred to a thousand animals (NOAA 2023a).

Studying the ear anatomy of the pantropical spotted dolphin, Ketten (1992, 1997) found that they have ear anatomy similar to other delphinids. While no empirical data on hearing ability for this species are available, functional hearing is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean functional hearing group (Southall et al. 2007).

Distribution. The pantropical spotted dolphin is distributed worldwide in offshore tropical and subtropical waters between about 40°N and 40°S latitudes (Perrin 2002b). It is found mostly in deeper offshore waters but does approach the coast in some areas (Perrin 2002b). In the eastern tropical Pacific, pantropical spotted dolphins are most abundant in waters with a sharp thermocline at depths of 50 m (164 ft) or less (Perrin 2002b). Based on known habitat preferences, occurrence is expected in waters 90 to 300 m (300 to 1,000 ft) deep during the day and possibly in deeper waters at night when foraging for prey (NOAA 2023a). Although pantropical spotted dolphins do not migrate, extensive movements are known in the eastern tropical Pacific (Scott and Chivers 2009).

Threats. Pantropical spotted dolphins are susceptible to the same potential threats that are generally applicable to all cetacean species known to occur in the waters of Kwajalein Atoll. Major threats for this species include entanglement in fishing gear, interactions with people, and hunting (NOAA 2023a).

Populations at Kwajalein Atoll. Pantropical spotted dolphins are frequently sighted in pelagic waters. There are documented occurrences of the pantropical spotted dolphin in the central and western Pacific Ocean, including in American Samoa, Cook Islands, Fiji, French Polynesia, Kiribati, and in the RMI (Miller 2023a).

2.1.14 Striped Dolphin (Stenella coeruleoalba)

Species Description. Striped dolphins are small dolphins that reach lengths of 2.4 m (7.9 ft) in the western Pacific and are often observed in schools of 10 to several hundred individuals (Archer 2002). Striped dolphins often feed on fish and squid in open sea or sea bottom zones beyond the continental shelf where they dive from 200 to 700 m (656 to 2,297 ft) for prey (Archer 2002). Striped dolphins give birth to a single calf during summer or autumn (NOAA 2023a). Kastelein et al. (2003), measured a striped dolphin’s range of most sensitive hearing to be 29 to 123 kHz, with maximum sensitivity occurring at 64 kHz with a signal strength of 42 dB re 1 μPa. Striped dolphins are in the mid-frequency functional hearing group for cetaceans which are estimated to have a full range of functional hearing between 150 Hz and 160 kHz (Southall et al. 2007).

Distribution. Striped dolphins are found primarily in warm equatorial and tropical waters but appear to prefer waters with more variable conditions with upwelling and large seasonal changes in temperature structure (Au and Perryman 1985). This abundant and widespread species is generally restricted to pelagic regions and is seen close to shore only where deep water approaches the coast. In some areas (e.g., the eastern tropical Pacific), striped dolphins are mostly associated with convergence zones and regions of upwelling (Au and Perryman 1985, Reilly 1990).

Threats. Striped dolphins are susceptible to the same potential threats that are generally applicable to all cetacean species known to occur in the waters of Kwajalein Atoll. Major threats for striped dolphins include entanglement in fishing gear, disease (specifically morbillivirus), and hunting (NOAA 2023a).

Populations at Kwajalein Atoll. These dolphins are abundant and widespread in oceanic regions. In a habitat use study around the main Hawaiian Islands, striped dolphins were among the most commonly observed cetaceans and were found at their highest rates in very deep water (> 3,000 m [9,843 ft]) (Baird et al 2013). The range of the striped dolphin includes the deep ocean waters of the RMI. In the central and western Pacific Ocean, there are documented occurrences in the waters of many islands including in Micronesia, the Northern Mariana Islands, the Solomon Islands, and the RMI (Miller 2023a).

2.1.15 Spinner Dolphin (Stenella longirostris)

Species Description. Adult spinner dolphins range in length from 1.3 to 2.4 m (4.2 to 7.7 ft) (Perrin and Gilpatrick 1994). Spinner dolphins feed primarily on small mid-water fishes, squid, and shrimp, and they dive to at least 200 to 300 m (655 to 985 ft) (Perrin and Gilpatrick 1994). Spinner dolphins have variable school size and are commonly found in schools with pantropical spotted dolphins (Perrin and Gilpatrick 1994). Mating and calving occur throughout the year but may be more seasonal in some regions (Perrin and Gilpatrick 1994). Dolphins in the genus *Stenella* are considered part of the mid-frequency cetaceans function hearing group which has an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007).

Distribution. Spinner dolphins occur throughout tropical and subtropical waters in both hemispheres (Perrin and Gilpatrick 1994). Spinner dolphins occur in large numbers in oceanic habitats but some populations in the eastern Pacific and in tropical waters occur in coastal habitats as well (Perrin and Gilpatrick 1994). In most areas, including the eastern tropical Pacific, spinner dolphins are found primarily in deep ocean waters (Perrin and Gilpatrick 1994). In the central and western Pacific, spinner dolphins are island-associated and expected to occur in shallow water resting areas (about 50 m [164 ft] deep or less) throughout the middle of the day, moving into deep waters offshore during the night to feed (NOAA 2022a). Island-associated stocks have an offshore boundary of 18.5 km (10 nautical miles) from shore based on observations that no dolphins have been seen farther than 18.5 km (10 nautical miles) from shore (NOAA 2022a). Spinner dolphins are reported to have strong seasonal shifts in habitats with year-to-year variation in habitat use (Perrin and Gilpatrick 1994).

Threats. Spinner dolphins are susceptible to the same potential threats that are generally applicable to all cetacean species known to occur in the waters of Kwajalein Atoll. Major threats for spinner dolphins include entanglement in fishing gear, illegal feeding and harassment, habitat degradation, ocean noise, disease, and vessel strike (NOAA 2023a).

Populations at Kwajalein Atoll. Spinner dolphins are known to occur throughout the central and western Pacific Ocean, including in American Samoa, Micronesia, Fiji, French Polynesia, Guam, Kiribati, the Northern Mariana Islands, Papua New Guinea, Samoa, Solomon Islands, Tuvalu, Vanuatu, and in the RMI (Miller 2023a). There have been multiple surface sightings of spinner dolphins recorded at Kwajalein Atoll and on 27 July 2006, a large group of spinner dolphins was sighted near the helipad on Illeginni Islet (USAF 2015). Because of the number of sightings of spinner dolphins in the area, as well as in the deep ocean waters of Kwajalein Atoll, it is likely that they are relatively common around Illeginni Islet.

2.1.16 Bottlenose Dolphin (Tursiops truncatus)

Species Description. Bottlenose dolphins are commonly found in groups of 2-15 individuals but larger groups of up to 1,000 have been recorded (Wells and Scott 2002). Group size and feeding habits may differ between coastal and pelagic populations with smaller group sizes in inshore populations (Wells and Scott 2002). Bottlenose dolphins feed primarily on bottom dwelling fish and squid, but some surface dwelling or pelagic fish are also consumed (Wells and Scott 2002). Bottlenose dolphins have been known to give birth in all seasons; however, calving occurs primarily in winter (Wells and Scott 2002).

Audiograms of bottlenose dolphins show that best sensitivity occurs near 50 kHz at a detection threshold level of about 45 dB re 1 µPa with a range of underwater hearing from 10 to 150 kHz (Houser and Finneran 2006). Below the maximum sensitivity, thresholds increased (indicating less sensitivity) continuously up to a level of 137 dB re 1 µPa at 75 Hz. Above 50 kHz, thresholds increased slowly up to a level of 55 dB re 1 µPa at 100 kHz, then increased rapidly above this to about 135 dB re 1 µPa at 150 kHz. Bottlenose dolphin hearing sensitivity varies with age and sex, with a progressive loss of high frequency hearing with age, and with males exhibiting an earlier onset of hearing loss than females (Houser and Finneran 2006). Bottlenose dolphins are in the mid-frequency cetaceans functional hearing group which has an estimated auditory bandwidth of 150 Hz and 160 kHz (Southall et al. 2007).

Distribution. The bottlenose dolphin has a worldwide distribution ranging from latitudes of 45°N to 45°S (Wells and Scott 2002). Bottlenose dolphins are found both in coastal and offshore waters with surface temperatures between 10 and 32°C (Wells and Scott 2002). Some populations of bottlenose dolphin appear to be migratory, others have year-round home ranges, and some a combination of long-range movements and local residency (Wells and Scott 2002). In the Hawaiian Islands stock complex, over 99% of the bottlenose dolphins belonging to the insular populations were documented in waters of 1,000 m (3,280 ft) or less (NOAA 2022a). In a habitat use study around the main Hawaiian Islands, Baird et al. (2013) recorded bottlenose dolphins throughout the year with most observations in waters less than 500 m (1,640 ft) deep. A Hawai`i pelagic stock is recognized, although little is known about their distribution.

Threats. Bottlenose dolphins are susceptible to the same potential threats that are generally applicable to all cetacean species known to occur in the waters of Kwajalein Atoll. Major threats for bottlenose dolphins include entanglement in fishing gear, habitat destruction and degradation, biotoxins linked to algal blooms, and illegal feeding and harassment (NOAA 2023a).

Populations at Kwajalein Atoll. There are coastal stocks of bottlenose dolphins around many central and western Pacific islands including American Samoa, Micronesia, Fiji, French Polynesia, Kiribati, and the RMI (Miller 2023a).

2.2 Reptiles

Two sea turtle species have the potential to be present at Kwajalein Atoll: green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) turtles (**Table 2**). Both of these species are listed under the ESA and are UES consultation species.

Summary of Threats to Sea Turtles. Threats to sea turtles in the Pacific Ocean and the RMI include bycatch, ship strikes, marine debris and contaminants, harvest, and climate change. Bycatch in commercial fisheries, ship strikes, and marine debris are primary threats to sea turtles in the Pacific Ocean (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). In another study of loggerhead turtles in the north Atlantic, 83% (n = 24) of juvenile turtles were found to have ingested plastic marine debris (Pham et al. 2017). Other marine debris, including derelict fishing gear and cargo nets, can entangle and drown turtles in all life stages.

Table 2. Reptile Species Requiring Consultation under the UES that have the Potential to Occur in Kwajalein Atoll Waters and on Illeginni Islet.

Scientific Name	Common Name	UES Consultation Species Listing Status[1]	
		ESA	RMI Statute
Chelonia mydas	Green turtle (Central West Pacific DPS)	E	1, 3
Eretmochelys imbricata	Hawksbill turtle	E	3

Sources: USASMDC 2021

Note:

1 UES Consultation Species Listing Status based on Appendix 3-4A of the UES (USASMDC 2021).

RMI Statutes: 1 = Endangered Species Act 1975, Title 8 MIRC Chapter 3; 3 = Fisheries Act 1997, Title 51 MIRC Chapter 2

Abbreviations: DPS = Distinct Population Segment, E = ESA Endangered, ESA = U.S. Endangered Species Act, UES: United States Army Kwajalein Atoll Environmental Standards (USASMDC 2021 Section 3-4.5.1).

Aquatic degradation issues, such as poor water quality and invasive species, can alter ecosystems, limit food availability, and decrease survival rates. 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, decreased growth rates, 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 (Poloczanska et al 2009). A study of green sea turtles foraging in the Great Barrier Reef found that warmer beaches are producing primarily female turtles (87–99% of turtles) (Jensen et al. 2018). Bjorndal et al. (2017) found declines in the growth rate of green turtles after 1999 and cited previous studies that revealed similar declines in hawksbill and loggerhead turtles starting in 1997. Ecological shifts due to warming waters, changing weather patterns, and anthropogenic activities may be among the stressors contributing to decreased growth rates in sea turtles (Bjorndal et al. 2017).

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% over 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 cm [34 in] carapace length) and hawksbills (69 cm [27 in] carapace length) and closed seasons from 1 June to 31 August and 1 December to 31 January. 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.

Sea turtles' long life expectancy and site fidelity may make them vulnerable to chronic exposure to marine contaminants (Bruno et al. 2021). Sea turtles may also be vulnerable to the bioaccumulation of heavy metals in their tissues (Bruno et al. 2021). At this time, the amount of contaminants in the marine environment near Illeginni Islet has not been measured, and sea turtles in the RMI 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 nearshore foraging habitat for green turtles in the RMI.

Sea Turtle Hearing. The range of maximum sensitivity for sea turtles appears to be 200 to 800 Hz (Lenhardt 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. Auditory evoked potentials of hatchling leatherback turtles revealed a hearing range between 50 and 1,200 Hz in water, with a maximum sensitivity between 100 and 400 Hz at 84 dB root mean squared (RMS) re 1 μPa (Dow Piniak et al. 2012). For loggerhead turtles, auditory evoked potentials audiograms revealed hearing in the range of 100 to 1,131 Hz with best sensitivity between 200 and 400 Hz at 110 dB re 1 μPa (Martin et al. 2012). Because sea turtle anatomy is similar among species, other sea turtle species are thought to have the same sensitivity ranges.

2.2.1 Green Turtle (Chelonia mydas)

Species Description. The green turtle was listed as threatened under the ESA in July 1978 because of excessive commercial harvest, a lack of effective protection, evidence of declining numbers, and habitat degradation and loss (NMFS and USFWS 2007). In March 2015, NMFS and USFWS proposed 11 DPSs globally for the green turtle (Seminoff et al. 2015) the rule was finalized in April 2016 (USFWS and NOAA 2016). Green turtles in the waters of Kwajalein Atoll likely belong to the Central West Pacific DPS. The Central West Pacific DPS is listed as endangered under the ESA (USFWS and NOAA 2016). Green turtles are mostly herbivorous. They feed primarily on sea grass and algae, at or near the surface in both coastal and open ocean areas (Bjorndal 1997). Green turtles spend the majority of their lives in coastal foraging grounds; however, oceanic habitats are used by oceanic-stage juveniles, migrating adults, and occasional foraging adults (NMFS and USFWS 2007).

Distribution. The green turtle is found in tropical and subtropical coastal and open ocean waters of the Atlantic, Pacific, and Indian oceans, generally between 30°N and 30°S (Hirth 1997). There are 6 major nesting populations in the Pacific Ocean and at least 166 smaller nesting sites (NMFS and USFWS 2007, Seminoff et al. 2015, Maison et al. 2010). Green turtle habitat varies by life stage. Hatchlings live in the open ocean for several years. Once reaching the juvenile stage, they congregate in shallower coastal feeding areas (Carr 1987, Pillans et al. 2022). Green turtles spend most of their lives as late juveniles and adults in relatively shallow waters 3 to 10 m (10 to 33 ft) deep with abundant seagrass and algae, near reefs or rocky areas used for resting (NMFS and USFWS 2007, Pillans et al. 2022). They are highly migratory; both males and females typically migrate seasonally along coastal routes from breeding areas to feeding grounds, while some populations migrate across entire ocean basins (NMFS and USFWS 2007).

Threats. The green sea turtle was listed under the ESA due to excessive commercial harvest, a lack of effective protection, evidence of declining numbers, and habitat degradation and loss (NMFS and USFWS 2007). The harvest of eggs and nesting females for food remains a primary threat to the species across the Pacific Ocean (Maison et al. 2010). In addition, green sea turtles are susceptible to the same potential threats that are generally applicable to all turtle species known to occur in the waters of Kwajalein Atoll.

Populations at Kwajalein Atoll. Green turtles occur in deep ocean waters of the RMI as hatchlings, pelagic juveniles, and migrating adults, but little is known of their distribution in these waters. As described above, green turtles forage in nearshore habitats. Shallow lagoons throughout RMI, especially areas with seagrass (*Halophila gaudichaudii*) beds, provide significant areas of potential foraging habitat for green turtles (Eckert 1993). Historical sightings of this species have occurred in these nearshore areas.

Green turtles nest on several RMI atolls, but Kwajalein Atoll is not a significant nesting area. Based on available information, Seminoff et al. (2015) estimated 300 nesting 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). The most significant green turtle nesting assemblage in RMI is in Bikar Atoll, in the northeastern corner of RMI. Nesting here occurs from May to November, peaking from June to September. NMFS and USFWS (1998b) estimated 100 to 500 green turtles might nest annually in RMI.

Within Kwajalein Atoll, sea turtle haulout and nesting has been recorded primarily on Kwajalein and Eniwetak Islets. 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. Three sea turtle nests (species unidentified) were found at Kwajalein Islet in September and October 2010, on a beach on the east-facing shore (USAF 2015). Successful sea turtle nesting on Eniwetak was confirmed by video recordings of turtle hatchlings entering the ocean at the islet in May 2011 (USAF 2015). Successful nesting was also observed on Kwajalein Islet in January 2015 when hatchlings were found and returned to the beach or ocean (USAF 2015). 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 (USAF 2015).

In a 2008 survey of Illeginni Islet, suitable nesting habitat (relatively open sandy beaches and seaward margins of herbaceous strand above tidal influence) for sea turtles was identified (**Figure 3**), and the Islet was thoroughly surveyed on foot for nesting pits and tracks. Suitable nesting habitat appears northwest and east of the helipad on the lagoon side of Illeginni Islet (**Figure 3**) (NMFS and USFWS 2012). However, no sea turtle nests or nesting activity has been observed on Illeginni in over 25 years. Sea turtle nest pits (unidentified species) were last found on Illeginni Islet in 1996, on the northern tip of the islet. No nesting or nesting activity was observed in surveys completed in 1998, 2000, 2002, 2004, 2006, 2008, or 2010, although suitable sea turtle nesting habitat was observed during all surveys (NMFS and USFWS 2011, NMFS and USFWS 2012).

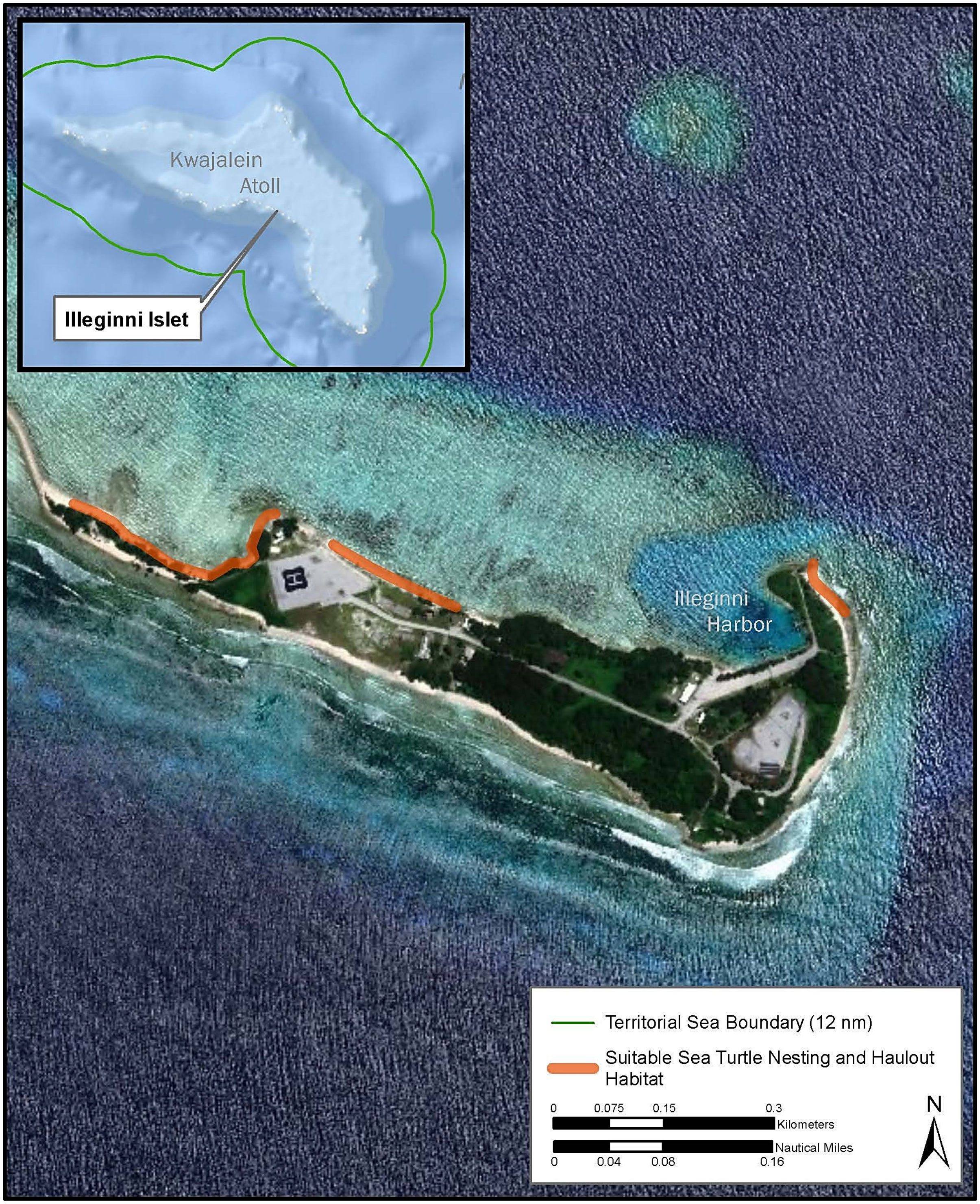


Figure 3. Suitable Sea Turtle Nesting Habitat on Illeginni Islet, Kwajalein Atoll.

Known green sea turtle activity in marine habitats near Illeginni Islet is limited to the following sightings:

- An adult green turtle was seen in nearshore waters on the ocean side of Illeginni in 1996 (NMFS and USFWS 2002);
- 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, one green sea turtle was observed off a lagoon patch reef adjacent to Illeginni Islet; and
- An adult green sea turtle was observed during the 2014 inventory in a dense area of seagrass (*Halophila minor*) in Illeginni Harbor.

The reported observations 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.

2.2.2 Hawksbill Turtle (Eretmochelys imbricata)

Species Description. The hawksbill turtle is listed as endangered as a single global population under the ESA (NMFS and USFWS 1998a). Genetic data may support the separation of hawksbill populations under the DPS policy, which has been applied to other sea turtle species (NMFS and USFWS 2007, NMFS and USFWS 2013b). This would lead to specific management plans for each designated population. Hawksbills feed primarily on sponges, which comprise as much as 95% of their diet (Meylan 1988) but are more omnivorous in the Indo-Pacific including algae, soft corals, and other invertebrate species (NMFS and USFWS 2013b). The shape of their mouth allows hawksbills to reach into crevices of coral reefs to find sponges and other invertebrates.

Distribution. The hawksbill turtle is the most tropical of the world’s sea turtles, rarely occurring higher than 30°N or lower than 30°S in the Atlantic, Pacific, and Indian ocean. Abundance estimates are largely based on annual reproductive effort for sea turtle species (NMFS and USFWS 2013b). A lack of nesting beach surveys for hawksbill turtles in the Pacific Ocean and the poorly understood nature of this species’ nesting have made it difficult for scientists to assess the population status of hawksbills in the Pacific (NMFS and USFWS 1998a). Surveys of known nesting assemblages in the western and central Pacific Ocean indicate mostly decreasing population trends over the past 20 years (NMFS and USFWS 2013b).

Hatchlings and small juveniles live in the open ocean where water depths are greater than 200 m (656 ft) before settling into nearshore habitats as older juveniles (NMFS and USFWS 2013b). Larger juvenile and adult hawksbills prefer neritic, coral reef habitats (NMFS and USFWS 2013b). Reefs provide shelter for resting hawksbills day and night, and they are known to repeatedly visit the same resting areas (NMFS and USFWS 2013b). Hawksbills are thought to have a mixed migration strategy where some turtles remain close to their rookery and others are highly mobile, traveling thousands of kilometers to foraging areas (NMFS and USFWS 2013b).

Threats. The hawksbill shell has been prized for centuries by artisans and their patrons for jewelry and other adornments. Despite being prohibited under the Convention on International Trade in Endangered Species, trade remains a critical threat to the species (NMFS and USFWS 2013b). Hawksbill turtles are susceptible to the same potential threats that are generally applicable to all turtle species known to occur in the waters of Kwajalein Atoll. In the Pacific, the most significant source of death for hawksbill turtles is direct take of turtles for trade of their shell. These takes generally occur in nearshore marine areas where hawksbills occur.

Populations at Kwajalein Atoll. In the central Pacific, hawksbills are known to nest on beaches in American Samoa, Fiji, the Mariana Archipelago, Micronesia, Palau, the Solomon Islands, and Vanuatu (NMFS and USFWS 2013b). Very little is known about the open ocean distribution of hawksbills in the central Pacific Ocean. Hawksbills tend to make short-range movements between nearshore nesting and feeding areas, rather than the long-range open-ocean migrations typical of other sea turtle species (Parker et al. 2009). Overall, hawksbills in the central Pacific have shown decreasing population trends both in the historic and recent time frames (NMFS and USFWS 2013b).

Hawksbill turtles occur in deep ocean waters of the RMI as hatchlings, pelagic juveniles, and migrating adults, but little is known of their distribution in these waters. As described above, hawksbill turtles forage in nearshore habitats. Shallow lagoons throughout RMI provide significant areas of potential foraging habitat for green and possibly hawksbill turtles (Eckert 1993). Historical sightings of this species have occurred in these nearshore areas.

Hawksbill nesting activity was reported on Wotje Islet in 1991 and at Nibung Islet in 1989 (NMFS and USFWS 1998a). In 2009, a hawksbill successfully nested on the lagoon side of Omelek Islet near the harbor area (Malone 2009). As described in **Section 2.2.1** for green turtles, suitable nesting habitat for sea turtles occurs on Illeginni Islet (**Figure 3**). However, no sea turtle nests or nesting activity have been observed on Illeginni in over 20 years (since 1996).

Known hawksbill sea turtle activity in marine habitats near Illeginni Islet is limited to the following sightings:

- A hawksbill was observed near shore in the lagoon north of Illeginni in 2002 (NMFS and USFWS 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) (NMFS and USFWS 2006). This high-relief habitat supports a complex community of coral, a foraging area for hawksbills;

- In 2006, a sea turtle (unknown species) was documented near Illeginni Islet; and
- An adult hawksbill was observed in the outer lagoon reef flat at Illeginni Islet.

As with green sea turtles, the reported observations listed above were made during single-day surveys that were part of biennial resource inventories.

2.3 Fish

The marine environment of Kwajalein Atoll provides a diversity of fish habitat including many reef habitats typical of atolls in the central Pacific, protected lagoon habitats, and deeper ocean habitats surrounding Kwajalein Atoll. There are seven fish species that require consultation under the UES that have the potential to occur in waters of Kwajalein Atoll (**Table 3**). The bigeye thresher shark (*Alopias superciliosus*), oceanic whitetip shark (*Carcharhinus longimanus*), oceanic giant manta ray (*Mobula birostris*), and Pacific bluefin tuna (*Thunnus orientalis*) are primarily open ocean species and have the potential to occur in deep ocean waters near Kwajalein Atoll. Relatively little is known about scalloped hammerhead sharks (*Sphyrna lewini*), but this species does have an affinity for coastal environments where it is known to give birth to live young. Juvenile scalloped hammerheads are known to occur in relatively shallow nearshore waters, and adults are known to occur in deeper coastal waters. This species may be found in both nearshore and deeper ocean waters of Kwajalein Atoll. The reef manta ray (*Mobula alfredi*) is a shallow water species found primarily in or near reef habitats and may be present near Illeginni Islet. The humphead wrasse (*Cheilinus undulatus*) is reef-associated and found in reef habitat throughout Kwajalein Atoll including the waters surrounding Illeginni Islet.

Summary of Threats to Fish. Due to their differing life histories, these fish species have many species-specific threats as discussed below. The reef-associated humphead wrasse is known to have close associations with coral cover (Sadovy et al. 2003) and is threatened by habitat loss and degradation, specifically destruction and degradation of reef habitats (NMFS 2009). The shark species are primarily threatened by overutilization due to targeted fishing as well as capture as bycatch in commercial fisheries.

Fish Hearing. While little is known about the specific hearing capabilities of fishes, most fish are able to detect a wide range of sounds from below 50 Hz up to 500 to 1,500 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 μPa 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 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).

Table 3. Fish Species Requiring Consultation under the UES that have the Potential to Occur in Kwajalein Atoll Waters.

Scientific Name	Common Name	UES Consultation Species Listing Status[1]		Likelihood of Occurrence in	
		ESA	UES 3-4.5.1(a)	Deeper Offshore Waters	Nearshore Waters at Illeginni Islet
Alopias superciliosus	Bigeye thresher shark		x	Potential	-
Carcharhinus longimanus	Oceanic whitetip shark	T		Potential	-
Cheilinus undulatus	Humphead wrasse		x	-	Likely
Mobula alfredi [2]	Reef manta ray		x	-	Potential
Mobula birostris [2]	Oceanic giant manta ray	T		Potential	Potential
Sphyrna lewini	Scalloped hammerhead (Indo-West Pacific DPS)	T		Potential	-
Thunnus orientalis	Pacific bluefin tuna		x	Potential	-

Sources: USASMDC 2021, NOAA 2023a

Notes:

1 UES Consultation Species Listing Status based on Appendix 3-4A of the UES (USASMDC 2021).
UES Section 3-4.5.1(a): X = Contained in RMI Environmental Protection Agency letter, 12 March 2015, or RMI Environmental Protection Agency letter, 28 September 2016

2 *Mobula alfredi* and *Modula birostris* are currently listed as consultation species in Appendix 3-4A of the UES under the genus *Manta*.

Abbreviations: DPS = Distinct Population Segment, ESA = U.S. Endangered Species Act, T = ESA Threatened, UES: United States Army Kwajalein Atoll Environmental Standards (USASMDC 2021 Section 3-4.5.1).

2.3.1 Bigeye Thresher Shark (Alopias superciliosus)

Species Description. This large, broad-headed shark has an elongated upper caudal lobe and distinctive large eyes (NMFS 2015a). Bigeye threshers feed on small to medium sized pelagic fishes, bottom fishes, and cephalopods and use their whip-like tail to stun and disorient prey (NMFS 2015a). Bigeye thresher sharks are ovoviviparous and give birth to two to four pups after a 12-month gestation (NMFS 2015a). Bigeye thresher sharks reproduce year-round but have low fecundity (Fu et al. 2016). Much of their reproductive phenology remains unknown (NMFS 2015a).

Distribution. The bigeye thresher shark is found throughout the world in tropical and temperate seas (NMFS 2015b). These sharks occur throughout the Pacific Ocean. In the eastern central Pacific, bigeye thresher sharks are known to occur from the area between Wake, Marshall, Howland and Baker, Palmyra, Johnston, and the Hawaiian Islands. Neonates and juvenile thresher sharks in the Pacific were found to be clustered near 10°N and S latitudes with pregnant females either at 10°N or at higher latitudes (20–30°N) (Fu et al. 2016). Habitat of the bigeye thresher is fairly broad including coastal waters over continental shelves, the epipelagic zone on the high seas, deep waters on continental slopes, and sometimes shallow inshore waters (NMFS 2015a). The bigeye thresher is thought to be a highly migratory species (Defenders of Wildlife 2015a); however, little is known about migrations, especially in the Pacific Ocean. Tagging studies of bigeye thresher sharks off Hawai`i reported movements of nearly 3,500 km (2,175 mi) over 240 days (Fu et al. 2016) These sharks are also move vertically in the water column throughout a day, feeding in deeper waters (up to 500 m [1,640 ft]) during the day and staying near the surface at night (Fu et al. 2016). Tagged sharks in the central Pacific were significantly more active at night than during the day with mean depths of 331 m (1,086 ft) during the day and 118 m (387 ft) at night (Musyl et al. 2011).

Threats. Little is known about global abundance of the bigeye thresher. In the eastern central Pacific, populations of these sharks may have declined 83% since surveys were conducted in the 1950s (Defenders of Wildlife 2015a). Reasons for the continued declines in this species are primarily overutilization and the inadequacy of existing regulatory mechanisms (Defenders of Wildlife 2015a). Overutilization from fishing is one of the primary threats to bigeye thresher populations. Commercial fishing, incidental bycatch in commercial fisheries, and recreational fishing have led to historical declines and due to the inadequacy of existing regulatory mechanisms, those fishing pressures remain a problem for shark populations (Defenders of Wildlife 2015a). Other factors cited as contributing to population declines are susceptibility due to low reproductive rates, late sexual maturation, and large migration distances.

Populations at Kwajalein Atoll. There is limited information about the distribution and abundance of the bigeye thresher shark in the central Pacific. The bigeye thresher is known to occur in deep ocean waters near the Hawaiian Islands (Defenders of Wildlife 2015a) and has also been observed in deep ocean waters of the Marshall Islands (Gilman et al. 2014). The highest densities of bigeye thresher sharks in the Pacific is between 5 and 15°N (Fu et al. 2016). Models of thresher shark density have used an upper bound of two million sharks for the population in the Pacific, which corresponds to a less than 5% chance of encountering more than one shark per square kilometer in the areas of highest density (Fu et al. 2016). The bigeye thresher shark is known to occur in the Marshall Islands. Onboard observers of the Marshall Islands longline tuna fishery between 2005 and 2009 documented capture of several shark species including the bigeye thresher shark (Gilman et al. 2014). This species has not been documented in the shallow waters near Illeginni Islet.

2.3.2 Oceanic Whitetip Shark (Carcharhinus longimanus)

Species Description. This large, highly migratory shark usually swims at or near the water surface with their huge pectoral fins outspread (Young et al. 2018). Oceanic whitetip sharks feed mainly on teleost fishes and cephalopods but have been known to feed on sea birds, marine mammals, other sharks, mollusks, and crustaceans (Young et al. 2018). This viviparous shark typically gives birth to 1 to 14 pups every other year after a 10 to 12-month gestation period (Young et al. 2018). In U.S. waters of the Pacific, Essential Fish Habitat for the oceanic whitetip shark is defined as the water column down to a depth of 1,000 m (621 ft) from the shoreline to the outer limit of the exclusive economic zone (Young et al. 2018).

Distribution. The oceanic whitetip is a highly migratory species and is one of the most widespread shark species in tropical and subtropical waters of the world (Young et al. 2018). This species is found in waters between 30ºN and 35ºS latitude; however, the species prefers open ocean waters between 10°N and 10°S (Young et al. 2018). The oceanic whitetip is found throughout the western and central Pacific Ocean including the Hawaiian Islands south to Samoa, Tahiti, and Tuamotu Archipelago and west to the Galapagos (Young et al. 2018). While these sharks may occasionally be found in coastal waters, these sharks are usually found far offshore in the open ocean, on the outer continental shelf, or around oceanic islands in deeper waters (Young et al. 2018). Abundance of this species has been observed to increase away from continental and insular shelves and is generally found in waters with bottom depths greater than 184 m (604 ft) (Young et al. 2018). Tagged sharks in the central Pacific spent most of their time in around 30 m (98 ft) deep both night and day with maximum depth of 317 m (1,040 ft) (Musyl et al. 2011). While oceanic whitetips are highly migratory, traveling hundreds to thousands of kilometers, there is evidence that these sharks commonly return to the same general areas over time (Defenders of Wildlife 2015c).

Threats. Western and central Pacific Ocean populations of the oceanic whitetip shark have been estimated to have declined by as much as 90% from 1996 to 2009 (Defenders of Wildlife 2015c). Major threats to this species include modification or reduction of habitat, overutilization, disease, and the inadequacy of existing regulatory mechanisms (Defenders of Wildlife 2015c). Overutilization includes historical and continued catch in targeted commercial fisheries for their fins, skin, and liver oil and as bycatch in tuna and swordfish fisheries (Defenders of Wildlife 2015c). This species is also considered vulnerable to decline due to their infrequent and low output reproduction strategy (Defenders of Wildlife 2015c).

Populations at Kwajalein Atoll. This species is known to occur in deeper oceanic waters near the RMI (Defenders of Wildlife 2015c, Rice et al. 2015). The oceanic whitetip shark is one of the most common shark species caught in the RMI (Young et al. 2018). From 2005 to 2009, observers in the RMI longline fisheries reported a catch per unit effort of 0.2904 fish per 1,000 hooks for oceanic whitetip sharks (Young et al. 2018). Even though the oceanic whitetip shark is known to occur in deep ocean waters of the RMI (Rice et al. 2015, Young et al. 2018), this shark is not known to occur in the shallow waters near Illeginni Islet.

2.3.3 Humphead Wrasse (Cheilinus undulatus)

Species Description. The humphead wrasse is found at low densities (one to eight per acre) where it occurs, even in its preferred habitat (Donaldson and Sadovy 2001). Humphead wrasses are observed as solitary male/female pairs or in small groups of two to seven individuals (NMFS 2009). The humphead wrasse is a predator of echinoderms including brittle stars, sea stars, and sea urchins, as well as of mollusks and crustaceans (WildEarth Guardians 2012). The feeding ecology of this wrasse may be beneficial to coral reefs, as their diet includes the crown-of-thorns starfish (*Acanthaster planci*), which feeds on coral (WildEarth Guardians 2012). *Cheilinus undulatus* have been observed to aggregate at discrete seaward edges of deep slope drop-offs to broadcast spawn in the water column; they do not deposit their eggs on the substrate (Colin 2010).

Distribution. The humphead wrasse occurs in coral reef regions of the Indo-Pacific in waters from 1 to 100 m (3 to 330 ft) deep (WildEarth Guardians 2012). Both juveniles and adults utilize reef habitats. Juveniles inhabit denser coral reefs closer to shore and 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). Humphead wrasse density increases with hard coral cover, where smaller fish are found in areas with greater hard coral cover (Sadovy et al. 2003).

Threats. Populations of this species have been in decline due to threats from 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 the species is habitat loss and degradation, specifically destruction and degradation of reef habitats, which is common throughout the Indo-Pacific (NMFS 2009).

Populations at Kwajalein Atoll. The humphead wrasse is known to occur in nearshore reef habitats at Illeginni Islet (**Table 4**). As was found in other studies (Donaldson and Sadovy 2001), the humphead wrasse appears to occur in low densities throughout Kwajalein Atoll (based on NMFS and USFWS biennial surveys). Occurrence records of *C. undulatus* suggest a broad, but scattered distribution at Kwajalein Atoll with observations of the species at 29% of sites (34 of 154) at 10 of the 11 surveyed islets and on reefs in the Mid-Atoll Corridor since 2010 (**Table 4**). Adult humphead wrasses have been recorded in seaward reef habitats at Illeginni Islet (shallowest depths approximately 5 m (15 ft) deep (NMFS and USFWS 2012, NMFS and USFWS 2018). Although encountered on numerous occasions at Kwajalein Atoll islets, direct density measures of *C. undulatus* have not been obtained. Two seaward reef flat sites at Illeginni Islet were noted to have adult *C. undulatus* present in 2008 (NMFS and USFWS 2011).

Shallow inshore branching coral areas with bushy macro-algae, such as those which may exist along the shallow lagoon reef flat at Illeginni Islet, have been noted as potential essential nursery habitat for juvenile *C. undulatus* (Tupper 2007). Recent settler and juvenile numbers are presumed to greatly exceed 20 in such habitat (Tupper 2007) and might be grossly approximated to range from 0 to 100 within the lagoon-side waters of Illeginni (NMFS 2014).

Table 4. Number of Kwajalein Atoll Survey Sites (2010 to 2018) with UES Consultation Fish Species Observations.

Family Scientific Name	RN	ET	GA	GL	OM	EK	MK	IL	LG	EN	KI	MAC	Total	Number of Islets
Labridae														
Cheilinus undulatus	4	3	3	1	3	1	1	**1**	-	3	9	5	**34**	10
Mobulidae														
Mobula sp.[1]	-	-	-	-	-	1	-	**1**	-	-	2	-	**4**	3
Total Number of Sites Surveyed	**13**	**8**	**5**	**8**	**7**	**5**	**8**	**5**	**7**	**5**	**19**	**64**	**154**	**11**

Sources: NMFS and USFWS 2012, NMFS and USFWS 2013a, NMFS and USFWS 2017, NMFS and USFWS 2018, NMFS and USFWS 2021.

Note:

1 The 2010 and 2016 inventory reports list *Manta (Mobula) birostris* for these observations. While not recorded during biennial inventories of Kwajalein Atoll islets, *Mobula alfredi* is also known to occur in Kwajalein Atoll waters.

Abbreviations: EK = Eniwetak, EN = Ennylabegan, ET = Ennugarett, GA = Gagan, GN = Gellinam, IL = Illeginni, KI = Kwajalein, LG = Legan, MAC = Mid-Atoll Corridor, MK = Meck, OM = Omelek, RN = Roi-Namur

2.3.4 Reef Manta Ray (Mobula alfredi)

Species Description. Until 2009, all manta rays were considered a single species, *Manta birostris*. The genus *Manta* has been synonymized with the genus *Mobula* (Farmer et al. 2022) and there are currently two species of manta ray, *Mobula alfredi* and *Mobula birostris*, as supported by morphological and genetic data. Reef manta rays are still listed as a consultation species in Appendix 3-4 of the UES under the name *Manta alfredi*. The giant manta ray is a more oceanic species while the reef manta ray is primarily a nearshore species. Consequently, many historic records of manta rays in nearshore waters likely refer to what is now known as the reef manta ray. While somewhat smaller than the giant manta ray, the reef manta ray is a large, cartilaginous elasmobranch up to 5 m (16 ft) wide (Marshall et al. 2022a). This species feeds on plankton, which it filters from seawater using gill plates (Defenders of Wildlife 2015b). While long lived, this species exhibits very low fecundity, typically producing only a single pup every 1 to 7 years after a 1-year gestation period (Marshall et al. 2022a). Females are thought to mature at 8 to 17 years and may only produce 4-7 pups during their estimated lifespan (Marshall et al. 2022a).

Distribution. This species has a circumglobal distribution in tropical and sub-tropical waters but is often resident in or along productive near-shore environments (Marshall et al. 2022a). The reef manta ray is typically found inshore in shallow waters but moves further offshore at night to feed (Marshall et al. 2022a). Acoustic tracking data suggest that reef manta rays do not often leave coastal waters, remaining within 6 km (3 nautical miles) of shore (Clark 2010). This species has relatively small home ranges with short seasonal migratory movements and established aggregation sites (Marshall et al. 2022a). Reef manta rays typically exhibit short migrations and do so infrequently; however, the reef manta ray is known to migrate up to 650 km (350 nautical miles) (Marshall et al. 2022a). In Hawai`i, reef manta rays may have even more limited movement, with no documented movement of rays between islands only 48 km (26 nautical miles) apart (Clark 2010).

Threats. Globally, reef manta rays have decreasing population numbers (Marshall et al. 2022a). Major threats to this species include both targeted and bycatch fishing (Marshall et al. 2022a). Manta rays are fished for meat, for their epidermis which is used for leather products, and for their gill rakers which are highly prized for use in Chinese medicinal products (Marshall et al. 2022a). Manta rays are also caught as bycatch in gillnet, purse seine, and other netting operations as well as entangled in monofilament fishing line (Marshall et al. 2022a).

Populations at Kwajalein Atoll. Manta rays were observed during 2010 and 2016 inventories of Kwajalein Atoll islets (**Table 4**). While these observations at two locations near Kwajalein Islet in 2010 and at single locations near Eniwetak, Illeginni, and Kwajalein Islets in 2016 were recorded as observations of "*Manta birostris"* (giant manta ray, now *Mobula*), *Mobula alfredi* is also known to occur in Kwajalein Atoll (V. Brown personal communication 2018). No abundance data is available for reef manta rays in Kwajalein Atoll; however, density data is available for another Pacific island with similar reef ecosystems, Guam. Data from a long-term study of the insular coral reef ecosystem of Guam resulted in an overall density estimate of less than 0.01 individuals per square kilometer (Martin et al. 2016). Densities in this study ranged from 0.0 to 0.03 per square kilometer with the highest densities in reef habitats predominantly covered by coral, turf, and macroalgae and in Marine Protected Areas around Guam (Martin et al. 2016). While this species is known to occur in nearshore waters of Kwajalein Atoll, there are no known records of the species in the near Illeginni Islet.

2.3.5 Oceanic Giant Manta Ray (Mobula birostris)

Species Description. Until 2009, all manta rays were considered a single species, *Manta birostris*. The genus *Manta* has been synonymized with the genus *Mobula* and there are currently two manta ray species, *Mobula alfredi* and *Mobula birostris*, as supported by morphological and genetic data (Farmer et al. 2022). The giant manta ray is a more oceanic species while the reef manta ray is primarily a nearshore species. Consequently, many historic records of manta rays in nearshore waters likely refer to what is now known as the reef manta ray. The oceanic giant manta ray is listed as a threatened species under the ESA and as a consultation species in the UES under the name *Manta birostris*. The giant manta ray reaches lengths of 7 m (23 ft) long and feeds on plankton, which it filters from seawater using gill plates (Defenders of Wildlife 2015b). While little is known about the life history of this species it is thought to be long lived and likely has low fecundity, with reports of litter size consistently being of a single offspring (Marshall et al. 2022b).

Distribution. This species has a circumglobal distribution in tropical and temperate waters. The giant manta ray is commonly sighted along productive coastlines with upwelling and primarily occurs in shelf waters or near offshore pinnacles and seamounts (Marshall et al. 2022b, Farmer et al. 2022). This species is thought to spend the majority of its time in deep water with occasional visits to coastal areas (Defenders of Wildlife 2015b). This species is commonly observed during cleaning visits to shallow reefs or feeding at the surface inshore and offshore. While more solitary than the reef manta ray, the giant manta ray is a seasonal migrant to coastal and offshore aggregation sites (Marshall et al. 2022b). Oceanic manta rays are capable of long-distance movements, but these long-distance movements may be rare (Marshall et al. 2022b). Based on satellite tagging, stable isotope, and genetic analysis, Stewart et al. (2016) found that Indo-Pacific oceanic manta rays form well-structured subpopulations with a high degree of residency. This species has been tracked diving to depths exceeding 1,000 m (3,281 ft) (Marshall et al. 2022b).

Threats. Globally, giant manta rays have decreasing population numbers (Marshall et al. 2022b). In its status review report, NMFS indicated the most significant threat to the giant manta ray was overutilization for commercial purposes (Miller and Klimovich 2016). This species is subject to both targeted and bycatch fishing (Marshall et al. 2022b, Miller and Klimovich 2016). Manta rays are fished for meat, for their epidermis which is used for leather products, and for their gill rakers which are highly prized for use in Chinese medicinal products (Marshall et al. 2022b). Manta rays are also caught as bycatch in gillnet, purse seine, and other netting operations as well as entangled in monofilament fishing line (Marshall et al. 2022b). This species is especially vulnerable to threats that decrease its abundance due to their low reproductive output (Miller and Klimovich 2016).

Populations at Kwajalein Atoll. Manta rays were observed during 2010 and 2016 inventories of Kwajalein Atoll islets (**Table 4**). *Manta* observations at two locations near Kwajalein Islet in 2010 and at single locations near Eniwetak, Illeginni, and Kwajalein Islets in 2016 were recorded as observations of *Manta birostris*. While the giant manta ray is generally a more oceanic species than the reef manta ray, both species are known to occur in Kwajalein Atoll waters (V. Brown personal communication 2018). No abundance data is available for oceanic manta rays in Kwajalein Atoll or other areas of the Central Pacific.

2.3.6 Scalloped Hammerhead Shark (Sphyrna lewini)

Species Description. Scalloped hammerhead sharks occur as solitary individuals, or in aggregations or schools associated with feeding habitats (e.g., near islands, reefs, or seamounts) or during the spawning season (Ketchum et al 2014, Compagno 1984). This species is ovoviviparous, giving birth to multiple live young in warm nearshore waters. Throughout the species' range, females migrate to coastal areas to give birth. In the Eastern Tropical Pacific, this occurs between May and September (Chávez et al. 2023). In general, small hammerhead sharks are found in shallow nearshore waters (0 to 60 m or 0 to 200 ft deep), while larger juvenile and adult sharks can be found in deeper offshore waters (Chávez et al. 2023). In the Hawaiian Islands, protected bays are utilized as juvenile nursery habitats between May and September. Pups move throughout the bay during a residency of approximately one year, with no discernible pattern in habitat use (Duncan and Holland 2006). Around the Galapagos Islands, scalloped hammerheads show a preference for nearshore and trench environments, which are thought to be foraging habitats (Ketchum 2014). At Galapagos, hammerheads remain in shallower waters during the warm season and in deeper waters in the cold season. The sharks move near or above the thermocline, presumably to thermoregulate (Ketchum 2014).

The scalloped hammerhead shark is a high-level trophic predator and feeds primarily at night (Compagno 1984, Bush and Holland 2002, Hussey et al. 2011). They feed opportunistically on teleost fishes, cephalopods, crustaceans, and rays (Compagno 1984, Vaske et al. 2009, Bethea et al. 2011). Scalloped hammerhead sharks are hearing generalists and, like many fishes, possess a lateral line sensory system sensitive to particle motion in the water column (Popper 2003). Electroreception is the primary sensory mechanism used by many sharks. Sharks have demonstrated highest sensitivity to low frequency sound (40 Hz to approximately 800 Hz), sensed solely through the particle-motion component of an acoustical field (Myrberg 2001). Free-ranging sharks are attracted to sounds possessing specific characteristics: irregularly pulsed, broadband (attractive frequencies are below 80 Hz), and transmitted without a sudden increase in intensity. Such sounds are reminiscent of those produced by struggling prey (Myrberg 2001).

Distribution. The scalloped hammerhead occurs in coastal, warm temperate waters and tropical seas throughout the world (Miller et al. 2013). This shark is found over continental and insular shelves from the surface and intertidal zones to depths of up to 512 m (1,680 ft) (Miller et al. 2013). They are highly mobile and partly migratory. Scalloped hammerheads typically inhabit nearshore waters of bays and estuaries where water temperatures are at least 22°C (72°F) (Compagno 1984). They remain close to shore during the day and move into deeper waters at night to feed (Bester 1999). These sharks have shown diel vertical movements in some studies. A tagged shark in the northern Gulf of Mexico showed consistent diel vertical movements, spending approximately 80% of daylight hours between depths of 50 to 100 m (164 to 328 ft) with no deep dives. Seventy percent of night hours were spent in surface waters of 0 to 50 m (0 to 164 ft), and the shark occasionally made dives to nearly 1,000 m (0.6 mi) (Hoffmayer et al. 2013).

Threats. Both target and bycatch capture in fisheries is a significant cause of mortality for the species. Because scalloped hammerheads aggregate in large schools, large numbers may be captured with minimal effort. They are sought for their highly valuable fins and are being increasingly targeted in some areas. The Indo-West Pacific DPS was proposed for listing as a threatened species (78 FR 20717 [5 April 2013] with high risk due to overutilization by industrial, commercial, and artisanal fisheries as well as illegal and unregulated fishing (Miller et al. 2013).

Populations at Kwajalein Atoll. The scalloped hammerhead sharks scattered distribution in the western Pacific includes all of the tropical/temperate Pacific Islands (Rigby et al. 2019). These sharks are considered to be semi-oceanic and occur primarily in coastal areas. Studies of hammerhead shark catches in longline fisheries indicate a limited distribution in the central Pacific with most catches concentrated in deeper waters off the coast of islands (Rice et al. 2015).

Scalloped hammerhead sharks are observed occasionally by biologists and recreational divers in Kwajalein Atoll waters, primarily at reefs and lagoon shipwrecks. A solitary adult scalloped hammerhead shark was observed by NMFS and USFWS biologists in approximately 7.6 m (25 ft) of water seaward of the atoll reef west of Roi-Namur Islet (DON 2017). Scalloped hammerhead sharks were observed by recreational divers on two separate occasions in 2019 (K. Miller 2023b personal communication). On the first occasion, three scalloped hammerhead sharks were observed in approximately 30.5 m (100 ft) of water in the lagoon at the Tateyama Maru (K-5 side) Shipwreck on 2 May 2019 (K. Miller 2023b personal communication). On 31 August 2019, a single scalloped hammerhead was observed in the lagoon at the Akibason Maru (P-Buoy) Shipwreck in approximately 18.3 m (60 ft) of water approximately 1.2 km (0.7 miles) from the north point of Kwajalein Island (K. Miller 2023b personal communication). This species has the potential to occur in all deeper waters around Kwajalein Atoll, including within the deep-water test impact zones, as well as in coastal nearshore habitats.

2.3.7 Pacific Bluefin Tuna (Thunnus orientalis)

Species Description. The Pacific bluefin tuna is one of several tuna species inhabiting the Pacific Ocean and reaches lengths of 3 m (9 ft) (CBD 2016). This species is a pelagic fish that tends to form schools based on size and cohort (CBD 2016). With a streamlined shape, lunate caudal fin, retractable dorsal fins, and a rigid body to provide greater power, Pacific bluefin tuna are uniquely adapted for long distance migrations and for catching their prey, fast moving fishes (CBD 2016). While larvae and small juveniles feed on small organisms such as brine shrimp, other fish larvae, and copepods, larger juveniles and adults feed primarily on smaller fish but are known to eat a wide range of marine prey (CBD 2016). This species is a highly migratory species known to migrate over long distances from the equator to high latitudes to feed and spawn (CBD 2016). These tuna are unusual among fish in that they can maintain their body heat up to 55°F higher than ambient water temperature (CBD 2016).

Distribution. The Pacific bluefin tuna is distributed throughout the Pacific Ocean. They primarily occur in the north Pacific between 20°N and 50°N but are also found in tropical waters and in the southern hemisphere (Pacific Bluefin Tuna Status Review Team 2017). In the eastern Pacific, populations are found in the California current from Washington State, south to Baja California (CBD 2016). In the western Pacific, fish are found from Sakhalin Island, Russia south to New Zealand and Australia (CBD 2016). There are two known spawning areas in the western Pacific (one in the East China Sea and one in the Sea of Japan), and all Pacific bluefin tuna are born in the western Pacific (CBD 2016). A majority of juveniles remain in the western Pacific; however, some migrate to the eastern Pacific in their first or second year where they feed off the Pacific coast of North America for one to four years before migrating back to the western Pacific to spawn (CBD 2016). These pelagic tunas prefer temperate waters but travel into polar and subpolar waters to feed and subtropical waters to reproduce (CBD 2016). Pacific bluefin tuna habitat includes the water column extending from the surface down to 1,000 m (3,281 ft) (CBD 2016). These fish are mostly found in the upper 100 m (328 ft) of the water column but are known to make diel vertical migrations, inhabiting deeper waters during daylight hours (CBD

2016). Studies have also found that juvenile fish spent more than 50% of their time in depths shallower than 10 m (33 ft) (CBD 2016).

Threats. Pacific bluefin tuna populations have decreased to approximately 2.6% of their estimated unfished biomass (CBD 2016). Major threats to this species include overutilization in both commercial and recreational fishing, overutilization in aquaculture operations, inadequacy of existing regulatory mechanisms, and destruction and modification of habitat (CBD 2016). Overfishing is the primary threat to Pacific bluefin tuna populations (CBD 2016). Because these fish are slow growing, long lived, and migrate long distances to spawn and feed, most (estimated 97.6%) are caught before they are able to spawn (CBD 2016). Destruction and modification of habitat within the species range has been primarily due to pollution from chemicals such as mercury, plastic pollution, oil and gas pollution and development, wind energy development, and prey depletion (CBD 2016).

Populations at Kwajalein Atoll. The density and distribution of this species is poorly understood in the central Pacific. The Pacific bluefin tuna probably occurs in the Marshall Islands (CBD 2016). If this species does occur in Kwajalein Atoll, it likely has a patchy and seasonal distribution in deeper waters. This species is not known to occur in nearshore waters of Kwajalein Atoll and there are no known records of Pacific bluefin tuna near Illeginni Islet.

2.4 Corals

The marine environment surrounding Illeginni Islet supports a community of corals that is typical of reef ecosystems in the tropical insular Pacific. NMFS and USFWS have conducted biannual inventories of the reef habitats around Illeginni Islet since 1996 as described in **Section 1.2**. The last biennial inventory of marine habitats at Illeginni Islet was conducted in 2016 (NMFS and USFWS 2018). In 2014, NMFS also surveyed the reef habitats offshore of the DoD test impact zone at Illeginni Islet (**Figure 1**) (NMFS-PIRO 2017a). NMFS estimated that the 2014 surveys covered all of the reef habitat area potentially affected by missile impact testing on the lagoon side and 99% of the reef area on the ocean side (NMFS-PIRO 2017a and 2017b). These data are still considered the best available information for coral species presence and density offshore of the terrestrial impact zone at Illeginni Islet. Based on the 2014 NMFS surveys (NMFS-PIRO 2017a), six UES consultation coral species (*Acropora microclados*, *A. polystoma*, *Cyphastrea agassizi*, *Heliopora coerulea*, *Pavona venosa*, and *Turbinaria reniformis*) are likely to occur in the reefs near the Illeginni Islet impact zone as adults (**Table 5**).

Table 5. Invertebrate Species Requiring Consultation under the UES that have the Potential to Occur near Illeginni Islet.

Scientific Name	Common Name	UES Consultation Species Listing Status [1]			Presence in Areas at Risk from Test Impact Effects Near Illeginni Islet [2]	Presence in Illeginni Harbor [3]
		ESA	RMI Statute	UES 3-4.5.1(a)		
Corals						
Acanthastrea brevis	Starry cup coral			x	-	Harbor
Acropora aculeus	Bottlebrush *Acropora*			x	-	-
Acropora aspera	Green staghorn coral			x	-	Harbor
Acropora dendrum				x	-	-
Acropora listeri				x	-	-
Acropora microclados	Strawberry shortcake *Acropora*			x	Ocean Side	Harbor
Acropora polystoma				x	Ocean Side	-
Acropora speciosa		T			-	-
Acropora tenella		T			-	-
Acropora vaughani				x	-	Harbor
Alveopora verrilliana				x	-	-
Cyphastrea agassizi	Agassiz's coral			x	Lagoon Side	Harbor
Heliopora coerulea	Blue coral			x	Lagoon Side	-
Leptoseris incrustans	Swelling coral			x	-	-
Montipora caliculata				x	-	Harbor
Pavona cactus				x	-	Harbor
Pavona decussata	Leaf or cactus coral			x	-	Harbor
Pavona venosa				x	Lagoon Side	Harbor
Turbinaria mesenterina	Vase coral			x	-	-
Turbinaria reniformis	Yellow scroll coral			x	Lagoon Side	-
Turbinaria stellulata	Disc coral			x	-	-
Mollusks						
Hippopus hippopus	Giant Clam	C			Ocean & Lagoon Sides	Harbor
Pinctada margaritifera	Black-lipped pearl oyster		3		-	-
Rochia nilotica [4]	Top shell snail		3		Lagoon Side	Harbor
Tridacna gigas	Giant Clam	C			-	Harbor
Tridacna squamosa	Giant Clam	C			Lagoon Side	Harbor

Sources: USASMDC 2021, NMFS-PIRO 2017a, NMFS-PIRO 2017b, NMFS and USFWS 2017

Notes:

1 UES Consultation Species Listing Status based on Appendix 3-4A of the UES (USASMDC 2021).
RMI Statutes: 3 = Fisheries Act 1997, Title 51 MIRC Chapter 2;
UES Section 3-4.5.1(a): X = Contained in RMI Environmental Protection Agency letter, 12 March 2015, or RMI Environmental Protection Agency letter, 28 September 2016

2 Presence based on observations during a 2014 assessment of the reef areas offshore of the Illeginni Islet Impact Zone (NMFS-PIRO 2017a and 2017b) survey areas shown in Figure 1.

3 Presence based on observation during 2014 survey of Illeginni Harbor (NMFS and USFWS 2017).

4 Within RMI legislation, top shell snails are listed in Appendix 3-4A as *Trochus niloticus and Trochus maximus*. This taxon is currently most commonly synonymized under the name *Rochia nilotica*.

Abbreviations: C = Species is a candidate for listing under the ESA, ESA = U.S. Endangered Species Act, T = ESA Threatened, UES: United States Army Kwajalein Atoll Environmental Standards, "-" = species was not observed during 2014 surveys.

An additional 15 UES consultation species that have been observed at other survey locations near Illeginni Islet since 2010 and/or have the potential to occur near in Illeginni Islet nearshore waters as gametes or larvae (see **Table 5**). Four of these species, *Acropora tenella*, *A. vaughani*, *Leptoseris incrustans*, and *Pavona cactus*, occur on lower reef slopes which occur below areas that may be affected by test program impacts on Illeginni Islet, and for this reason, adults are considered unlikely in areas subject to DoD test effects. Two other species are only known to occur in Illeginni Harbor, *Pavona decussata* and *Acropora aspera*, and are not known or expected to be near the impact zone on Illeginni Islet. The other species listed in **Table 5** (*Acanthastrea brevis*, *Acropora aculeus*, *A. dendrum*, *A. listeri*, *A. speciosa*, *Alveopora verrilliana*, *Montipora caliculata*, *Turbinaria mesenterina*, and *T. stellulata*) have either not been recorded near Illeginni Islet or have been recorded at other locations near Illeginni Islet but have not been recorded in the area potentially affected by impact debris or shock waves (NMFS PIRO 2017a). Adults of these 15 species are considered unlikely in the area offshore of the Illeginni Islet test impact zone and are not expected to be exposed to stressors from DoD testing.

Generally, coral cover and diversity near Illeginni Islet are moderate to high on the lagoon reef slopes and around to the southern and western seaward reef crest and slopes, while abundance and diversity appear lower off the seaward northwestern side of the islet. Offshore of the Illeginni impact zone, deeper ocean-side habitats (up to 4 m or 13 ft) include raised limestone plateaus which are highly colonized by corals separated by deep coral and cobble valleys (NMFS-PIRO 2017a). Shallower ocean-side habitats include areas with high coral colonization as well as an area that is primarily pavement and cobble with small patches of coral (NMFS-PIRO 2017a). Habitats on the lagoon side of the impact zone have less coral cover, mostly consisting of small, scattered coral aggregates with some large patches of *Montipora digitata* (NMFS-PIRO 2017a). Illeginni Harbor has a sandy bottom with dense seagrass beds but supports a diversity of coral species on both the wall and bottom habitats including nine consultation coral species (**Table 5**).

All shallow-water corals of the Marshall Islands are found throughout much of the insular Pacific and the coral triangle (i.e., the area surrounding Indonesia and the Philippines) (Brown and Wolf 2009). No known shallow-water coral species are endemic to the Marshall Islands. Within Kwajalein Atoll, all coral species found at Illeginni Islet in NMFS and USFWS biennial inventories are found in reefs of at least two other surveyed Kwajalein Atoll islets (n = 11 islets) (**Table 6**) and at other locations in the Marshall Islands (Beger et al. 2008, Pinca et al. 2002, NMFS and USFWS 2012).

Table 6. Number of Kwajalein Atoll Survey Sites (2010 to 2018) with UES Consultation Coral Species Observations.

Family Scientific Name	RN	ET	GA	GL	OM	EK	MK	IL	LG	EN	KI	MAC	Total	Number of Islets
Acroporidae														
Acropora aculeus	-	-	-	2	-	1	-	**1**	2	1	3	6	16	6
Acropora aspera	4	3	1	1	2	-	2	**1**	1	-	9	2	26	9
Acropora dendrum	-	-	1	1	2	2	4	**1**	1	1	7	5	25	9
Acropora listeri	-	-	1	1	-	1	2	**-**	1	-	2	2	10	6
Acropora microclados	3	3	4	6	6	5	8	**5**	7	5	16	55	123	11
Acropora polystoma	1	-	2	1	-	-	1	**-**	1	-	3	14	23	6
Acropora speciosa	-	1	-	-	-	-	2	**-**	-	-	4	6	13	3
Acropora tenella	1	-	-	-	-	-	1	**1**	-	1	5	1	10	5
Acropora vaughani	2	3	3	3	2	1	2	**2**	-	-	10	13	41	9
Montipora caliculata	2	4	2	7	5	4	8	**5**	6	2	6	52	103	11
Agariciidae														
Leptoseris incrustans	3	2	-	4	2	1	2	**2**	2	1	5	43	67	10
Pavona cactus	2	3	3	1	3	-	4	**2**	-	-	10	8	36	8
Pavona decussata	1	-	-	-	-	-	1	**1**	-	2	1	1	7	5
Pavona venosa	1	1	3	1	1	1	2	**3**	3	3	7	16	42	11
Dendrophylliidae														
Turbinaria mesenterina	1	-	1	-	1	-	-	-	1	-	-	-	4	4
Turbinaria reniformis	4	3	2	4	2	3	1	**4**	2	1	2	23	51	11
Turbinaria stellulata	3	2	1	1	-	-	-	**3**	1	-	-	18	29	6
Faviidae														
Cyphastrea agassizi	-	2	1	1	4	2	4	**3**	2	-	2	18	39	9
Helioporidae														
Heliopora coerulea	3	2	1	6	4	5	5	**4**	7	2	5	60	104	11
Mussidae														
Acanthastrea brevis	2	-	2	-	1	1	3	**4**	5	2	4	40	64	9
Portidae														
Alveopora verrilliana	-	-	-	1	-	-	-	**2**	1	-	2	10	16	4
Total Number of Sites or Islets Surveyed	**13**	**8**	**5**	**8**	**7**	**5**	**8**	**5**	**7**	**5**	**19**	**64**	**154**	**11**

Sources: NMFS and USFWS 2012, NMFS and USFWS 2013a, NMFS and USFWS 2017, NMFS and USFWS 2018

Abbreviations: EK = Eniwetak, EN = Ennylabegan, ET = Ennugarett, GA = Gagan, GN = Gellinam, IL = Illeginni, KI = Kwajalein, LG = Legan, MAC = Mid-Atoll Corridor, MK = Meck, OM = Omelek, RN = Roi-Namur

Summary of General Coral Characteristics. 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 to 30 m (0 to 100 ft), although some species have more specific depth and sub habitat preferences (Brown and Wolf 2009). The optimal water temperature and salinities for most shallow-water tropical corals are 77°F to 84°F (25°C to 29°C), and 34 to 37 parts per thousand, although short-term anomalies are usually tolerated, with minor physiological consequences (Wallace 1999). Corals generally require high oxygen content, low nutrient levels, and clear water to allow sufficient sunlight to support zooxanthellae (symbiotic photosynthetic organisms) (Beger et al. 2008, Spalding et al. 2001). Most coral species tolerate short-term turbidity with minimal physiological consequences, and some species tolerate long-term turbidity (Beger et al. 2008, Rogers 1990).

Predators of corals include sea stars, snails, and fishes (e.g., crown-of-thorns starfish, parrotfish, and butterfly fish) (NOAA 2022b, Keesing 2021). Crown-of-thorns starfish are the primary predators of most listed coral species known to occur at Illeginni Islet.

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. The coral host provides nitrogen in the form of waste to the zooxanthellae, and the zooxanthellae provide organic compounds produced by photosynthesis to its host (Brusca and Brusca 2003, Schuhmacher and Zibrowius 1985). Some corals derive most of their energy from their zooxanthellae symbionts, resulting in dramatically reduced need for the coral to feed on zooplankton (Lough and Van Oppen 2009). Zooxanthellae also provide corals with most of their characteristic color.

Coral Reproduction. Most coral species can reproduce both sexually and asexually (NOAA 2023b). Most of the shallow-water species requiring consultation in **Table 5** reproduce sexually 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). Many corals are also capable of asexual reproduction by dividing or fragmentation (NOAA 2023b). Fragmentation is most often seen in branching or plating corals that are more likely to break (NOAA 2023b).Sexual reproduction in corals is accomplished primarily by broadcast spawning where corals release eggs and sperm into the water where eggs are then fertilized (NOAA 2023b). After fertilization of the egg, free-floating, or planktonic, larvae form (NOAA 2023b). These coral planulae are carried by water currents but are also capable of directional swimming in response to cues including chemical signals and light (NOAA 2023b). Larval duration ranges from a few days to months (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 2,000 km (1,080 nautical miles), but local short-distance dispersal occurs much more frequently than long-distance dispersal (Jones et al. 2009, Mumby and Steneck 2008). Less frequent long-distance dispersal is dependent on the buoyant gametes and planktonic larvae (typically free-swimming planulae) that are more likely to be found in open ocean areas. Spatial modelling of dispersal of coral larvae across the Pacific has indicated that 50% of dispersal connectivity between reefs occurs within 50 to 100 km (27 to 54 nautical miles) (Wood et al. 2014). Altogether this information suggests that gametes and planulae will be found in the open ocean, but at very low densities. The portion of the total pool of gametes, planulae, and larvae that are likely to be found in the open ocean is likely very small.

Coral planulae density in the water directly over the reef is zero except during reproduction when density peaks at 16,000 per 100 cubic meters (453 per 100 cubic feet) for some spawning species (Hodgson 1985). In a study of a reef off Oahu, Hawai`i, Hodgson (1985) sampled larvae on 4 transects from the inner reef flat to 20 m seaward of the reef and found an average abundance of all types of coral planulae of 328 per 100 cubic meters (9.3 per 100 cubic feet) from June to August. On the Great Barrier Reef, similar densities of coral larvae directly over the reef rapidly dispersed by three to five orders of magnitude in waters 5 km (3 mi) distant from the reef (Oliver et al. 1992). Eggs, larvae, and planulae are not homogenously distributed but sometimes travel in semi-coherent aggregations (slicks) or become concentrated along oceanic fronts (Hughes et al. 2000, Jones et al. 2009). Overall, larval densities at DoD test sites, especially for UES consultation species, are likely to be near the lower range except during peak spawning when density may approach the upper range.

After their planktonic stage, coral planulae will swim down to the bottom where they will settle if conditions are favorable (NOAA 2023b). Once the planulae settle, they metamorphose into polyps which are attached to the substrate (NOAA 2023b). These polyps will form colonies that increase in size over time. After the colony is established (1 or 2 years), coral growth rates are generally constant as the colony ages, varying widely among species from approximately 5 to 130 millimeters (0.25 to 5 inches) per year (Buddemeier et al. 1974, Edinger et al. 2000, Hoeke et al. 2011). In general, branching corals grow faster than massive or encrusting corals. Reproductive maturity is reached between three and eight years, the average generation time is 10 years, and longevity ranges from several decades to a millennium (De'ath et al. 2009, Soong et al. 1999, Wallace 1999).

Summary of Threats to Corals. The consultation coral species are all classified as vulnerable by the International Union for Conservation of Nature (IUCN) (2023). This means that their global population is estimated to be at least 36% reduced over three generations. Threats to coral health and coral reef ecosystems in the Pacific Islands include macroalgae, coral bleaching, diseases, predation, overfishing, pollution, and marine debris (NOAA 2022b). Based on a summary of the state of coral reef ecosystems in 2008, RMI reefs are generally in good condition compared to reefs in southeast Asia and other Pacific Islands (Beger et al. 2008). While many threats to coral reefs have been comparatively low in the RMI, these reefs have become increasingly threatened by threats associated with overfishing, climate change, sea-level rise, urbanization, and loss of cultural traditions (Beger et al. 2008). Direct estimates of population status for corals in the RMI are incomplete, although an excellent qualitative time-series data set of species presence-absence for many USAKA locations has been maintained by collaboration among USAG-KA, NMFS, and USFWS (NMFS and USFWS 2002, 2004, 2006, 2011, 2012, 2013a, 2017, 2018, 2021).

There are no known species-specific threats for any particular coral species listed in **Table 5**, 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 starfish (*Acanthaster planci*) feeds preferentially, but not exclusively, on *Acropora* and *Pocillopora* species (Keesing 2021). 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).

Threats to corals such as coastal development (, pollution and erosion, overexploitation and destructive fishing practices, global climate change and acidification, tropical storms, disease, predation, harvesting for the aquarium trade, boat anchors, invasive species, ship groundings, and possibly human-made noise (NOAA, 2023b, Beger et al. 2008, Vermeij et al. 2010) can impact coral health and populations. Taken together, these threats can result in coral death, reduced growth rates caused by a decrease in the pH of the ocean from pollution, reduced tolerance to global climate change, and malnutrition and weakening due to coral bleaching (Carilli et al. 2010, Cohen et al. 2009). Many stressors may cause coral bleaching, but large scale bleaching events are generally closely associated with high sea temperatures (Eakin et al. 2018, Beger et al. 2008). Human-made noise may affect coral larvae by masking the natural sounds that orient them toward suitable settlement sites (Vermeij et al. 2010).

Coral bleaching has been observed across Kwajalein Atoll in recent years (NMFS and USFWS 2021, NMFS and USFWS 2018). NMFS observed a considerable amount of coral bleaching across the atoll between 2014 and 2016 (NMFS-PIRO 2017a). The majority of coral bleaching observed seemed to correlate with regional elevation in ocean temperatures during that time period (NMFS-PIRO 2017a). The pattern of bleaching across Kwajalein Atoll was scattered and inconsistent both in terms of species affected and spatial distribution of bleached corals (NMFS-PIRO 2017a). While there has been evidence of coral bleaching within the area potentially affected by test program impacts at Illeginni Islet, there is no evidence that there were losses of entire species assemblages or total geographic losses across Kwajalein Atoll (NMFS-PIRO 2017a). During the most recent biological inventories at Illeginni Islet (NMFS and USFWS 2018), evidence of coral bleaching was observed in lagoon flat, lagoon slope, ocean flat, and ocean slope habitats offshore of the RTS impact zone. NMFS has stated that coral bleaching events in the RMI are likely to increase in frequency because ocean waters are expected to reach severe coral bleaching temperatures annually within the next 20 years (NMFS and USFWS 2021).

2.4.1 Acanthastrea brevis

Species Description. *Acanthastrea brevis* is a uniform or mottled brown, yellow, or green hard coral species in the family Mussidae with a spiny appearance (Vernon et al. 2016). This species is generally not fleshy and colonies are mostly submassive (Vernon et al. 2016).

Distribution. *Acanthastrea brevis* is found in the Red Sea and Gulf of Aden, the Southwest Indian Ocean, Northern Indian Ocean, the Central Indo-Pacific, the Oceanic West Pacific, the Great Barrier Reef, and Fiji (Brown and Wolf 2009). This range includes the waters of American Samoa, Micronesia, the Northern Mariana Islands, and Palau (Brown and Wolf 2009). *Acanthastrea brevis* is found in all types of reef habitat at depths of 1 to 20 m (3 to 66 ft) (Brown and Wolf 2009).

Threats. This species is particularly susceptible to crown-of-thorns starfish, which is a significant threat to many corals throughout the Indo-Pacific (Brown and Wolf 2009). Due to this and other general coral threats listed above, this species is declining and has an estimated reduction in habitat of 36% over 30 years (Brown and Wolf 2009).

Populations near Illeginni Islet. *Acanthastrea brevis* has been observed at 9 of the 11 surveyed Kwajalein Atoll islets since 2010 (**Table 6**). In addition to Illeginni Islet, it has been observed during inventories at Kwajalein, Roi-Namur, Gagan, Omelek, Eniwetak, Meck, Legan, and Ennylabegan islets as well as on reefs in the Mid-Atoll Corridor. Overall, *A. brevis* has been observed at 42% (64 of 154) of survey sites in Kwajalein Atoll. This species was observed at 80% (4 of 5) of biennial inventory sites at Illeginni Islet since 2010, including a site in Illeginni Harbor, but was not observed in the 2014 surveys near the Illeginni Islet terrestrial impact zone.

2.4.2 Acropora aculeus

Species Description. *Acropora aculeus* is a gray, bright blue-green, or yellow hard coral species with tips that are yellow, lime green, pale blue, or brown in the family Acroporidae (Vernon et al. 2016). *Acropora aculeus* forms colonies of corymbose clumps with thin, spreading horizontal branches and fine, upward projecting branchlets (Brown and Wolf 2009).

Distribution. *Acropora aculeus* is found throughout the central Indo-Pacific and is present, but not common in the Southwest, Northern, and Eastern Indian Ocean, Australia, Southeast Asia, Japan and the East China Sea, and the Oceanic West Pacific (Brown and Wolf 2009). This range includes the waters of American Samoa, Micronesia, the Northern Mariana Islands, the Marshall Islands, and Palau (Brown and Wolf 2009). *Acropora aculeus* is found in reef slopes and lagoons at depths of 5 to 35 m (16 to 115 ft) (Brown and Wolf 2009).

Threats. This species is particularly susceptible to crown-of-thorns starfish, which is a serious threat to many corals throughout the Indo-Pacific (Brown and Wolf 2009). Like other *Acropora* species, *A. aculeus* is susceptible to bleaching and disease and is slow to recover (Brown and Wolf 2009). Aquarium harvest and extensive habitat reduction are also significant threats to this species (Brown and Wolf 2009). Due to these and other general coral threats listed above, this species is declining and has an estimated habitat loss and population reduction of 37% over 30 years (Brown and Wolf 2009).

Populations near Illeginni Islet. *Acropora aculeus* has been observed at 6 of the 11 surveyed Kwajalein Atoll islets since 2010 (**Table 6**). In addition to Illeginni, it has been observed during inventories at Kwajalein, Gellinam, Eniwetak, Legan, and Ennylabegan islets as well as on reefs in the Mid-Atoll Corridor. Overall, *A. aculeus* has been observed at 10% (16 of 154) of survey sites in Kwajalein Atoll. This species was observed at 20% (1 of 5) of biennial inventory sites at Illeginni Islet since 2010 but was not observed in the 2014 surveys near the Illeginni Islet impact zone nor in Illeginni Harbor. *Acropora aculeus* has also been observed during surveys of Kwajalein Harbor.

2.4.3 Acropora aspera

Species Description. *Acropora aspera* is a pale blue-gray, green, cream, or bright blue species in the family Acroporidae (Vernon et al. 2016). This species is found in thick-branching corymbose colonies that vary in length due to wave action (Vernon et al. 2016).

Distribution. *Acropora aspera* is uncommon but found throughout the Northern Indian Ocean, the Central Indo-Pacific, Australia, Japan and the East China Sea, and the Oceanic West Pacific (Brown and Wolf 2009). This range includes the waters of American Samoa, Micronesia, the Northern Mariana Islands, the Marshall Islands, and Palau (Brown and Wolf 2009). *Acropora aspera* is found on reef flats, shallow lagoons, and exposed upper reef slopes at depths up to 5 m (16 ft) (Brown and Wolf 2009).

Threats. Like many other *Acropora* species, *A. aspera* is susceptible to predation by crown-of-thorns starfish, bleaching, and disease and is slow to recover (Brown and Wolf 2009). Aquarium harvest and extensive habitat reduction and degradation are also significant threats to this species (Brown and Wolf 2009). Due to these and other general coral threats listed above, this species is declining and has an estimated habitat loss of 37% over 30 years (Brown and Wolf 2009).

Populations near Illeginni Islet. *Acropora aspera* has been observed at 9 of the 11 surveyed Kwajalein Atoll islets since 2010 as well as on reefs in the Mid-Atoll Corridor (**Table 6**). In addition to Illeginni Islet, it has been observed during inventories at Kwajalein, Roi-Namur, Ennugarett, Gagan, Gellinam, Omelek, Meck, and Legan islets as well as on reefs in the Mid-Atoll Corridor. This species has been observed only in harbor surveys at Illeginni islet (20% of sites, 1 of 5 sites) and was not observed during 2014 surveys near the Illeginni Islet impact zone. Overall, *A. aspera* has been observed at 17% (26 of 154) of survey sites in Kwajalein Atoll since 2010, including in Kwajalein Harbor.

2.4.4 Acropora dendrum

Species Description. *Acropora dendrum* is a pale brown or cream colored hard coral species in the family Acroporidae (Vernon et al. 2016). *Acropora dendrum* forms colonies of corymbose plates that are 0.5 to 1 m (1.6 to 3.3 ft) across and have widely spaced, tapering branchlets (Vernon et al. 2016).

Distribution. *Acropora dendrum* is uncommon throughout the Northern Indian Ocean, Central Indo-Pacific, Australia, Southeast Asia, Japan and the East China Sea, and the Oceanic West Pacific (Brown and Wolf 2009). This range includes the waters of American Samoa, Micronesia, the Marshall Islands, and Palau (Brown and Wolf 2009). *Acropora dendrum* is found on upper reef slopes at depths of 5 to 20 m (16 to 66 ft) (Brown and Wolf 2009).

Threats. This species is particularly susceptible to crown-of-thorns starfish, which is a serious threat to many corals throughout the Indo-Pacific (Brown and Wolf 2009). Like other *Acropora* species, *A. dendrum* is susceptible to bleaching and disease and is slow to recover (Brown and Wolf 2009). Aquarium harvest and extensive habitat reduction and degradation are also significant threats to this species (Brown and Wolf 2009). Due to these and other general coral threats listed above, this species is declining and has an estimated habitat loss and population reduction of 35% over 30 years (Brown and Wolf 2009).

Populations near Illeginni Islet. *Acropora dendrum* has been observed at 9 of the 11 surveyed Kwajalein Atoll islets since 2010 (**Table 6**). In addition to Illeginni, it has been observed during inventories at Kwajalein, Gagan, Gellinam, Omelek, Eniwetak, Meck, Legan, and Ennylabegan islets as well as on reefs in the Mid-Atoll Corridor. Overall, *A. dendrum* has been observed at 16% (25 of 154) of survey sites in Kwajalein Atoll, including in Kwajalein Harbor. This species was observed at 20% (1 of 5) of biennial inventory sites at Illeginni Islet since 2010 (**Table 6**) but was not observed in the 2014 surveys offshore of the Illeginni Islet impact zone or in Illeginni Harbor.

2.4.5 Acropora listeri

Species Description. *Acropora listeri* is a cream or brown colored hard coral species in the family Acroporidae (Vernon et al. 2016). *Acropora listeri* forms colonies of irregular clumps or corymbose plates with thick, highly irregular branches that may vary in form depending on wave action (Vernon et al. 2016).

Distribution. *Acropora listeri* is found throughout the Northern Indian Ocean, Central Indo-Pacific, Australia, Southeast Asia, Japan and the East China Sea, the Oceanic West Pacific, the Central Pacific and Mauritius (Brown and Wolf 2009). This range includes the waters of American Samoa, Micronesia, the Marshall Islands, the Northern Mariana Islands, and Palau (Brown and Wolf 2009). *Acropora listeri* is found on upper reef slopes at depths of 3 to 15 m (10 to 49 ft) (Brown and Wolf 2009).

Threats. Like other *Acropora* species, *A. listeri* is susceptible to predation by crown-of-thorns starfish, bleaching, and disease and is slow to recover from disturbance events (Brown and Wolf 2009). Aquarium harvest and extensive habitat reduction and degradation are also significant threats to this species (Brown and Wolf 2009). Due to these and other general coral threats listed above, this species is declining and has an estimated habitat loss and population reduction of 35% over 30 years (Brown and Wolf 2009).

Populations near Illeginni Islet. *Acropora listeri* has been observed at all 6 of the 11 surveyed Kwajalein Atoll islets since 2010 and on reefs in the Mid-Atoll Corridor (**Table 6**). the species has not been observed near Illeginni islet but has been observed near Kwajalein, Gagan, Gellinam, Eniwetak, Meck, ang Legan islets. Overall, *A. listeri* has been observed at 6% (10 of

154) of survey sites in Kwajalein Atoll since 2010 (**Table 6**). It is unlikely that this species would occur offshore of the terrestrial impact zone or in Illeginni Harbor.

2.4.6 Acropora microclados

Species Description. *Acropora microclados*, in the family Acroporidae, is a pale pinkish-brown colored hard coral species with pale gray tentacles (Vernon et al. 2016). *Acropora microclados* forms colonies of corymbose plates that are up to 1 m (3.3 ft) across and have short, uniform, tapered branchlets that are up to 10 mm (0.4 inch) thick at their bases (Vernon et al. 2016).

Distribution. *Acropora microclados* is found throughout the Red Sea and Gulf of Aden, the Northern Indian Ocean, Central Indo-Pacific, Australia, Southeast Asia, Japan and the East China Sea, the Oceanic West Pacific, Samoa, the Cook Islands, and the Chagos Archipelago (Brown and Wolf 2009). This range includes the waters of American Samoa, Micronesia, the Marshall Islands, and Palau (Brown and Wolf 2009). *Acropora microclados* is found on upper reef slopes at depths of 5 to 20 m (16 to 66 ft) (Brown and Wolf 2009).

Threats. This species is particularly susceptible to crown-of-thorns starfish, which is a serious threat to many corals throughout the Indo-Pacific (Brown and Wolf 2009). Like other *Acropora* species, *A. microclados* is susceptible to bleaching and disease and is slow to recover (Brown and Wolf 2009). Aquarium harvest and extensive habitat reduction and degradation are also significant threats to this species (Brown and Wolf 2009). Due to these and other general coral threats listed above, this species is declining and has an estimated habitat loss and population reduction of 33% over 30 years (Brown and Wolf 2009).

Populations near Illeginni Islet. During NMFS surveys of the reef habitats offshore of the terrestrial impact zone at Illeginni Islet, this species was observed at very low densities in ocean-side reef areas (**Table 7**) (NMFS-PIRO 2017a). *Acropora microclados* has been observed at all 11 of the surveyed Kwajalein Atoll islets since 2010 and on reefs in the Mid-Atoll Corridor (**Table 6**). Overall, *A. microclados* has been observed at 80% (123 of 154) of survey sites in Kwajalein Atoll, including in Kwajalein Harbor. This species was observed at 100% (5 of 5) of sites at Illeginni Islet since 2010 including in Illeginni Harbor.

Table 7. Density Estimates for UES Consultation Coral and Mollusk Species in Reef Habitats Offshore of the Illeginni Islet Impact Zone.

Species	Ocean Side Survey Area		Lagoon Side Survey Area	
	Mean Colonies or Individuals (per m²)	99% UCL (per m²)	Mean Colonies or Individuals (per m²)	99% UCL (per m²)
Corals				
Acropora microclados	0.0004	0.0017		
Acropora polystoma	≤0.0004	0.0017		
Cyphastrea agassizi			0.0003	0.0013
Heliopora coerulea			0.16	0.45
Pavona venosa			0.0003	0.0013
Turbinaria reniformis			≤0.0003	0.0013
Mollusks				
Hippopus hippopus	0.0003	0.0015	0.002	0.006
Rochia nilotica			0.00006	0.0003
Tridacna squamosa			0.0002	0.0011

Sources: NMFS-PIRO 2017a and 2017b

Abbreviations: m^2 = square meter, UCL = upper confidence limit

2.4.7 Acropora polystoma

Species Description. This species in the family Acroporidae is a cream, blue, or yellow colored hard coral species (Vernon et al. 2016). *Acropora polystoma* forms colonies of irregular clumps or corymbose plates with tapered, uniform branches (Vernon et al. 2016).

Distribution. *Acropora polystoma* is an uncommon species found throughout the Red Sea and the Gulf of Aden, the Southwest and Northern Indian Ocean, the Central Indo-Pacific, Australia, Southeast Asia, Japan, the Oceanic West Pacific, Samoa, and the Cook Islands (Brown and Wolf 2009). This range includes the waters of American Samoa, Micronesia, the Marshall Islands, and Palau (Brown and Wolf 2009). *Acropora polystoma* is found in tropical reef-edge habitats at depths of 3 to 10 m (9.8 to 33 ft) including upper reef slopes exposed to strong wave action (Brown and Wolf 2009).

Threats. Like other *Acropora* species, *A. polystoma* is susceptible to predation by crown-of-thorns starfish, bleaching, and disease and is slow to recover (Brown and Wolf 2009). Aquarium harvest and extensive habitat reduction and degradation are also significant threats to this species (Brown and Wolf 2009). This species has also been reported to have severe white-band/white-plague disease, which affects reproduction and can have devastating regional impacts. Due to these and other general coral threats listed above, this species is declining and has an estimated habitat loss and population reduction of 35% over 30 years (Brown and Wolf 2009).

Populations near Illeginni Islet. During NMFS surveys of the reef habitats offshore of the terrestrial impact zone at Illeginni Islet, this species was observed at very low densities in ocean-side reef areas (**Table 7**) (NMFS-PIRO 2017a). *Acropora polystoma* has been observed at 6 of the 11 Kwajalein Atoll islets and on reefs in the Mid-Atoll Corridor since 2010. Though not observed during surveys at Illeginni islet, this species has been observed near Kwajalein, Roi-Namur, Gagan, Gellinam, Meck and Legan islets. Overall, *A. polystoma* has been observed at 15% (23 of 154) of survey sites in Kwajalein Atoll (**Table 6**).

2.4.8 Acropora speciosa

Species Description. *Acropora speciosa* was listed as a threatened species under the ESA in August 2014. This species in the family Acroporidae has cream-colored colonies consisting of thick cushions and bottlebrush branches with contrasting corallite tips (Vernon et al. 2016).

Distribution. *Acropora speciosa* occurs in the Central Indo-Pacific, Australia, Southeast Asia, the Central Pacific, New Caledonia, the Philippines, Fiji, Sarawak, Ban Ngai, Papua New Guinea, Western Samoa, and the Oceanic West Pacific (Brown and Wolf 2009). This range includes the waters of American Samoa, the Marshall Islands, Micronesia, and Palau (Brown and Wolf 2009). *Acropora speciosa* is found in protected reef environments with clear water and high *Acropora* diversity and also occurs subtidally on walls and steep slopes in deep or shaded shallow conditions (Brown and Wolf 2009). This species is typically found at depths of 12 to 30 m (39 to 98 ft) (Brown and Wolf 2009).

Threats. This species exhibits a decreasing population trend and like other *Acropora* species, *A. speciosa* is particularly susceptible to bleaching, disease, crown-of-thorns starfish predation, trade, and habitat degradation (Brown and Wolf 2009). Due to these and other general coral threats listed above, this species is declining and has an estimated habitat loss and population reduction of 35% over 30 years (Brown and Wolf 2009).

Populations in near Illeginni Islet. *Acropora speciosa* has been observed at 3 of the 11 surveyed Kwajalein Atoll islets since 2010 and has also been observed at sites in the Mid-Atoll Corridor (**Table 6**). Overall, *A. speciosa* has been observed at only 8% (13 of 154) of survey sites in Kwajalein Atoll. This species has been observed in Kwajalein harbor. This species has not been observed at biennial survey sites at Illeginni Islet and was not observed during 2014 surveys of the area offshore of the Illeginni Islet impact zone. Since *A. speciosa* is a deeper dwelling species, it occurs below areas that have the potential to be affected by test impacts on Illeginni islet as an adult.

2.4.9 Acropora tenella

Species Description. *Acropora tenella* was listed as a threatened species under the ESA in August 2014. This species in the family Acroporidae has colonies consisting of horizontal plates or flattened branches with white or blue tips that either fan out or form irregular tangles (Vernon et al. 2016).

Distribution. *Acropora tenella* is common in some areas throughout the Central Indo-Pacific, Australia, Southeast Asia, Japan and the East China Sea, and the Oceanic West Pacific (Brown and Wolf 2009). This range includes the waters of the Northern Mariana Islands, Micronesia, and Palau (Brown and Wolf 2009). *Acropora tenella* is found on lower reef slopes below 40 m (131 ft) and on subtidal, protected slopes and shelves at depths of 25 to 70 m (82 to 246 ft) (Brown and Wolf 2009).

Threats. This species is particularly susceptible to crown-of-thorns starfish, which is a serious threat to many corals throughout the Indo-Pacific (Brown and Wolf 2009). Like other *Acropora* species, *A. tenella* is susceptible to bleaching and disease and is slow to recover (Brown and Wolf 2009). Aquarium harvest and extensive habitat reduction and degradation are also significant threats to this species (Brown and Wolf 2009). Due to these and other general coral threats listed above, this species is declining and has an estimated habitat loss and population reduction of 39% over 30 years (Brown and Wolf 2009).

Populations near Illeginni Islet. *Acropora tenella* has been observed at 5 of the 11 Kwajalein Atoll islets since 2010. In addition to Illeginni Islet, it has been observed during inventories at Kwajalein, Roi-Namur, Meck, and Ennylabegan islets and on reefs in the Mid-Atoll Corridor. Overall, *A. tenella* has been observed at only 6% (10 of 154) of survey sites in Kwajalein Atoll. This species was observed at 20% (1 of 5) of sites at Illeginni Islet since 2010. However, since *A. tenella* is a deeper dwelling species, it was not observed during 2014 surveys of the marine habitats offshore of the terrestrial impact zone on Illeginni Islet and is not likely to occur there or in Illeginni Harbor.

2.4.10 Acropora vaughani

Species Description. *Acropora vaughani* is a blue, cream, or pale brown colored hard coral species in the family Acroporidae (Vernon et al. 2016). This species forms open branched colonies with a bushy appearance due to compact branchlets protruding from the main branches (Vernon et al. 2016).

Distribution. *Acropora vaughani* is uncommon but found throughout the Northern Indian Ocean, Central Indo-Pacific, Australia, Southeast Asia, Japan and the East China Sea, the Oceanic West Pacific, the Central Pacific, and Madagascar (Brown and Wolf 2009). This range includes the waters of American Samoa, Micronesia, the Marshall Islands, the Northern Mariana Islands and Palau (Brown and Wolf 2009). *Acropora vaughani* is restricted to protected subtidal habitats such as contained lagoons and sandy slopes in turbid waters around fringing reefs at depths of 3 to 20 m (10 to 66 ft) (Brown and Wolf 2009).

Threats. This species is particularly susceptible to crown-of-thorns starfish, which is a serious threat to many corals throughout the Indo-Pacific (Brown and Wolf 2009). Like other *Acropora* species, *A. vaughani* is susceptible to bleaching and disease and is slow to recover (Brown and Wolf 2009). Aquarium harvest and extensive habitat reduction and degradation are also significant threats to this species (Brown and Wolf 2009). Due to these and other general coral threats listed above, this species is declining and has an estimated habitat loss and population reduction of 35% over 30 years (Brown and Wolf 2009).

Populations near Illeginni Islet. *Acropora vaughani* has been observed at 9 of the 11 surveyed Kwajalein Atoll islets since 2010 (**Table 6**). In addition to Illeginni, it has been observed during inventories at Kwajalein, Roi-Namur, Ennugarett, Gagan, Gellinam, Omelek, Eniwetak, and Meck islets as well as on reefs in the Mid-Atoll Corridor. Overall, *A. vaughani* has been observed at 27% (41 of 154) of survey sites in Kwajalein Atoll, including in Kwajalein Harbor. This species was observed at 40% (2 of 5) of sites at Illeginni Islet since 2010 including during surveys of Illeginni harbor (**Table 6**). However, since A. vaughani is a deeper dwelling species, it was not observed during 2014 surveys of the marine habitats offshore of the terrestrial impact zone on Illeginni Islet and is not likely to occur there.

2.4.11 Alveopora verrilliana

Species Description. *Alveopora verrilliana* is a dark greenish-brown, gray, or chocolate brown colored hard coral species in the family Acroporidae (Vernon et al. 2016). *Alveopora verrilliana* forms hemispherical colonies with short, irregularly dividing, knob-like branches (Vernon et al. 2016).

Distribution. *Alveopora verrilliana* is uncommon but found in the Red Sea and Gulf of Aden, the Northern Indian Ocean, Central Indo-Pacific, Australia, Southeast Asia, Japan and the East China Sea, the Oceanic West Pacific, the Central Pacific, and the Southern Mariana Islands (Brown and Wolf 2009). This range includes the waters of American Samoa, Micronesia, the Marshall Islands, the Northern Mariana Islands, Palau, and Johnston Atoll (Brown and Wolf 2009). This species is found in reef environments at depths of up to 30 m (98 ft) (Brown and Wolf 2009).

Threats. Like other *Alveopora* species, *A. verrilliana* is susceptible to bleaching and harvest for the aquarium trade (Brown and Wolf 2009). Due to these and other general coral threats listed above, this species has an estimated habitat loss and population reduction of 35% over 30 years; however, recent population trends are unknown (Brown and Wolf 2009).

Populations near Illeginni Islet. *Alveopora verrilliana* has been observed at 4 of the 11 surveyed Kwajalein Atoll islets since 2010 (**Table 6**). In addition to Illeginni, it has been observed during inventories at Kwajalein, Gellinam, and Legan islets as well as on reefs in the Mid-Atoll Corridor. Overall, *A. verrilliana* has been observed at 10% (16 of 154) of survey sites in Kwajalein Atoll. This species was observed at 40% (2 of 5) of the biennial survey sites at Illeginni Islet since 2010 (**Table 6**) but was not observed during 2014 surveys of the area offshore of the terrestrial impact zone at Illeginni Islet or in Illeginni Harbor.

2.4.12 Cyphastrea agassizi

Species Description. This species in the family Faviidae is a pale brown or green colored coral species (Vernon et al. 2016). This species forms massive colonies that are only a few inches in diameter with deeply grooved surfaces and widely spaced corallites (Vernon et al. 2016).

Distribution. *Cyphastrea agassizi* is uncommon but found in shallow reef environments of the Andaman Sea, the Central Indo-Pacific, Australia, Southeast Asia, Japan and the East China Sea, the Oceanic West Pacific, and Fiji (Brown and Wolf 2009). This range includes the Hawaiian Islands and the waters of Johnston Atoll, Micronesia, the Northern Mariana Islands, and Palau (Brown and Wolf 2009). *Cyphastrea agassizi* occurs in shallow reef environments including back slopes, fore slopes, and lagoons as well as in the outer reef channel at depths of up to 20 m (66 ft) (Brown and Wolf 2009).

Threats. This species is particularly susceptible to bleaching, disease, and habitat reduction throughout its range (Brown and Wolf 2009). Due to these and other general coral threats listed above, this species is declining and has an estimated habitat loss and population reduction of 36% over 30 years (Brown and Wolf 2009).

Populations near Illeginni Islet. During NMFS surveys of the reef habitats offshore of the terrestrial impact zone at Illeginni Islet, this species was observed at low densities in lagoon-side reef areas (**Table 7**) (NMFS-PIRO 2017a). *Cyphastrea agassizi* has been observed at 9 of the 11 surveyed Kwajalein Atoll islets since 2010 as well as on reefs in the Mid-Atoll Corridor (**Table 6**). In addition to Illeginni Islet, this species was observed during surveys of Kwajalein, Ennugarett, Gagan, Gellinam, Omelek, Eniwetak, Meck, and Legan islets as well as on reefs in the Mid-Atoll Corridor. Overall, *C. agassizi* has been observed at 25% (39 of 154) of survey sites in Kwajalein Atoll, including in Kwajalein Harbor. This species was observed at 60% (3 of 5) of sites at Illeginni Islet since 2010 including in Illeginni Harbor in 2014.

2.4.13 Heliopora coerulea

Species Description. This species, in the family Helioporidae, is a blue or greenish stony, non-scleractinian coral species that has a permanently blue skeleton (Vernon et al. 2016). *Heliopora coerulea* has polyps with eight tentacles and demonstrates significant variability in growth form based on habitat (Vernon et al. 2016).

Distribution. *Heliopora coerulea* is widespread in the Indo-Pacific from the Red Sea and East Africa to Southeast Asia and Polynesia, including Southern Japan, Australia, and the Coral Sea (Brown and Wolf 2009). This range includes the waters of American Samoa, Micronesia, the Marshall Islands, and Palau (Brown and Wolf 2009). This species is found in very shallow (less than 2 m [7 ft]) reef flats and intertidal zones and in potentially deeper waters as well (Brown and Wolf 2009).

Threats. This species is locally common, but the population is thought to be declining. *Heliopora coerulea* is particularly susceptible to harvest for curios, jewelry, and the aquarium trade and is also vulnerable to bleaching, local stochastic events, and habitat reduction (Brown and Wolf 2009). Due to these and other general coral threats listed above, this species has an estimated habitat loss and population reduction of 37% over 30 years (Brown and Wolf 2009).

Populations near Illeginni Islet. During NMFS surveys of the reef habitats offshore of the terrestrial impact zone at Illeginni Islet, this species was observed in lagoon-side reef areas

(**Table 7**) (NMFS-PIRO 2017a). *Heliopora coerulea* has been observed at all 11 of the surveyed Kwajalein Atoll islets since 2010 as well as on reefs in the Mid-Atoll Corridor (**Table 6**). Overall, *H. coerulea* has been observed at 68% (104 of 154) of survey sites in Kwajalein Atoll. This species was observed at 80% (4 of 5) of sites at Illeginni Islet since 2010.

2.4.14 Leptoseris incrustans

Species Description. *Leptoseris incrustans* is a small, pale to dark brown or greenish-brown hard coral species in the family Agariciidae (Vernon et al. 2016). Colonies of this species are usually encrusting, though sometimes they develop broad explanate laminae with radiating ridges (Vernon et al. 2016). This species also has small, compacted columellae and superficial corallites with a secondary radial symmetry (Vernon et al. 2016).

Distribution. *Leptoseris incrustans* is found in the Indo-West Pacific in the Red Sea, the Southwest and Central Indian Ocean, the Central Indo-Pacific, Southern Japan and the South China Sea, Eastern Australia, the Oceanic West Pacific, and the Central Pacific (Brown and Wolf 2009). This range includes the waters of the Hawaiian Islands, Johnston Atoll, American Samoa, Micronesia, the Marshall Islands, the Northern Mariana Islands, and Palau (Brown and Wolf 2009). This species is found on reef slopes and vertical walls at depths of 10 to 20 m (33 to 66 ft) (Brown and Wolf 2009).

Threats. This species is an uncommon species with unknown population trends (Brown and Wolf 2009). *Leptoseris incrustans* is susceptible to bleaching, disease, crown-of-thorns starfish predation, and reef habitat reduction (Brown and Wolf 2009). Due to these and other general coral threats listed above, this species has an estimated habitat loss and population reduction of 35% over 30 years (Brown and Wolf 2009).

Populations near Illeginni Islet. *Leptoseris incrustans* has been observed at 10 of the 11 surveyed Kwajalein Atoll islets since 2010 (all except Gagan Islet) as well as on reefs in the Mid-Atoll Corridor (**Table 6**). Overall, *L. incrustans* has been observed at 44% (67 of 154) of survey sites in Kwajalein Atoll, including in Kwajalein Harbor. This species was observed at 40% (2 of 5) of biennial survey sites at Illeginni Islet since 2010 but was not observed in the 2014 surveys offshore of the Illeginni Islet impact zone.

2.4.15 Montipora caliculata

Species Description. *Montipora caliculata* is a brown or blue coral species in the family Acroporidae (Vernon et al. 2016). *Montipora caliculata* forms massive colonies with a mixture of immersed and funnel-shaped corallites; the latter generally have wavy rims (Vernon et al. 2016).

Distribution. *Montipora caliculata* is uncommon but found in Kenya, Tanzania, Northern Madagascar, the Andaman Islands, Thailand, Southeast Asia, the South China Sea, Southern Japan, Papua New Guinea, Australia, the Solomon Islands, Vanuatu, New Caledonia, Ogasawara Island, Samoa, Fiji, the Cook Islands, Kiribati, French Polynesia, and the Pitcairn Islands (Brown and Wolf 2009). It is also found in the waters of Micronesia, the Marshall

Islands, the Northern Mariana Islands and Palau (Brown and Wolf 2009). This species is found in most reef environments at depths of up to 20 m (66 ft) or more (Brown and Wolf 2009).

Threats. *Montipora caliculata* is susceptible to bleaching, disease, crown-of-thorns starfish predation, and habitat degradation (Brown and Wolf 2009). Like other species in the *Montipora* genus, it is also vulnerable to heavy harvest levels (Brown and Wolf 2009). Due to these and other general coral threats listed above, this species is declining and has an estimated habitat loss and population reduction of 36% over 30 years (Brown and Wolf 2009).

Populations near Illeginni Islet. *Montipora caliculata* has been observed at all 11 of the surveyed Kwajalein Atoll islets since 2010 as well as on reefs in the Mid-Atoll Corridor (**Table 6**). Overall, *M. caliculata* has been observed at 67% (103 of 154) of survey sites in Kwajalein Atoll. This species was observed at 100% (5 of 5) of biennial survey sites at Illeginni Islet since 2010 including in Illeginni Harbor (**Table 6**) but was not observed in the 2014 surveys offshore of the Illeginni Islet impact zone.

2.4.16 Pavona cactus

Species Description. *Pavona cactus* is a pale brown or greenish-brown coral species with white margins in the family Agariciidae (Vernon et al. 2016). *Pavona cactus* forms colonies with thin, contorted, bifacial, upright fronds with sometimes-thickened branching bases (Vernon et al. 2016).

Distribution. *Pavona cactus* is found throughout the Red Sea and Gulf of Aden, the Persian and Arabian Gulfs, the Southwest and Central Indian Ocean, Central Indo-Pacific, Australia, Southern Japan and the South China Sea, the Oceanic West Pacific, and the Central Pacific (Brown and Wolf 2009). This range includes the waters of American Samoa, Micronesia, the Marshall Islands, the Northern Mariana Islands and Palau (Brown and Wolf 2009). This species is found in lagoons and on upper reef slopes, especially those of fringing reefs, and in turbid water protected from wave action at depths of 3 to 20 m (10 to 66 ft) (Brown and Wolf 2009).

Threats. *Pavona cactus* is susceptible to bleaching, extensive reduction of reef habitat, and aquarium harvest (Brown and Wolf 2009). Due to these and other general coral threats listed above, this species is declining and has an estimated habitat loss and population reduction of 36% over 30 years (Brown and Wolf 2009).

Populations near Illeginni Islet. *Pavona cactus* has been observed at 8 of the 11 surveyed Kwajalein Atoll islets since 2010. In addition to Illeginni, it has been observed during inventories at Kwajalein, Roi-Namur, Ennugarett, Gagan, Gellinam, Omelek, and Meck islets as well as on reefs in the Mid-Atoll Corridor. Overall, *Pavona cactus* has been observed at 23% (36 of 154) of survey sites in Kwajalein Atoll. *Pavona cactus* has been observed during surveys of Kwajalein Harbor. This species was observed at 40% (2 of 5) of sites at Illeginni Islet since 2010 including in Illeginni Harbor (**Table 6**). However, since *A. vaughani* is a deeper dwelling species, it occurs below the 2014 survey areas offshore of the Illeginni Islet terrestrial impact zone and was not observed during those surveys.

2.4.17 Pavona decussata

Species Description. *Pavona decussata* is a brown, creamy-yellow, or greenish color coral with colonies that grow into thick, upright plates in the family Agariciidae (Brainard et al. 2011). These variable shaped colonies can grow to several meters across (Brown and Wolf 2009).

Distribution. *Pavona decussata* has a global distribution from the Red Sea to French Polynesia and as far north as Japan south to the Western coasts of Australia and Madagascar (Brainard et al. 2011). This range includes the waters of American Samoa, the Marshall Islands, Micronesia, the Northern Mariana Islands, and Palau (Brown and Wolf 2009). *Pavona decussata* occurs most commonly in shallow reef environments at depths of 3 to 11 m (10 to 36 ft) and more rarely at depths of 12 to 15 m (39 to 49 ft) (Brown and Wolf 2009).

Threats. *Pavona decussata* is susceptible to bleaching, disease, ocean acidification, fisheries, and extensive reduction of reef habitat; however, its current population trend is unknown (Brown and Wolf 2009). Due to these and other general coral threats listed above, this species has an estimated habitat loss and population reduction of 36% over 30 years (Brown and Wolf 2009).

Populations near Illeginni Islet. *Pavona decussata* has been observed at 5 of the 11 surveyed Kwajalein Atoll islets since 2010 as well as or reefs in the Mid-Atoll Corridor (**Table 6**). In addition to Illeginni, *P. decussata* had been observed near Kwajalein, Roi-Namur, Meck, and Ennylabegan islets. Overall, *P. decussata* has been observed at 5% (7 of 154) of survey sites in Kwajalein Atoll. At Illeginni Islet, this species was observed only at Illeginni Harbor (20% of Illeginni sties) and is not known or expected to occur at reefs on the western end of Illeginni Islet, including in the area offshore of the terrestrial impact zone.

2.4.18 Pavona venosa

Species Description. *Pavona venosa* is in the family Agariciidae and is a yellowish- or pinkish-brown coral that is sometimes mottled (Vernon et al. 2016). This species forms massive to encrusting colonies that are generally less than 50 cm (20 inches) in diameter with sunken corallites arranged in short valleys (Vernon et al. 2016, Brown and Wolf 2009).

Distribution. *Pavona venosa* is uncommon but found in the Red Sea and Gulf of Aden, the Southwest, Northwest, and Central Indian Ocean, the Arabian/Iranian Gulf, Central Indo-Pacific, Tropical Australia, Southern Japan and the South China Sea, and the Oceanic West Pacific (Brown and Wolf 2009). This range includes the waters of Micronesia, the Marshall Islands, the Northern Mariana Islands and Palau (Brown and Wolf 2009). *Pavona venosa* occurs in shallow reef environments at depths of 2 to 20 m (7 to 66 ft) (Brown and Wolf 2009).

Threats. *Pavona venosa* is susceptible to bleaching, disease, and extensive reduction of reef habitat; however, its current population trend is unknown (Brown and Wolf 2009). Due to these and other general coral threats listed above, this species has an estimated habitat loss and population reduction of 37% over 30 years (Brown and Wolf 2009).

Populations near Illeginni Islet. During NMFS surveys of reef habitats offshore of the terrestrial impact zone at Illeginni Islet, this species was observed at very low densities in lagoon-side reef areas (**Table 7**) (NMFS-PIRO 2017a). *Pavona venosa* has been observed at all 11 of the surveyed Kwajalein Atoll islets since 2010 as well as on reefs in the Mid-Atoll Corridor (**Table 6**). Overall, *P. venosa* has been observed at 27% (42 of 154) of survey sites in Kwajalein Atoll. This species was observed at 60% (3 of 5) of sites at Illeginni Islet since 2010, including at Illeginni Harbor.

2.4.19 Turbinaria mesenterina

Species Description. *Turbinaria mesenterina* is a gray-green or gray-brown coral in the family Dendrophylliidae (Brainard et al. 2011). *Turbinaria mesenterina* colonies form large "lettuce-like" assemblages of variable plates depending on wave motion and light conditions (Brainard et al 2011). Colonies of *T. mesenterina* are generally less than 1 m (3 ft) in diameter but can be much larger on fringing reefs (Brown and Wolf 2009).

Distribution. *Turbinaria mesenterina* has a broad distribution from eastern Africa to the central Pacific north to Japan and south to southern Africa and the Great Barrier Reef (Brainard et al. 2011). This range includes the waters of American Samoa, Micronesia, the Marshall Islands, the Northern Mariana Islands and Palau (Brown and Wolf 2009). This species is found in shallow waters at depths of up to 20 m (66 ft) (Brown and Wolf 2009).

Threats. *Turbinaria mesenterina* is susceptible to bleaching, disease, and harvest for the aquarium trade (Brown and Wolf 2009). This species is also threatened by extensive habitat reduction; however, current population trends are unknown (Brown and Wolf 2009). Due to these and other general coral threats listed above, this species has an estimated habitat degradation of 36% over 30 years (Brown and Wolf 2009).

Populations near Illeginni Islet. *Turbinaria mesenterina* has been observed at 4 of the 11 surveyed Kwajalein Atoll islets since 2010 (**Table 6**). This species has been observed during inventories at Roi-Namur, Gagan, Omelek, and Legan islets. Overall, *T. mesenterina* has been observed at 3% (4 of 154) of survey sites in Kwajalein Atoll. This species is not known or expected to occur in reef habitat on the western end of Illeginni Islet near the terrestrial impact zone or within Illeginni Harbor.

2.4.20 Turbinaria reniformis

Species Description. This species in the family Dendrophylliidae is a yellow-green coral with contrasting colored margins (Vernon et al. 2016, Brown and Wolf 2009*). Turbinaria reniformis* colonies form large stands on fringing reefs where water is turbid and unifacial laminae sometimes form horizontal tiers (Brown and Wolf 2009).

Distribution. *Turbinaria reniformis* is found throughout the Red Sea and Gulf of Aden, the Southwest, Northwest, and Central Indian Ocean, the Arabian/Iranian Gulf, the Central Indo-Pacific, Australia, Southern Japan and the South China Sea, the Oceanic West Pacific, and the

Central Pacific (Brown and Wolf 2009). This range includes the waters of American Samoa, Micronesia, the Marshall Islands, the Northern Mariana Islands and Palau (Brown and Wolf 2009). This species is found at depths of 2 to 15 m (7 to 49 ft) (Brown and Wolf 2009).

Threats. *Turbinaria reniformis* is susceptible to bleaching and disease due to its restricted depth range (Brown and Wolf 2009). This species is also threatened by extensive habitat reduction; however, current population trends are unknown (Brown and Wolf 2009). Due to these and other general coral threats listed above, this species has an estimated habitat degradation of 36% over 30 years (Brown and Wolf 2009).

Populations near Illeginni Islet. During NMFS surveys of the reef habitats offshore of the terrestrial impact zone at Illeginni Islet, this species was observed at very low densities in lagoon-side reef areas (**Table 7**) (NMFS-PIRO 2017a). *Turbinaria reniformis* has been observed at all 11 of the surveyed Kwajalein Atoll islets since 2010 as well as on reefs in the Mid-Atoll Corridor (**Table 6**). Overall, *T. reniformis* has been observed at 33% (51 of 154) of survey sites in Kwajalein Atoll. This species was observed at 80% (4 of 5) of sites at Illeginni Islet since 2010 but was not observed in Illeginni Harbor.

2.4.21 Turbinaria stellulata

Species Description. *Turbinaria stellulata* is most frequently a brown or green coral but has a wide range of colors (Vernon et al. 2016). *Turbinaria stellulata* is in the family Dendrophylliidae and forms colonies less than 50 cm (20 in) in diameter that are primarily encrusting and sometimes dome-shaped (Vernon et al. 2016).

Distribution. *Turbinaria stellulata* is found throughout the Indo-West Pacific including the Red Sea and Gulf of Aden, the Southwest and Central Indian Ocean, the Central Indo-Pacific, Australia, Southern Japan and the South China Sea, and the Oceanic West Pacific (Brown and Wolf 2009). This range includes the waters of American Samoa, Micronesia, the Marshall Islands, the Northern Mariana Islands and Palau (Brown and Wolf 2009). This species is found in waters that are not turbid at depths of 2 to 15 m (7 to 49 ft) (Brown and Wolf 2009).

Threats. *Turbinaria stellulata* is susceptible to bleaching and disease due to its restricted depth range (Brown and Wolf 2009). This species is also threatened by extensive habitat reduction; however, current population trends are unknown (Brown and Wolf 2009). Due to these and other general coral threats listed above, this species has an estimated habitat degradation of 36% over 30 years (Brown and Wolf 2009).

Populations near Illeginni Islet. *Turbinaria stellulata* has been observed at 6 of the 11 Kwajalein Atoll islets since 2010 (**Table 6**). In addition to Illeginni, it has been observed during inventories at Roi-Namur, Gagan, Ennugarett, Gellinam, and Legan islets as well as on reefs in the Mid-Atoll Corridor. Overall, *T. stellulata* has been observed at 19% (29 of 125) of survey sites in Kwajalein Atoll. This species was observed at 60% (3 of 5) of sites at Illeginni Islet since 2010 (**Table 6**) but was not observed in the 2014 surveys offshore of the Illeginni Islet impact zone and is unlikely to occur there.

2.5 Mollusks

Five mollusk species that require consultation under the UES have the potential to occur near Illeginni Islet (**Tables 5 and 8**). NMFS and USFWS have conducted biannual inventories of the reef habitats around Illeginni Islet since 1996 as described in **Section 1.2**. The last biennial inventory of marine habitats at Illeginni Islet was conducted in 2016 (NMFS and USFWS 2018). In 2014, NMFS also surveyed the reef habitats offshore of the terrestrial impact zone at Illeginni Islet (**Figure 1**) (NMFS-PIRO 2017b). NMFS estimated that these surveys covered all of the reef habitat area potentially affected by missile impact testing on the lagoon side and 99% of the reef area on the ocean side (NMFS-PIRO 2017b). These data are still considered the best available information for consultation mollusk species presence and density in the area potentially impacted by testing on Illeginni Islet. Based on the 2014 NMFS surveys (NMFS-PIRO 2017b), three UES consultation mollusk species (*Hippopus hippopus*, *Rochia nilotica*, and *Tridacna squamosa*) are likely to occur near the Illeginni Islet test impact zone as adults. Two additional UES consultation species, *Pinctada margaritifera* and *Tridacna gigas*, have the potential to occur in the Illeginni Islet nearshore area as adults but are considered very unlikely.

Pinctada margaritifera and *Tridacna gigas* have not been recorded in the area of potential effect offshore of Illeginni Islet and are not likely to occur in this area as adults. The black-lipped pearl oyster (*Pinctada margaritifera*) has been observed on the lagoon-side reef slope during biennial resource surveys at Illeginni Islet (**Table 8**) but is a reef slope dwelling species, that occurs below the areas that have the potential to be affected by testing on Illeginni Islet. The giant clam *Tridacna gigas* has been observed at biennial survey locations at Illeginni Islet and throughout Kwajalein Atoll but has not been observed in habitats near the terrestrial impact zone on Illeginni Islet (NMFS-PIRO 2017a and 2017b).

Larvae of all the mollusk species listed in **Table 8** have the potential to occur in Illeginni Islet nearshore waters; however, larval concentrations are likely very low and a small fraction of the total larval pool at Kwajalein Atoll. Additional information about mollusk reproduction can be found in the subsections below. Due to the short time between fertilization and settlement in these mollusk species and their time-limited dispersal capability, the abundance of mollusk larvae (especially viable larvae) is likely extremely low in the Illeginni Islet nearshore area.

Table 8. Number of Kwajalein Atoll Survey Sites (2010 to 2018) with UES Consultation Mollusk Species Observations.

Family Scientific Name	RN	ET	GA	GL	OM	EK	MK	IL	LG	EN	KI	MAC	Total	Number of Islets
Cardiidae														
Hippopus hippopus	7	3	3	4	4	1	1	**2**	5	1	7	16	54	11
Tridacna gigas	1	1	2	2	1	2	2	**2**	2	1	1	20	37	11
Tridacna squamosa	2	2	-	4	4	4	3	**3**	4	2	-	50	78	9
Pteriidae														
Pinctada margaritifera	2	2	1	-	-	1	2	**1**	1	-	6	4	20	8
Tegulidae														
Rochia nilotica [1]	8	6	5	4	4	2	3	**5**	7	5	18	12	79	11
Total Number of Sites Surveyed	**13**	**8**	**5**	**8**	**7**	**5**	**8**	**5**	**7**	**5**	**19**	**35**	**125**	**11**

Sources: NMFS and USFWS 2012, NMFS and USFWS 2013a, NMFS and USFWS 2017, NMFS and USFWS 2018, NMFS and USFWS 2021

Note:

1 Within RMI legislation and in UES Appendix 3-4A, top shell snails are listed as *Trochus maximus* and *Trochus niloticus*. This taxon is currently most commonly synonymized under the name *Rochia nilotica*.

Abbreviations: EK = Eniwetak, EN = Ennylabegan, ET = Ennugarett, GA = Gagan, GN = Gellinam, IL = Illeginni, KI = Kwajalein, LG = Legan, MAC = Mid-Atoll Corridor, MK = Meck, OM = Omelek, RN = Roi-Namur

2.5.1 Giant Clam (Hippopus hippopus)

Species Description. *Hippopus hippopus* are giant clams in the family Cardiidae. These filter feeding bivalves consume plankton; however, in many giant clams, much of their nutrition is obtained from their photosynthetic zooxanthellae symbionts (Klumpp and Lucas 1994). These mollusks are hermaphrodite broadcast spawners, releasing gametes into the water on a seasonal basis at least in the northern and southern limits of their range (Meadows 2016). *Hippopus hippopus* is known to spawn in the austral summer months (December to March) on the Great Barrier Reef but has been known to spawn in June near Palau (Meadows 2016). Fertilized eggs hatch into trochophore larvae which, within a few days, develop into bivalve veligers that feed on plankton (Ellis 1997). Eight to 14 days post fertilization, these veligers metamorphose into juvenile clams that settle on the substrate and acquire mutualistic zooxanthellae (Ellis 1997). The photosynthetic zooxanthellae reside in the mantle of the giant clams where they contribute to clam growth (Mies et al. 2012, Meadows 2016).

Distribution. *Hippopus hippopus* is widely distributed in shallow reef habitats throughout the tropical Indo-Pacific from Burma to the Marshall Islands and from the northern Philippines to New Caledonia (Munro 1993). This species is known to occur in the Marshall Islands, Micronesia, Palau, the Solomon Islands, and Vanuatu but is possibly extirpated from American Samoa, Fiji, Guam, and the Northern Mariana Islands (IUCN 2022). *Hippopus hippopus* is found in a wide range of habitats including lagoon or fringing reefs, sandy lagoon floors, or exposed intertidal habitats (Munro 1993). It is typically found at depths less than 20 m (66 ft) (Meadows 2016).

Threats. The major threats for this species include habitat degradation in the form of sedimentation and pollution; harvesting for subsistence, commercial fisheries, the aquarium trade, and the curio trade; and threats from global climate change including bleaching of their symbiotic zooxanthellae and shell degradation from ocean acidification (Meadows 2016).

Populations near Illeginni Islet. During NMFS surveys of the reef habitats offshore of the terrestrial impact zone at Illeginni Islet, this species was observed at low densities in both ocean-side and lagoon-side reef areas (**Table 7**) (NMFS-PIRO 2017b). *Hippopus hippopus* was observed at all 11 of the surveyed Kwajalein Atoll islets since 2010 as well as at survey sites in the Mid-Atoll Corridor (**Table 8**). Since 2010, *Hippopus hippopus* individuals have been observed at 35% (54 of 154) of survey sites throughout Kwajalein Atoll, including at Kwajalein Harbor. This species was recorded at 40% (2 of 5) of sites at Illeginni Islet, during biennial inventories, on lagoon-side reef crest and slope habitat as well as in Illeginni Harbor.

2.5.2 Black-lipped pearl oyster (Pinctada margaritifera)

Species Description. *Pinctada margaritifera* are filter feeders, preying on plankton, bacteria, and particulate organic matter. This species is protected by RMI statute (RMI Marine Resources Act) and under the UES. These mollusks have protandrous hermaphroditic adults that first develop as male and then as females. Eggs and sperm are broadcast into the water where fertilization takes place. These oysters typically spawn bimonthly throughout the year with a peak in the austral summer (Thomas et al. 2014). Female black-lipped pearl oysters may produce 40-50 million eggs (Thomas et al. 2014). First stage larvae form within 24 hours of fertilization. The pelagic larval stage lasts for 15 to 30 days before larvae metamorphose and settle to the bottom (Thomas et al. 2014).

Distribution. The black-lipped pearl oyster is found on reef habitats throughout the tropical Indo-Pacific. The location of this species may depend on the locality and local ecosystem conditions. In Hawai`i, *P. margaritifera* was typically found shallower than 8 m (25 ft) (Keenan et al. 2006) while deep-water stocks at Takapoto Atoll, French Polynesia, exhibited peak abundance between 20 and 40 m (65–130 ft) depth (Zanini and Salvat 2000). Although Pinctada margaritifera are occasionally found in the low intertidal zone and can tolerate brief aerial exposure, they are generally found at subtidal depths. The pelagic larval stage of black-lipped pearl oysters is the free-swimming stage (veliger) that enables dispersal and genetic connectivity among populations (Thomas et al. 2014). Dispersal on smaller spatial scales of tens of kilometers is much more common than long distance dispersal (Cowen and Sponaugle 2009, Mumby and Steneck 2008). Altogether this information suggests that veligers may be found in the open ocean but would constitute a small fraction of the total pool of veligers.

Threats. *Pinctada margaritifera* are subject to predation by specialist invertebrates and vertebrates, particularly octopus, sea stars, and some fish. The black-lipped pearl oyster is intensively fished for pearls and nacre (mother of pearl). Wild populations are dramatically reduced from historical baselines. For example, between 1928 and 1930 at Pearl and Hermes Atolls (in the Northwest Hawaiian Islands), at least 150,000 black-lipped pearl oysters were harvested for pearls and nacre, primarily for making buttons. The same locations in 2003 had approximately 1,000 of these oysters (Keenan et al. 2006). The pearl industry throughout the Pacific now relies heavily on cultivated oyster farms, but wild harvest continues, and population recoveries have not been reported.

Species-specific fisheries are the only known species-specific threats to pearl oysters. 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 some 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.

Populations near Illeginni Islet. *Pinctada margaritifera* was observed at 8 of the 11 surveyed Kwajalein Atoll islets since 2010 (**Table 8**). In addition to Illeginni, it was found at Kwajalein, Roi-Namur, Ennugarett, Gagan, Omelek, Eniwetak, and Meck islets. Since 2010, *Pinctada margaritifera* individuals have been observed at 13% (20 of 154) of survey sites throughout Kwajalein Atoll, including in Kwajalein Harbor. At Illeginni Islet, this species has been recorded at 20% (1 of 5) of survey sites on the lagoon-side reef slope (**Table 8**). Since *P. margaritifera* is a reef slope dwelling species, it occurs below the areas that have the potential to be affected by test activities near Illeginni islet.

2.5.3 Top Shell Snail (Rochia nilotica)

Species Description. This species is protected under RMI statute (RMI Marine Resources (Trochus) Act of 1983) and under the UES. Within RMI legislation, top shell snails are listed as a consultation species under the species names *Trochus maximus* and *Trochus niloticus.* The names *Tectus niloticus* and *Tectus maximus* have also been used more recently for these top shell snails. These names are all currently synonymized under the name *Rochia nilotica* (the commercial top shell snail), based on genetic information (see Bouchet 2018). *Rochia nilotica* is typically found shallower than 12 m (40 ft), and the typical adult shell is 10 to 12 cm (4 to 5 inches) long. Although some species are occasionally found in the low intertidal zone and can tolerate brief aerial exposure, all members of Tegulidae are generally found at subtidal depths (Dumas et al. 2010, Tardy et al. 2008). These snails are oviparous with females releasing more than 1 million eggs (SPC 2016). Pelagic veligers of *Rochia nilotica* are free-swimming for at least 3 to 5 days before metamorphosis and subsequent settlement on substrate (SPC 2016). All members of this snail family are herbivores and occasionally detritivores.

Distribution. *Rochia nilotica* occurs throughout the Indo-Pacific and due to its commercial value, it has been translocated or introduced to many Indo-Pacific regions. 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).

Threats. All members of the family Tegulidae are subject to predation by specialist invertebrates and vertebrates, but principally by octopus and triggerfish (Family Balistidae). The rate of predation decreases as the animals grow, and it is thought that the largest individuals are not preyed on because there are no predators large enough to take them (McClanahan 1990). All members of the family Tegulidae, including *Rochia nilotica*, are also subject to fishing pressure for food and for the aquarium and curio trades (Tardy et al. 2008). This has led to widespread declines of top shell snails near human populations and to regional extinctions on small reef habitats next to large human populations (e.g., all top shell snails on Guam and the Northern Mariana Islands) (Munro 1994).

Species-specific fisheries are the only known species-specific threats to top shell snails. 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.

Populations near Illeginni Islet. During NMFS surveys of the reef habitats offshore of the terrestrial impact zone at Illeginni Islet, this species was observed at low densities in lagoon-side reef areas (**Table 7**) (NMFS-PIRO 2017a). *Rochia nilotica* was observed at all 11 of the Kwajalein Atoll islets as well as on reefs in the Mid-Atoll Corridor (**Table 8**). Top shell snails are fairly widespread and common. Since 2010, *R. nilotica* individuals have been observed at 55% (85 of 154) of survey sites) throughout Kwajalein Atoll during biennial inventories, including all four survey sites at Illeginni islet, in Illeginni Harbor, and in Kwajalein Harbor.

2.5.4 Giant Clam (Tridacna gigas)

Species Description. *Tridacna gigas* are in the family Cardiidae and are the largest species, reaching widths of 120 cm (47 in) and 200 kg (440 lb) (Meadows 2016). These filter feeding bivalves consume plankton but also obtain a portion of their nutrition from their photosynthetic zooxanthellae symbionts (Klumpp and Lucas 1994). In contrast to many giant clams, *T. gigas* is a very efficient filter feeder and gets a large portion of the carbon it needs for respiration and growth (34 to 65%) from filter-feeding (Klumpp and Lucas 1994). These mollusks are hermaphrodite broadcast spawners, releasing gametes into the water on a seasonal basis at least in the northern and southern limits of their range (Meadows 2016). The optimal reproductive season for *Tridacna gigas* may be from October to February and spawning has been known to coincide with incoming tides and moon phases (Meadows 2016). Fertilized eggs hatch into trochophore larvae which, within a few days, develop into bivalve veligers that feed on plankton (Ellis 1997). Eight to 14 days post fertilization, these veligers metamorphose into juvenile clams that settle on the substrate and acquire mutualistic zooxanthellae (Ellis 1997).

The photosynthetic zooxanthellae reside in the mantle of the giant clams where they contribute to clam growth (Mies et al. 2012, Meadows 2016).

Distribution. *Tridacna gigas* was historically widely distributed in shallow reef habitats throughout the tropical Indo-Pacific (Munro 1993) from Burma to the Marshall Islands and from Japan to New Caledonia (Meadows 2016). This species is known to occur in the Marshall Islands, Micronesia, Palau, and the Solomon Islands but is possibly extirpated from Fiji, Guam, Vanuatu, New Caledonia, and the Northern Mariana Islands (Munro 1993, IUCN 2022). *Tridacna gigas* is found in a wide range of habitats including high- and low-islands and lagoon or fringing reefs (Munro 1993). It is typically found at depths less than 20 m (66 ft) (Meadows 2016).

Giant clams are synchronous spawners where release of sperm is triggered by the presence of a spawner with ripe eggs (Munro 1993). Due to the limited time frame of gamete viability (viable up to 8 hours in *T. squamosa* but fertilization success decreased within hours of spawning [Neo et al. 2015]), viable gametes are not likely to be found far from adult clams. Giant clam larvae are considered the dispersal phase where ambient currents and larval swimming speed influence long-distance dispersal (Neo et al. 2015). This long-distance dispersal is limited by the time period during which larvae are able to survive before settlement/recruitment. For most giant clam species, the period from spawning to settlement is approximately 14 days (Ellis 1997, Neo et al. 2015). Due to the short time between fertilization and settlement in giant clams and their time-limited dispersal capability, the abundance of giant clam larvae (especially viable larvae) is likely very low in the open ocean.

Threats. *Tridacna gigas* are subject to the same threats as other giant clam species. The major threats for this species include habitat degradation in the form of sedimentation and pollution; harvesting for subsistence, commercial fisheries, the aquarium trade, and the curio trade; and threats from global climate change including bleaching of their symbiotic zooxanthellae and shell degradation from ocean acidification (Meadows 2016). There is some evidence that *T. gigas* may also be threatened by protozoan and gastropod parasites which may be lethal for clams or reduce their growth rate (Meadows 2016).

Populations near Illeginni Islet. *Tridacna gigas* was observed at all 11 of the surveyed Kwajalein Atoll islets since 2010 as well as on reefs in the Mid-Atoll Corridor (**Table 8**). While found at all islets, *Tridacna gigas* had a relatively low distribution at these islets; being found at only 24% (237 of 154) of survey sites throughout Kwajalein Atoll since 2010, including at Kwajalein Harbor. This species was found at 40% (2 of 5) of biennial inventory sites at Illeginni Islet, including at a lagoon reef crest site and in Illeginni Harbor (**Table 8**) but was not observed in 2014 surveys near the Illeginni Islet impact zone.

2.5.5 Giant Clam (Tridacna squamosa)

Species Description. *Tridacna squamosa* is a giant clam species in the family Cardiidae that reaches more than 35 cm (14 in) (Munro 1993). These filter feeding bivalves consume plankton; however, in many giant clams, much of their nutrition is obtained from their photosynthetic zooxanthellae symbionts (Klumpp and Lucas 1994). These mollusks are hermaphrodite broadcast spawners, releasing gametes into the water (Meadows 2016). Spawning phenology for this species is unknown for most areas. Fertilized eggs hatch into trochophore larvae which, within a few days, develop into bivalve veligers that feed on plankton (Ellis 1997). These veligers then metamorphose into juvenile clams that settle on the substrate and acquire mutualistic zooxanthellae (Ellis 1997). In *T. squamosa*, 80% of larvae had settled by 13-days post fertilization and no swimming was observed in larvae greater than 14 days old (Neo et al. 2015). The photosynthetic zooxanthellae reside in the mantle of the giant clams where they contribute to clam growth (Mies et al. 2012, Meadows 2016).

Distribution. *Tridacna squamosa* has a wide but fairly limited distribution. This species is found in shallow reef habitats from west Africa to French Polynesia and the East China Sea to the Great Barrier Reef (Meadows 2016). This species is known to occur in the Marshall Islands, Micronesia, Palau, Vanuatu, and the Solomon Islands but is possibly extirpated from Japan and the Northern Mariana Islands (IUCN 2022). Tridacna squamosa is found in sheltered lagoon environments adjacent to high islands and larvae may prefer substrate with crustose coralline algae (Meadows 2016). This species is typically found at depths less than 20 m (66 ft) (Meadows 2016).

Threats. The major threats for this species include habitat degradation in the form of sedimentation and pollution; harvesting for subsistence, commercial fisheries, the aquarium trade, and the curio trade; and threats from global climate change including bleaching of their symbiotic zooxanthellae and shell degradation from ocean acidification (Meadows 2016). High ocean temperature bleaching has been recorded in *T. squamosa* in Singapore and increased respiration and decreased production in response to increase temperature has also been observed for this species (Meadows 2016).

Populations near Illeginni Islet. During NMFS surveys of the reef habitats offshore of the terrestrial impact zone at Illeginni Islet, this species was observed at low densities in lagoon-side reef areas (**Table 7**) (NMFS-PIRO 2017a). *Tridacna squamosa* was observed at 9 of the 11 surveyed Kwajalein Atoll islets since 2010 as well as on reefs in the Mid-Atoll Corridor (**Table 8**). This species was recorded at 51% (78 of 154) of sites throughout Kwajalein Atoll. *Tridacna squamosa* was found at 60% (3 of 5) of sites at Illeginni Islet, including in lagoon reef crest and both lagoon and ocean slope habitats as well as in Illeginni Harbor.

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Addendum to the Navy Conventional Prompt Strike Weapon System Flight Tests Biological Assessment for Activities at Kwajalein Atoll 5 April 2024

This addendum to the Navy Conventional Prompt Strike (CPS) Weapon System Flight Tests Biological Assessment (BA) for Activities at Kwajalein Atoll (DON and USASMDC 2023) was prepared to answer questions posed by the National Marine Fisheries Service (NMFS) Pacific Islands Regional Office (PIRO) during consultation under Section 3-4 of the Environmental Standards and Procedures for United States Army Kwajalein Atoll (USAKA) Activities in the Republic of the Marshall Islands (UES).

The addendum is intended to address NMFS PIRO questions or recommendations provided during a meeting and via email on 11 January 2024. The following sections provide additional information, clarification, or revisions to conclusions in the Navy CPS BA and any information provided should supersede information within the BA where appropriate.

Requested Information Related to the Description of the Action, Action Area, or Action Stressors

1) Question from NMFS PIRO regarding pre- and post-flight test operations:

   "Please expand the description of what pre-flight and post-flight preparation will occur within Kawajlien [*sic*] Atoll and on Illeginni Island. Is anything expected to occur on Gagan Island? (Programmatic BA sections 2.2.2 and 2.2.4)".

   Response:

Both pre-flight preparations and post-flight cleanup activities may result in elevated levels of human activity in terrestrial and marine environments for several weeks.

Human activity and equipment operation in marine environments at Kwajalein Atoll would only involve vessel traffic to and from payload target sites and use of sensor rafts. Kwajalein Missile Impact Scoring System (KMISS) optical and electronic sensors and system support equipment are already in place on Gagan Islet and in the offshore ocean waters. No pre-flight or post-flight activities would occur at Gagan Islet. For nominal missions, payloads that impact in deep ocean waters of KMISS would not be recovered and no post-test cleanup or recovery activities are anticipated to be required for flight tests in the KMISS portion of the Action Area.

Elevated levels of human activity are expected for several weeks at Illeginni Islet. During this period, several vessel round-trips are likely. Helicopters would also be used to transport equipment and personnel to Illeginni Islet. Most of the human activity and equipment operation related to the Proposed Action would take place in terrestrial environments at Illeginni Islet. Personnel and equipment would be used for preparation of the target site including equipment placement in terrestrial areas. Post-flight cleanup would involve recovery of all visible man-made test debris, as practicable, and would include personnel and equipment use in terrestrial habitats. Man-made debris would be removed from the impact crater and it would be filled with surrounding substrate that was ejected from the crater. These post-test activities may include use of heavy equipment such as a backhoe or grader. Human activity on Illeginni Islet pre- and post-test would also include environmental compliance personnel implementing best management practices and mitigations measures (see item number 12 below) such as sea turtle surveys and post-test soil and groundwater sampling.

In the vicinity of Illeginni Islet, human activity in marine areas would involve pre-test deployment and post-test recovery of up to 12 sensor rafts. Sensor rafts with onboard optical or acoustic sensors would be deployed by landing craft utility in the lagoon or ocean waters no less than 3 meters (m; 10 feet [ft]) deep.

Post-test human activity in marine areas near Illeginni Islet would likely only involve vessel traffic to and from Illeginni Islet and collection of sensor rafts. Use of heavy equipment in the nearshore marine environment is not expected since shallow water and reef habitats would not be targeted. However, if test debris enters the nearshore marine environment, including the reef flat, test personnel may manually recover debris. Human activity in the nearshore marine environment would be limited to the area near the payload land impact where debris entered the water. In the event of an unexpected shoreline or reef-flat payload impact, several measures and procedures would be in place (Section 2.2 of the Navy CPS BA) to guide post-test activities in order to avoid impacts to consultation organisms. 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.

2) <u>Question from NMFS PIRO regarding support vessels:</u>

   "How many support ships are anticipated and what are their types/sizes? How many vessel/aircraft trips are expected per flight test at Illeginni?"

   <u>Response:</u>

The exact number of support ships which would operate within Kwajalein Atoll to support proposed CPS activities and the exact number of vessel and aircraft trips per CPS flight test are unknown. Based on typical United States Army Garrison – Kwajalein Atoll (USAG-KA) and Ronald Reagan Ballistic Missile Defense Test Site (RTS) vessel operations supporting flight test activities at USAKA, it is anticipated that several vessel round-trips would occur to and from Illeginni Islet. For example, a Landing Craft Utility (the U.S. Army Vessel Great Bridge) typically travels to and from Illeginni Islet 2 to 3 times per week for a flight test with impacts on the Islet. Pre-test activities would include several vessel round-trips to and from Illeginni Islet for personnel and equipment transport. Sensor rafts would be deployed from a vessel, likely a Landing Craft Utility or a Landing Craft Mechanized vessel, near the target sites. Post-test recovery efforts would also result in vessel traffic to Illeginni Islet. Vessels would be used to transport heavy equipment (such as backhoe or grader) and personnel for manual cleanup of debris, backfilling of any craters, and instrument recovery. Deployed sensor rafts would also be recovered by a vessel. The scope and magnitude of the vessel activity associated with the

Proposed Action would be within the envelope of normal USAG-KA and RTS vessel operations at Illeginni Islet and USAKA more broadly. The types of support ships typically used for USAG-KA and RTS operations supporting flight tests and their specifications are listed in **Table A-1**.

Table A-1. Vessels Typically Used to Support Flight Test Activities at USAKA

Vessel Type	Vessel Size Length x Width	Vessel Draft	Maximum Operating Speed	Typical Operations at USAKA
Landing Craft Utility	53 m (174 ft) x 13 m (42 ft)	2.4 m (8 ft)	10 knots	Transports cargo, equipment, supplies, and passengers within Kwajalein Atoll waters. May also be used for work inside lagoons and harbors.
Landing Craft Mechanized	23 m (74 ft) x 6 m (21 ft)	1.4 m (4.5 ft)	9 knots	Transports passengers, cargo, and vehicles, May be used for work in harbors and around piers.
Catamarans	22 m (73 ft) x 8 m (27 ft)	1.1 m (3.6 ft)	25 knots	Rapidly transports passengers between Kwajalein, Meck, and other intra-atoll harbors (including Illeginni).

Abbreviations:, ft = feet, m = meters

Helicopters or fixed wing aircraft may be used to transport equipment and personnel to Illeginni Islet and to conduct pre- and post-test surveys at target sites. The number of aircraft flights which would be conducted to support a flight test at USAKA is not known but several round trips may occur per flight test event. The scope and magnitude of the aircraft activity associated with the Proposed Action would be within the envelope of normal USAG-KA and RTS aircraft operations at Illeginni Islet and USAKA more broadly.

3) Question from NMFS PIRO regarding action area size:

   "What is the square miles or km of the action area?".

   Response:

The Action Area at USAKA includes areas which would be subject to the potential effects of the Proposed Action. While proposed activities may take place within the larger USAKA area, potential stressors would occur over smaller areas as defined in the BA and summarized in **Table A-2** (also detailed in Tables 5, 6, and 8 of the Navy CPS BA). USAKA covers an area consisting of all or part of 11 of the 100 Kwajalein Atoll islets, the mid-atoll corridor, and associated sea beds, ocean areas, and airspace (USASMDC 2021). Kwajalein Atoll as a whole encloses an area of over 2,900 square kilometers (km^2; 1,100 square miles [mi^2]). However, stressors would not occur within the entire USAKA area. Similarly, KMISS covers an ocean area of approximately 290 km^2 (110 mi^2), but Proposed Action stressors would not occur across the entire KMISS area during a test.

Table A-2. Stressor Potential Marine Effect Areas for Navy CPS Flight Tests Activities

Stressor and Stressor Sources	Stressor Details	Potential Effect Area for a Single Flight Test km^2 (mi^2)	Location
Elevated Sound Pressures from Sonic Booms	Peak SPLs ≥ 175 dB re 1 μPa	Unknown	Kwajalein Atoll
Elevated Sound Pressures from Payload Impact	Peak SPLs ≥ 186 dB re 1 μPa	0.00001 km^2 (0.000004 mi^2)	KMISS (deep ocean waters centered at payload impact point)
	Peak SPLs ≥ 160 dB re 1 μPa	0.004 km^2 (0.002 mi^2)	
	Peak SPLs ≥ 150 dB re 1 μPa	0.04 km^2 (0.02 mi^2)	
Direct Contact	Test Components	0.026 km^2 (0.010 mi^2)	KMISS (deep ocean waters centered at payload impact point)
	Test Debris and Ejecta	0.013km^2 (0.005 mi^2)	Illeginni nearshore waters (half circle extending out from a shoreline payload impact)
Hazardous Materials	Test Components	0.026 km^2 (0.010 mi^2)	KMISS (deep ocean waters centered at payload impact point)
	Potential leaching of chemicals into nearshore marine environments	Unknown	Illeginni nearshore waters
Vessel and Aircraft Operations	Vessels and aircraft operations for equipment and personnel transport; sensor raft operations	Unknown	USAKA

Abbreviations: μPa = micropascals, dB = decibels, km^2 = square kilometers, KMISS = Kwajalein Missile Impact Scoring System, mi^2 = square miles, SPL = Sound Pressure Level, USAKA = United States Army at Kwajalein Atoll

4) <u>Question from NMFS PIRO regarding chemical amounts:</u>

   "Thank you for listing the chemicals that occur within the missiles and the amount of tungsten that may occur. However, I do not see an estimated amount listed in the documents for what chemical amounts will remain when the CPS impacts KMISS or Illeginni. Can you please provide me with that information?".

   <u>Response:</u>

No additional information regarding the exact amounts of chemicals contained on the payload or which would remain in marine or terrestrial environments after the test can be provided here. The test payloads would contain varying quantities of hazardous materials, potentially including batteries, explosives, asbestos, tungsten, and other heavy metals.

Following a payload impact in KMISS waters, fragmentation of the payload would disperse any onboard hazardous materials in water around the impact point. Most payload components would sink relatively quickly to the ocean floor and would not be recovered. Some residual hazardous chemicals are likely to be introduced in the marine environment; however, the area affected by the dissolution of chemicals would be relatively small because of the size of the payload components and the minimal amount of residual materials they would contain. Any chemicals introduced to the water column would be quickly diluted and dispersed by wave action, ocean currents, and the large volume of water.

Following a payload impact on land, fragmentation of the payload would disperse any of the residual onboard hazardous materials up to 91 m (300 ft) from the impact point. The majority of the payload fragments and materials would be expected to remain close to the impact point in terrestrial habitats. Only in the unplanned and unexpected event of a shoreline impact would debris be expected to enter marine habitats. During post-test cleanup activities, attempts would be made to recover all visible man-made test debris. Only trace amounts of hazardous materials would be expected to remain in terrestrial areas after the test. Few, if any, hazardous materials would be expected to enter the nearshore marine environment for a nominal test. Any materials that entered the nearshore marine environment would be quickly diluted and dispersed by the large volume of ocean water and wave action and would be very unlikely to be present at concentrations high enough to affect consultation species. Up to 454 kilograms (1,000 pounds) of tungsten alloy would be contained on the payload. Most of the tungsten is expected to be cleaned up during recovery operations. However, it is possible that a small (but unknown) amount of tungsten alloy would remain in terrestrial habitats at Illeginni Islet.

Requested Information Related to Listed Species in the Action Area and Effects of the Proposed Action

5) Request from NMFS PIRO regarding conclusions for coral species:

   "These 15 species all occur at Illignni [sic] and may need to be added to the action due to increased vessel activity and or effects on larve [sic]: 15 coral species(Acanthastrea brevis, Acropora aculeus, A. aspera, A. dendrum, A. listeri, A. speciosa, A. tenella, A. vaughani, Alveopora verrilliana, Leptoseris incrustans, Montipora caliculata, Pavona cactus, P. decussata, Turbinaria mesenterina, and T. stellulata), Black-lip pearl oyster, and giant clam (T. gigas")."

   Response:

Gametes and larvae of these 15 corals and 2 mollusk species (listed in Table 4 of the BA) have the potential to occur in the Action Area. In addition, adult *Pavona decussata* and *Acropora aspera* are known to occur in Illeginni Harbor (NMFS and USFWS 2017). Descriptions of these species and information regarding their distribution at USAKA can be found in Appendix A of the Navy CPS BA. Because these species have the potential to occur within the Action Area, these species may be affected by the Proposed Action. Based on the information and analyses in the BA and summarized in the following paragraphs, the Proposed Action may affect but is not likely to adversely affect these 15 coral species (*Acanthastrea brevis*, *Acropora aculeus*, *A. aspera*, *A. dendrum*, *A. listeri*, *A. speciosa*, *A. tenella*, *A. vaughani*, *Alveopora verrilliana*, *Leptoseris incrustans*, *Montipora caliculata*, *Pavona cactus*, *P. decussata*, *Turbinaria mesenterina*, and *T. stellulata*) and 2 mollusk species (*Pinctada margaritifera* and *Tridacna gigas*).

With regards to species which may occur in Illeginni Harbor, these species have the potential to be affected by proposed vessel activity. No modifications to Illeginni Harbor would be required for proposed Navy CPS activities. Illeginni Harbor is routinely used for docking of support vessels for ongoing Department of Defense testing activities. The coral species that occur in Illeginni Harbor exist there under the baseline conditions of routine USAG-KA vessel traffic (established over the past decades) and proposed activities would not change those baseline conditions. Therefore, proposed flight test support activities involving vessels would have insignificant effects on consultation species in Illeginni Harbor.

At various times of the year the gametes (eggs and sperm) and larvae of reef-associated invertebrates may occur in ocean 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 in the Action Area, especially for UES consultation species, are likely to be very low except during peak spawning when density may be high over the reef for a short period of time. Only up to one flight test per year would involve impact on Illeginni Islet and a shoreline payload impact is not planned or expected. There is a small possibility that tests might introduce debris into nearshore reef habitats, and the reef area with the potential to be impacted is a small portion of the reef area at Illeginni Islet and throughout Kwajalein Atoll. Therefore, the Proposed Action would have insignificant effects on gamete or larvae concentrations of UES consultation coral species.

Giant clams (*Hippopus* and *Tridacna* species) are synchronous spawners where release of sperm is triggered by the presence of a spawner with ripe eggs (Munro 1993). Due to the limited time frame of gamete viability (viable up to 8 hours in *Tridacna squamosa* but fertilization success decreased within hours of spawning [Neo et al. 2015]), viable gametes are not likely to be found far from adult clams. Giant clam larvae are considered the dispersal phase where ambient currents and larval swimming speed influence long-distance dispersal (Neo et al. 2015). This longer-distance dispersal is limited by the time period during which larvae are able to survive before settlement/recruitment. For most giant clam species, the period from spawning to settlement is approximately 14 days (Ellis 1997, Neo et al. 2015). Black-lipped pearl oysters are also broadcast spawners, producing 40-50 million eggs per female (Thomas et al. 2014). First-stage larvae form within 24 hours of fertilization and the pelagic larval stage lasts for 15 to 30 days before larvae metamorphose and settle to the bottom (Thomas et al. 2014). Top shell snail (*Rochia nilotica*) females release more than 1 million eggs (SPC 2016) and pelagic larvae are free-swimming for at least 3 to 5 days before metamorphosis and subsequent settlement on substrate (SPC 2016). Due to the short time between fertilization and settlement in these mollusk species and their time-limited dispersal capability, the abundance of mollusk larvae (especially viable larvae) is likely extremely low in the Action Area. Since proposed flight tests are discrete events, most flight tests utilizing USAKA would have payload impact in deep ocean waters, and proposed support activities in the marine environment are limited, the Proposed Action would have insignificant effects on gamete or larvae concentrations of UES consultation mollusk species.

6) <u>Request from NMFS PIRO regarding pelagic species:</u>

   "Pelage species should be added to the action due to their possible presence at or near KMISS (turtle and cetaceans)."

   <u>Response:</u>

While documented evidence that three pelagic species of sea turtles (*Caretta caretta, Dermochelys coriacea*, and *Lepidochelys olivacea*) occur in waters of the Republic of the Marshall Islands (RMI) was not found, these species are highly migratory, are known to occur in pelagic habitats throughout the Pacific (NOAA 2023a), and have the potential to occur in deep waters of the RMI, including KMISS. For many sea turtle species, hatchlings and early juveniles are largely pelagic (Dutton et al. 2008, USFWS and NMFS 2013a, Musick and Limpus 1997). While older juveniles and adults of many species (i.e., green, hawksbill, loggerhead, olive ridley) are mainly found in nearshore habitats, these species likely occur in the open ocean during foraging, developmental, and/or reproductive migrations (USFWS and NMFS 2013a, Godley et al. 2003, Polovina et al. 2004). Loggerhead turtle (*Caretta caretta*) hatchlings and early juveniles live in the open ocean, often associating with mats of *Sargassum*, before moving to nearshore foraging habitats close to their birth area (DON 2018b, Musick and Limpus 1997). Leatherback turtles (*Dermochelys coriacea*) occur mostly in the open ocean and are only occasionally found in coastal areas. While hatchling distribution is likely determined by passive drift, juveniles begin to actively swim toward warmer latitudes during winter and higher latitudes during spring (USFWS and NMFS 2013b). Olive ridley turtles (*Lepidochelys olivacea*) are mainly pelagic but may live in coastal habitats, especially during breeding migrations (NOAA 2023a).

As with the two species of sea turtle likely to occur in RMI waters (green and hawksbill), and for the same reasons (see Section 4.0 of the Navy CPS BA), *Caretta caretta, Dermochelys coriacea*, and *Lepidochelys olivacea* may be affected but are not likely to be adversely affected by Proposed Action stressors. These turtle species would be rare in the Action Area and would have even lower densities than green and hawksbill turtles; therefore, all the effects of all Proposed Action stressors would be insignificant or discountable (see detailed analysis in Section 4.0 of the Navy CPS BA).

There is some evidence that false killer whales (*Pseudorca crassidens*) may occur in deep ocean waters of the Central Pacific (Buden and Bourgoin 2018, Miller 2023) and therefore have the potential to occur in deep ocean waters of Kwajalein Atoll, including KMISS. This species has the potential to be exposed to the same Proposed Action stressors as other cetaceans in the Action Area (see Section 4.0 of the Navy CPS BA). While no reliable density estimates are available for false killer whales at Kwajalein Atoll, the density of this species in the Action Area would not be expected to be higher than other UES listed cetaceans in the Action Area (Table 7 of the Navy CPS BA). For the same reasons listed in the Navy CPS BA for other listed cetacean species, all effects of the Proposed Action on false killer whales would be insignificant or discountable. The Proposed Action may affect but is not likely to adversely affect false killer whales.

7) Request from NMFS PIRO regarding shortfin mako sharks:

   "Please note shortfin Mako sharks are currently a UES consultation species."

   Response:

The shortfin mako shark (*Isurus oxyrinchus*) was petitioned for listing as a threatened or endangered species in 2021 (Defenders of Wildlife 2021). Since shortfin mako sharks may occur within the Marshall Islands, this species was added to the UES list of consultation species (UES Appendix 3-4A) at that time. While NOAA Fisheries determined that listing the species as threatened or endangered under the Endangered Species Act (ESA) was not warranted in 2022, the shark remains on the UES consultation species list. The shortfin mako shark is found globally in temperate and tropical waters where it inhabits open ocean, continental shelf, shelf edge, and shelf slope habitats (Defenders of Wildlife 2021). Because the shortfin mako shark may occur in areas far offshore as well as close to shore in the central Pacific Ocean, this species has the potential to occur in the deep ocean waters of the Action Area, including KMISS. Threats to mako sharks are similar to those facing other sharks in the central Pacific and include modification of habitat, targeted commercial and recreational fishing, and bycatch (Defenders of Wildlife 2021).

The Proposed Action has the potential to affect shortfin mako sharks in the same ways and to the same extent as other deep water fish species in the Action Area (Section 4.0 of the Navy CPS BA). While no density estimates are available for shortfin mako sharks in Kwajalein Atoll waters, the density of this species is likely not higher than other listed species in the Action Area. For the same reasons described in the Navy CPS BA for other fish species in deep ocean waters (including KMISS), Proposed Action stressors would have discountable or insignificant effects on shortfin mako sharks. The Proposed Action may affect but is not likely to adversely affect shortfin mako sharks.

8) Request from NMFS PIRO regarding bumpheaded parrot fish:

   "Three juvenile Bumpheaded [sic] Parrot fish were seen during the most recent (2023) UES surveys. These fish are reef-associated, similar to humphead wrasse, therefore there is a possible LAA that may need to be considered."

   Response:

Bumphead parrotfish (*Bolbometopon muricatum*) is a reef-associated species listed as a UES consultation species. This species occurs throughout the Indo-Pacific where adults inhabit deeper coral reefs and juveniles primarily inhabit shallow (0-10 m [0-33 ft]) mangrove, coral reef lagoon, seagrass beds, and areas with plumose, fleshy algae or patch *Turbinaria* spp. or *Acropora* spp. coral formations (NMFS 2012, Sundberg et al. 2015). Primary threats to this species include habitat loss and degradation; harvest in subsistence, commercial, and recreational fisheries; and ocean warming and acidification related to climate change (NMFS 2012). Reported densities of bumphead parrotfish in reef habitats vary greatly throughout their range (Kobayashi et al. 2011). Maximum reported density was 5.17 fish per 1,000 square meters (m^2) (0.00517 per m^2) in Palau (Kobayashi et al. 2011). This is a substantially higher estimate than most reported in the central Pacific with densities of 1.41 to 1.92 per 1,000 m^2 reported in surveys in Papua New Guinea, 1.10 in Micronesia, 0.45 in the Northern Mariana Islands and Guam, 0.42 to 0.91 in the Solomon Islands, and 0.00 in the Marshall Islands (Kobayashi et al. 2011). Based on known survey data, it is likely that bumphead parrot fish densities in the Marshall Islands would be relatively low and below the range-wide total abundance presented by Kobayashi et al. (2011) which was 0.7 (Figure 11 in Kobayashi et al. 2011). During biennial surveys of USAKA islets between 2010 and 2018, only one bumphead parrotfish was recorded on an outer reef slope of Kwajalein Islet in 2016 (NMFS and USFWS 2018). NMFS biologists have also observed this species in Legan Harbor (2 adults), Eniwetak Harbor (4 adults), and Gagan Harbor (6 adults) (S. Kolinski personal communication 2024).

Since the bumphead parrotfish has been observed recently in harbors of USAKA, including at Legan Islet which is 16 kilometers (km; 10 miles) from Illeginni Islet, it is possible that this species would occur in Illeginni reef habitats and may be affected by the Proposed Action. As with the reef-associated humphead wrasse, bumphead parrotfish have the potential to be affected by direct contact from test debris or ejecta, elevated sound pressure levels, exposure to hazardous materials and waste, human activity and equipment operations, and vessel traffic. For the same reasons as humphead wrasse, Proposed Action elevated sound levels, hazardous materials, human activity, and vessel activity would have insignificant or discountable effects on bumphead parrotfish. While unlikely, there is a small chance that bumphead parrotfish may be adversely affected by direct contact from payload debris and ejecta in the event of a shoreline payload impact. While a shoreline impact is not planned or expected, the Navy CPS BA evaluates the worst-case scenario of shoreline payload impact. As specified in the BA (Section 4.2.2), the maximum potential direct contact area for a single test would be approximately 13,008 m^2 (15,557 square yards [yd^2]) in a half circle extending out from the shoreline (Figure 8 of the Navy CPS BA). Within this potential direct contact area, NMFS has determined that approximately 80% of the lagoon-side survey area and 75% of the ocean-side survey area are considered potentially viable habitat for consultation coral, mollusk, and reef-associated fish species (NMFS 2019). Using these estimates of suitable habitat and assuming the ejecta would only cover approximately 1,950 m^2 (2,332 yd^2) on only one side of the islet for a given test (i.e., either on the lagoon or ocean sides of the islet); the area of suitable habitat which may be impacted by debris for each test would be 1,657 m^2 (1,982 yd^2) on the ocean-side or 1,767 m^2 (2,113 yd^2) on the lagoon side. Based on reported densities for this species throughout their range (densities in the Marshall Islands are estimated to be less than the range average of 0.7 individuals per 1,000 m^2), up to 1.2 bumphead parrotfish might be exposed to payload debris or ejecta in the event of either an ocean-side or lagoon-side shoreline payload impact. Since there would be a maximum of 10 CPS flight tests with payload impact at Illeginni Islet (one per year over 10 years) up to 12 bumphead parrot fish have the potential to be exposed to and be injured by direct contact from test debris or ejecta. Based on reported densities of bumphead parrotfish in the Marshall Islands (Kobayashi et al. 2011), these exposure estimates are likely high and maximum estimates of potential effects for the Proposed Action on bumphead parrotfish.

9) Request from NMFS PIRO regarding acoustics:

   "Please state source levels represented- peak to peak, zero to peak, or root mean square."

   Response:

The sound pressure levels for Proposed Action sounds presented in the Navy CPS BA are peak or "zero-to-peak" sound pressure levels. All sound pressure levels are in in peak decibels (dB) which are unweighted and are referenced to 1 micropascal (re 1 μPa) for in-water sounds and 20 micropascals (re 1 μPa) for in-air sounds. **Figure A-1** illustrates example sound pressure metrics for a hypothetical impulsive sound from DON 2018b.

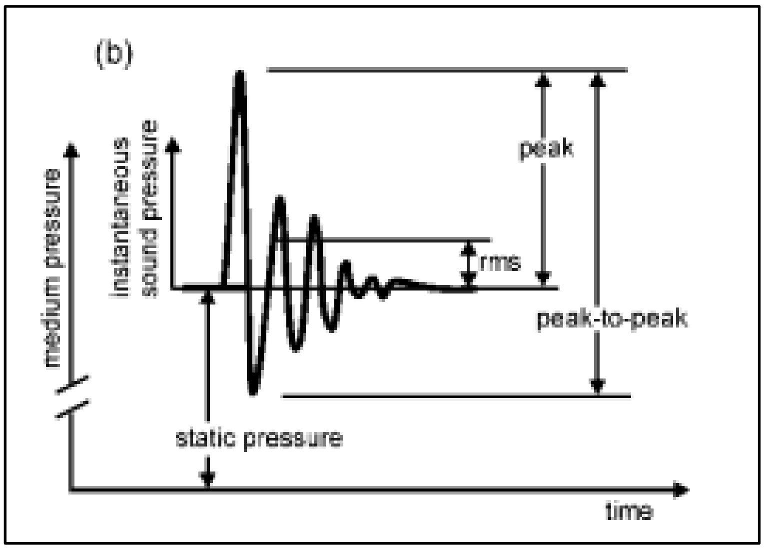

Figure Source: DON 2018b

Figure A-1. Example Sound Pressure Metrics of a Hypothetical Impulsive Sound

10) Request from NMFS PIRO regarding acoustics:

   "We also need a distance reference for the measurement (i.e. 1 meter, 10 meters, etc). I believe they are peak, either peak to peak or zero to peak, but either way we need this information to estimate distances to thresholds."

   Response:

Unless specifically indicated, all sound pressures in the Navy CPS BA are modeled peak sound pressures at the source or have been back calculated to source levels and are therefore referenced to 1 meter. Included in this section are some additional details about the acoustics analysis methodology.

For each marine functional hearing group, the range to potential effect was calculated for Proposed Action noise sources where the maximum expected sound pressure exceeded injury or behavioral effect thresholds (**Table A-3**). The range to potential effect was calculated using a spherical spreading model:

$$Range\ to\ Threshold\ (m) = 10^\wedge\left(\frac{dB_{source} - dB_{threshold}}{x}\right)$$

where x is the spreading coefficient (x=20 for deep ocean waters and x=15 for shallow waters), and sound pressure levels are in dB_{peak} re 1µPa. The distance to potential effect from CPS launch, booster splashdown, and payload impact is detailed in **Table A-3** for each functional hearing group of animals. This is a simplified and conservative approach, as it does not account for differential sound attenuation due to ocean conditions such as water depth, temperature, salinity, or stratification, and likely represents the maximum area where pressures would be above respective effect thresholds. The potential effect area was then calculated for each relevant threshold using the formula:

$$Affect\ Area\ (km^2) = \pi(Range\ to\ Threshold)^2$$

The number of animal exposures to sound pressures above the relevant potential effect thresholds (see **Table A-3**) for each Proposed Action noise source was calculated based on the best available density information for each species and the effect area.

11) Request from NMFS PIRO regarding acoustics:

"Comments on Table 6:

a) PTS and TTS thresholds are dual metrics and should be calculated for both SEL and Peak source levels, with the greater distance being used. Table 6 only reports the peak thresholds.
b) For sea turtles, NMFS uses 232 dB Peak for PTS and 226 dB peak for TTS.
c) For sea turtles, NMFS uses 175 dB RMS as the threshold.
d) For fish, NMFS uses only 206 dB peak at onset of physical injury.
e) For marine mammals, the threshold is 160 dB RMS (not peak). The calculation of 35.5 meters is correct for a source level of 191 dB RMS re 1 µPa @ 1 m. If the source level is a peak measurement, this distance is overestimated as the source level in RMS would be lower. This also assumes a reference distance of 1 meter for the source level. Please review and clarify."

Response:

a) While it is true that NMFS' conventionally-used Permanent Threshold Shift (PTS) and Temporary Threshold Shift (TTS) effect onset thresholds (NOAA 2018, NMFS 2023) are dual metrics, a dual metric comparison can only be used if both peak and Sound Exposure Level (SEL) project-related sound estimates are available. Since the Navy CPS Flight Tests program is a developmental program, no empirical measurements of project-related sound pressures are available. Only modeled/estimated peak sound pressures are available for Proposed Action sounds; therefore, only the peak metric was used in calculating the areas of potential effect. We consider this a valid approach for several reasons. First, because the exact duration and amplitude over time are not known for Proposed Action sounds and because sound level estimates are maximum (bounding) estimates rather than actual expected sound pressures, any SEL estimates would be hypothetical and likely over-simplified. Second, no frequency data are available for Proposed Action sounds, which does not allow for use of weighting factor adjustments nor accurate estimation of weighted SELs.

Additionally, as NMFS describes in NOAA 2018, "sound exposure containing transient components (e.g., short duration and high amplitude; impulsive sounds) can create a greater risk of causing direct mechanical fatigue to the inner ear (as opposed to strictly metabolic) compared to sounds that are strictly non-impulsive" and "often the risk of damage from these transients does not depend on the duration of exposure." Finally, the estimated peak pressures used in analyses are conservatively high, bounding estimates for Proposed Action sounds which would lead to conservatively high estimates of potential effects to protected species.

b) Sea turtle PTS and TTS effect thresholds and potential effect areas have been updated based on the information provided by NMFS and are presented in **Table A-3**.
c) Sea turtle behavioral effect threshold and potential effect areas have been updated based on the information provided by NMFS and are presented in **Table A-3**.
d) Effect thresholds used for fishes have been updated based on the information provided by NMFS and are presented in **Table A-3**.

Table A-3. Maximum Underwater Radial Distance to Elevated Sound Pressure Level Effect Thresholds for UES Consultation Species from Ocean Payload Impact

Species Group	Effect Category	Threshold Criterion (re 1 µPa)	Radial Distance from Payload Impact Point	Area Around Impact Point
Low Frequency Cetaceans (*Balaenoptera* and *Megaptera* whales)	PTS (non-lethal injury)	219 dB_{peak}	-	-
	TTS	213 dB_{peak}	-	-
Mid Frequency Cetaceans (*Delphinus*, *Grampus*, *Stenella*, and *Tursiops* dolphins; *Feresa*, *Globicephala*, *Mesoplodon*, *Orcinus*, *Peponocephala*, and *Physeter* whales)	PTS (non-lethal injury)	230 dB_{peak}	-	-
	TTS	224 dB_{peak}	-	-
High Frequency Cetaceans (*Kogia* whales)	PTS (non-lethal injury)	202 dB_{peak}	-	-
	TTS	196 dB_{peak}	-	-
All Cetaceans	Behavioral Disturbance	160 dB_{RMS}	35.5 m (116 ft)	0.0040 km^2 (0.0015 mi^2)
Sea Turtles	PTS (non-lethal injury)	232 dB_{peak}	-	-
	TTS	226 dB_{peak}	-	-
	Behavioral Disturbance	175 dB_{RMS}	6.3 m (21 ft)	0.0001 km^2 (0.0001 mi^2)
Fishes	Physical Injury	206 dB_{peak}	-	-
	Behavioral Disturbance	150 dB_{RMS}	112 m (367 ft)	0.0396 km^2 (0.0153 mi^2)

Sources: NMFS 2023

Abbreviations: µPa = micropascals, dB = decibels, ft = feet, km = kilometers, km^2 = square kilometers, m = meters, mi = miles, mi^2 = square miles, PTS = Permanent Threshold Shift, RMS = root mean square, SPL = Sound Pressure Level, TTS = Temporary Threshold Shift, "-" = sound pressures would not exceed threshold criterion

e) The assumption of a 1 meter reference distance for the presented sources levels is correct. While several functional hearing group effect thresholds are defined by NMFS as root mean square (RMS) sound pressure levels (**Table A-3**; NOAA 2018, NMFS 2023), all modeled Proposed Action sound pressure levels are available only in peak decibels and no RMS decibel estimates are available. RMS sound pressure is the average sound pressure across the duration of a sound; therefore, RMS decibels would by definition be lower than peak decibels for a single impulsive sound (**Figure A-1**; DON 2018b). For these analyses estimated peak decibels for Proposed Action sounds were compared to RMS effect thresholds, where necessary, as a conservative approach which would lead to an overestimation of potential effects. Even using this approach, which would lead to an overestimation of the potential behavioral effect area and potential exposures, all potential effects of the Proposed Action elevated sound pressure levels would be insignificant or discountable as detailed in Section 4.1.2 of the Navy CPS BA.

f) Even with NMFS recommended changes to acoustic effect thresholds, the conclusions regarding the potential effect of Proposed Action sounds remains the same as detailed in Section 4.1.2 of the Navy CPS BA. All effects of Proposed Action elevated sound levels would have discountable or insignificant effects on UES consultation species.

Requested Information Related to Avoidance, Minimization, and Mitigation Measures

12) Request from NMFS PIRO regarding mitigations measures:

During consultation, NMFS PIRO requested that mitigation measures and standard operating procedures to be implemented as part of the Proposed Action include all measures detailed in recent NMFS biological opinions for flight test actions occurring at USAKA.

Response:

The list of avoidance, minimization, and mitigation measures to be implemented as part of the Proposed Action has been revised to the following list of measures equivalent to measures presented in NMFS 2021a and NMFS 2021b:

Marine Mammal and Sea Turtle Monitoring

- During travel to and from payload target sites, including Illeginni Islet, ship personnel would monitor for marine mammals and sea turtles to avoid potential ship strikes. Vessel operators would adjust speed or raft deployment based on the presence of special-status species and on lighting and turbidity conditions.
- A helicopter or fixed-wing aircraft overflight in the vicinity of the KMISS or Illeginni Islet target site would be conducted during the week prior to the test and as close to launch as safely practical to survey for marine mammals and sea turtles. Any sightings or the lack of sightings would be recorded and reported according procedures detailed below.
- Any marine mammals or sea turtle opportunistic sightings collected during ship travel, overflights, and deployment of sensor rafts in the vicinity of the Illeginni Islet or KMISS target sites would be recorded and reported according procedures detailed below.
- Pre-flight test monitoring by qualified personnel would be conducted on Illeginni Islet for sea turtles or sea turtle nests. For at least 8 weeks preceding the launch, Illeginni Islet would be surveyed weekly by pre-test personnel for sea turtles, sea turtle nesting activity, and sea turtle nests. If possible, personnel would inspect the area within days of the launch. Sea

turtles or sea turtle nest observations near the target site or the lack of observations would be recorded and reported according procedures detailed below.
- Post-test overflights of the impact area would be conducted to survey for dead or injured cetaceans and sea turtles.
- Although unlikely and unexpected, any dead or injured marine mammals or sea turtles sighted by project personnel would be reported immediately to USASMDC and USAG-KA Environmental Office; USASMDC would as soon as possible, and within 24 hours, inform the RMI Environmental Protection Authority, NMFS, and USFWS. USAG-KA aircraft pilots or vessel operators otherwise operating in the vicinity of the impact and test support areas would also report any opportunistic sightings of dead or injured marine mammals or sea turtles through the procedures detailed below.
- For all surveys and incidental observations, data would be recorded including location, date, time, species, and number of individuals or reports of no sightings when animals are not seen on surveys. Observations would be reported to the USAG-KA Environmental Office, the RTS Range Directorate, the Flight Test Operations Director, and USASMDC. USASMDC and the USAG-KA Environmental Office would maintain records of these observations and USASMDC would distribute survey reports to the RMI Environmental Protection Authority, NMFS, and USFWS within 6 months of completion of each fiscal year.

Hazardous Materials Measures

- Vessel and heavy equipment operators would inspect and clean equipment for fuel or fluid leaks prior to use or transport and would not intentionally discharge fuels or waste materials into terrestrial or marine environments.
- Any accidental spills from support equipment operations would be contained and cleaned up and all waste materials would be transported to Kwajalein Islet for proper disposal.
- Response to releases of oil, fuels, and lubricants into the USAKA environment would be in accordance with the Kwajalein Environmental Emergency Plan (UES § 3-6.5.8).
- All equipment and packages/materials shipped from the United States to RTS would be inspected prior to shipment and washed if necessary to prevent the introduction of animals, plants, and seeds.
- Following an Illeginni Islet land-impact test, soil and groundwater samples would be collected at various locations around the payload impact site and samples would be tested for metals (not limited to, but including arsenic, barium, cadmium, chromium, and lead). Testing results exceeding the UES standards would trigger an immediate investigation of the soil on Illeginni Islet, as detailed in the UES § 3-6.5.8. Coordination would be initiated with the Defense Program, USASMDC, RMI Environmental Protection Authority, and the other UES Appropriate Agencies to determine the scope and methods/procedures to be followed during the investigation and any subsequent soil removal or other remediation activities.
- Following completion of a flight test at KMISS, a vessel or aircraft from USAG-KA would inspect the ocean impact area for any floating debris. Any visible debris found floating would be recovered, as much as practicable.

<u>*Reef Protection Measures*</u>

- To avoid impacts on coral heads in waters near Illeginni Islet, sensor rafts would be located in waters at least 3 m (10 ft) deep.
- When feasible, within 1 day after the land impact test at Illeginni Islet, USAKA RTS environmental staff would survey the islet and the near-shore waters for any injured wildlife, damaged coral, or damage to sensitive habitats (i.e., reef habitat). Any impacts to biological resources would be reported to the UES Appropriate Agencies via USASMDC, with USFWS, RMI Environmental Protection Authority, and NMFS offered the opportunity to inspect the impact area to provide guidance on mitigations.
- 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 NMFS, USFWS, and RMI Environmental Protection Authority would be offered the opportunity 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 RTS representatives, decide on any response measures that may be required.
- If any man-made debris were to enter the marine environment and divers were 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.
- In the event of a payload impact that affects the reef at Illeginni Islet, personnel would secure or remove from the water any substrate or coral rubble from the ejecta impact area that may become mobilized by wave action.
    - Ejecta greater than 15 centimeters (cm; 6 inches) in any dimension would be removed from the water or positioned such that it would not become mobilized by expected wave action, including replacement in the payload crater.
    - If possible, coral fragments greater than 15 cm (6 inches) in any dimension would be positioned on the reef such that they would not become mobilized by expected wave action and in a manner that would enhance their survival (i.e., away from fine sediments with the majority of the living tissue [polyps] facing up).
    - UES consultation coral fragments that could not be secured in-place would be relocated to suitable habitat where they are not likely to become mobilized.
- In the event of a payload impact that affects the reef at Illeginni Islet, impacts on top shell snails and clams would be reduced.
    - Any living top shell snails or clams that are buried or trapped by rubble would be rescued and repositioned.
    - Any living top shell snails or clams that are in the path of any heavy equipment that must be used in the marine environment would be relocated to suitable habitat.

<u>*General Measures*</u>

- Test personnel would be briefed on Best Management Practices and conservation requirements and the requirement to adhere to them during test activities.

- When feasible, within 1 day after the land impact test at Illeginni Islet, USAKA RTS environmental staff would survey the islet and the near-shore waters for any injured wildlife or damage to sensitive habitats (i.e., sea turtle nesting habitat). Any impacts to special-status biological resources would be documented and reported to the UES Appropriate Agencies via USASMDC, with USFWS, RMI Environmental Protection Authority, and NMFS offered the opportunity to inspect the impact area to provide guidance on mitigations.
- In the event that any UES consultation species is found injured or killed, the finding would be recorded using digital photography. As practicable, digital photographic records would include (1) photographs of all damaged corals or other UES consultation species observed injured or dead; (2) include a scaling device (such as a ruler) in photographs to aid in the determination of size; and (3) the location of the photograph. Any photographs or records of injured or killed UES consultation species would be reported to USFWS, RMI Environmental Protection Authority, and NMFS via USASMDC within 60 days of completing post-test cleanup operations.
- Debris recovery and site cleanup would be performed for the land impact. To minimize long-term risks to marine life, all visible project-related man-made debris 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.
- During post-test recovery and cleanup, should personnel observe highly mobile endangered, threatened, or other species requiring consultation moving into the area, work would be delayed until such species are out of harm's way or leave the area of their own volition.
- Within 6 months of completion of each fiscal year, USASMDC would provide a report to NMFS, USFWS, and RMI Environmental Protection Authority. The report would identify: (1) the flight test and date; (2) the target site; (3) the results of the pre- and post-flight surveys; (4) the identity and quantity of affected UES consultation resources (include photographs and videos as applicable); and (5) the disposition of any relocation efforts.

Literature Cited

Literature cited in this addendum includes literature originally cited in the Navy CPS BA (Section 7.0) as well as the following additions:

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