

**Biological Assessment and Essential Fish Habitat
Assessment for the Proa and TPU Cable Systems - Tinian
Branching Units**

Prepared For:



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Appendix B – Terrestrial Biological Survey Report Proa Cable System
Appendix C – Coral Mitigation Plan Proa and TPU Cable Systems – Tinian Branching Units

Acronyms and Abbreviations

BMP	Best Management Practice
CNMI	Commonwealth of the Northern Mariana Islands
COTS	Crown-of-thorns sea star
DON	Department of the Navy
DPS	distinct population segments
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
ESA	Endangered Species Act
HAPC	Habitat Area of Particular Concern
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act of 1976
MUS	Management Unit Species
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
U.S.	United States
USACE	U.S. Army Corps of Engineers
U.S.C	U.S. Code
USFWS	United States Fish and Wildlife Service
WPRFMC	Western Pacific Regional Fishery Management Council

1. Introduction

1.1. Background

This document assesses the effects of the Proposed Action on species protected under the Endangered Species Act (ESA) (16 United States [U.S.] Code [U.S.C.] 1531 *et seq.*) and the Magnuson Stevenson Fishery Conservation and Management Act of 1976 (MSFCMA) as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267).

This assessment focuses on the Proa Tinian Branching Unit and the TPU Tinian Branching Unit landing on Tinian, and part of what is referred to as “Project Pika” (Figure 2). Some of the infrastructure at the beach landing site, including the beach manhole, will be built and permitted separately. This project includes the two undersea cables that run from the junction with the main trunk lines to the reef at Lasarino Beach on Tinian. The landing site infrastructure includes a pre-cast marine bulkhead located in the back reef where the undersea cables will enter conduits buried in the reef flat between the marine bulkhead and the beach manhole. Two ocean ground beds and grounding cables will be built to ground the cables (Figure 3). All nearshore (bulkhead and 4 conduits) and onshore (4 conduits and ocean ground beds) infrastructure will be buried.

This Biological Assessment/Essential Fish Habitat (EFH) Assessment was prepared to assist the U.S. Army Corps of Engineers (USACE) with initiation of consultation under Section 7 of the ESA (16 U.S.C. 1536 *et seq.*) and the MSFCMA as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267). Section 7(a)(2) of the ESA requires federal agencies to ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any federally threatened or endangered species, or any species proposed for listing under the ESA, or result in the destruction or adverse modification of designated or proposed critical habitat. The MSFCMA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), requires federal agencies to consult with National Oceanic and Atmospheric Administration (NOAA) Fisheries office on activities that may adversely affect essential fish habitat.

1.2. Project Location and Purpose

The Proa Cable System – Tinian Branch (Proa Tinian Branch) begins in the U.S. Exclusive Economic Zone 53 miles offshore at 144.851848°E, 14.884687°N, enters the Contiguous Zone of the CNMI at 145.3497459°E, 16.7201017°N, enters the Territorial Sea of CNMI at 145.2884925°E, 14.8441942°N, and continues to Tinian (Figure 2).

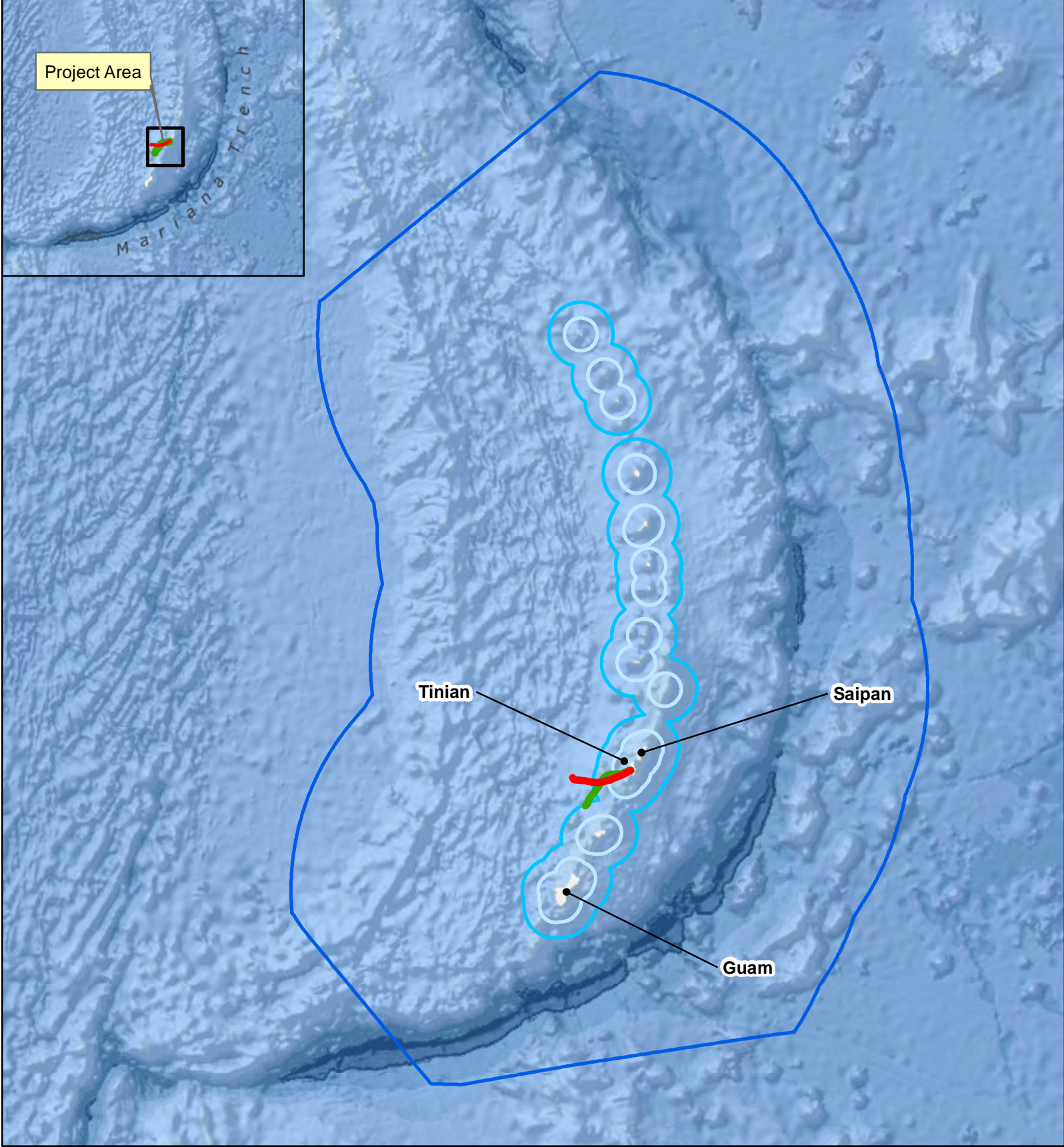
The TPU Cable System – Tinian Branch (TPU Tinian Branch) begins in the Contiguous Zone of CNMI 44 miles offshore at 145.01908°E, 14.524749°N, enters the United States Exclusive Economic Zone at 145.047061°E, 14.556652°N, re-enters the Contiguous Zone at 145.141475°E, 14.705473°N, and enters the Territorial Sea of the CNMI at 145.348119°E, 14.927152°N, and continues to Tinian (Figure 2).

Both cables land at Lasarino Beach along the western shore of Tinian (Figure 3).

The Project will enhance data communications capacity between the CNMI, mainland United States, and the western Pacific.

1.3. Proposed Action Area

The Action Area includes those areas of land, water, and air that would be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 Code of Federal Regulations §402.02). The Action Area is determined in part by the proposed activities, site geography, topography, and hydrology, and by an understanding of the distribution, habitat requirements, phenology, and vulnerability of the listed species potentially occurring in the project area. The Action Area for the proposed project includes a 100-foot buffer around the terrestrial construction area on shore and on the reef flat and a 50-foot buffer around the cable and articulated pipe installation area on the fore reef to account for noise, movement of boats and divers, construction, and indirect effects. In the pelagic environment, the Action Area includes the immediate area around the cable ship on the surface of the ocean, the water column below the ship, and a 50-foot buffer around the cable on the seafloor from Tinian out to the trunk cables inside the Exclusive Economic Zone (EEZ) boundary (Figure 3).



Project Area

Mariana Trench

Tinian

Saipan

Guam

Legend

- Proa Tinian Branching Unit
- TPU Tinian Branching Unit

Maritime Limits and Boundaries

- Territorial Sea
- Contiguous Zone
- Exclusive Economic Zone



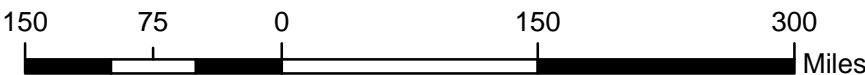
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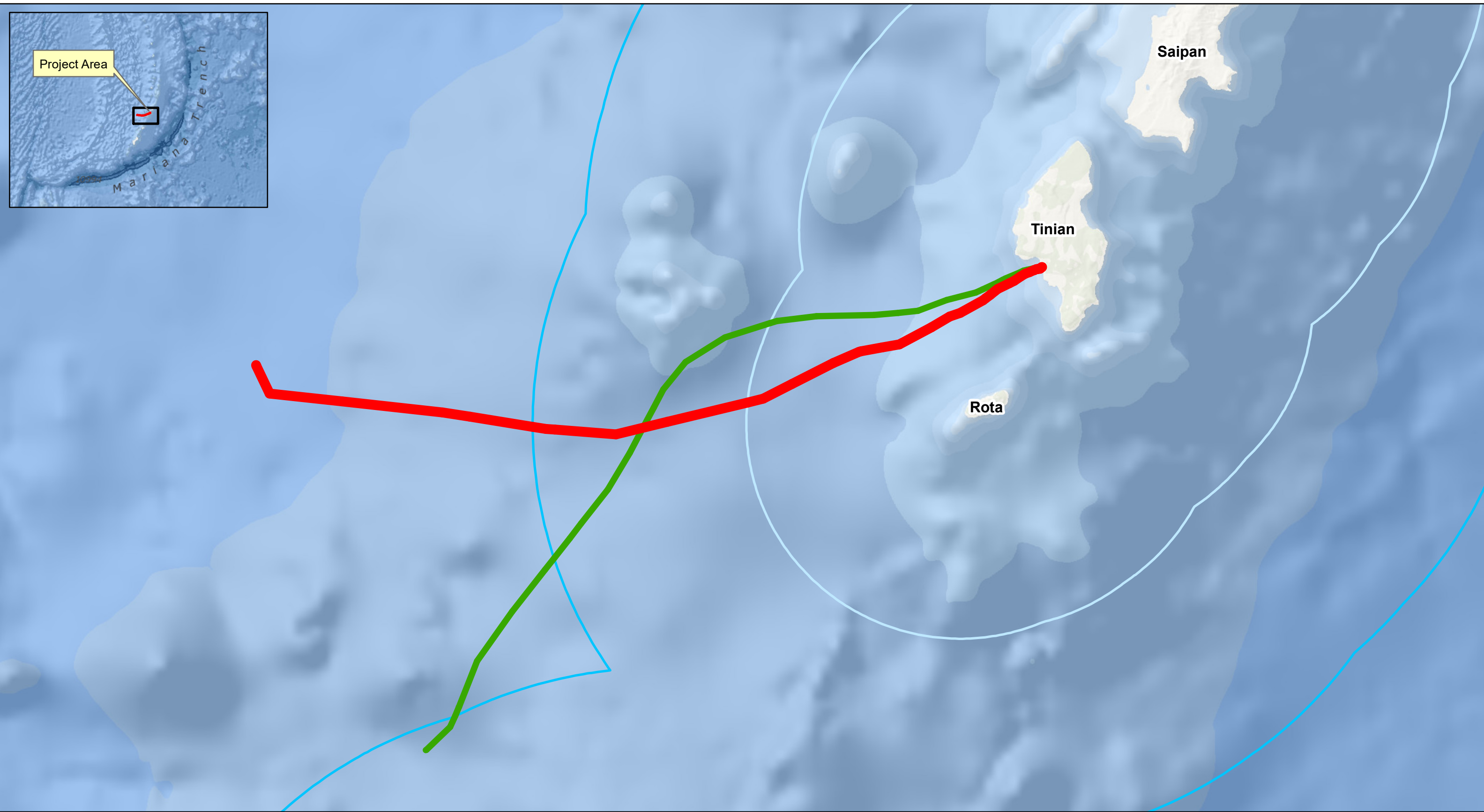
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Draft Biological Assessment and Essential Fish Habitat Assessment for Project Pika Subsea Cable System

Figure 1
Project Pika Overview

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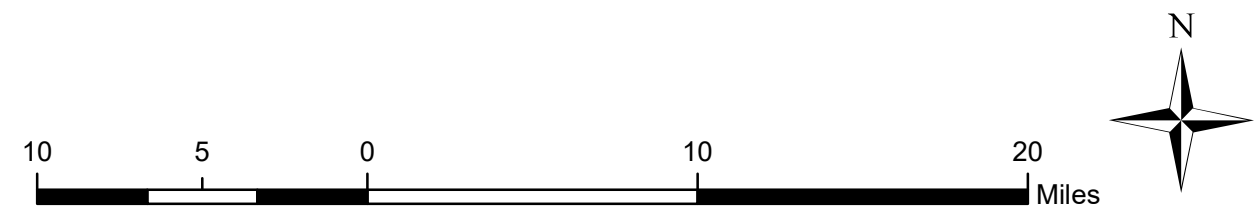




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Legend

- Proa Tinian Branching Unit
- TPU Tinian Branching Unit
- Territorial Sea
- Contiguous Zone

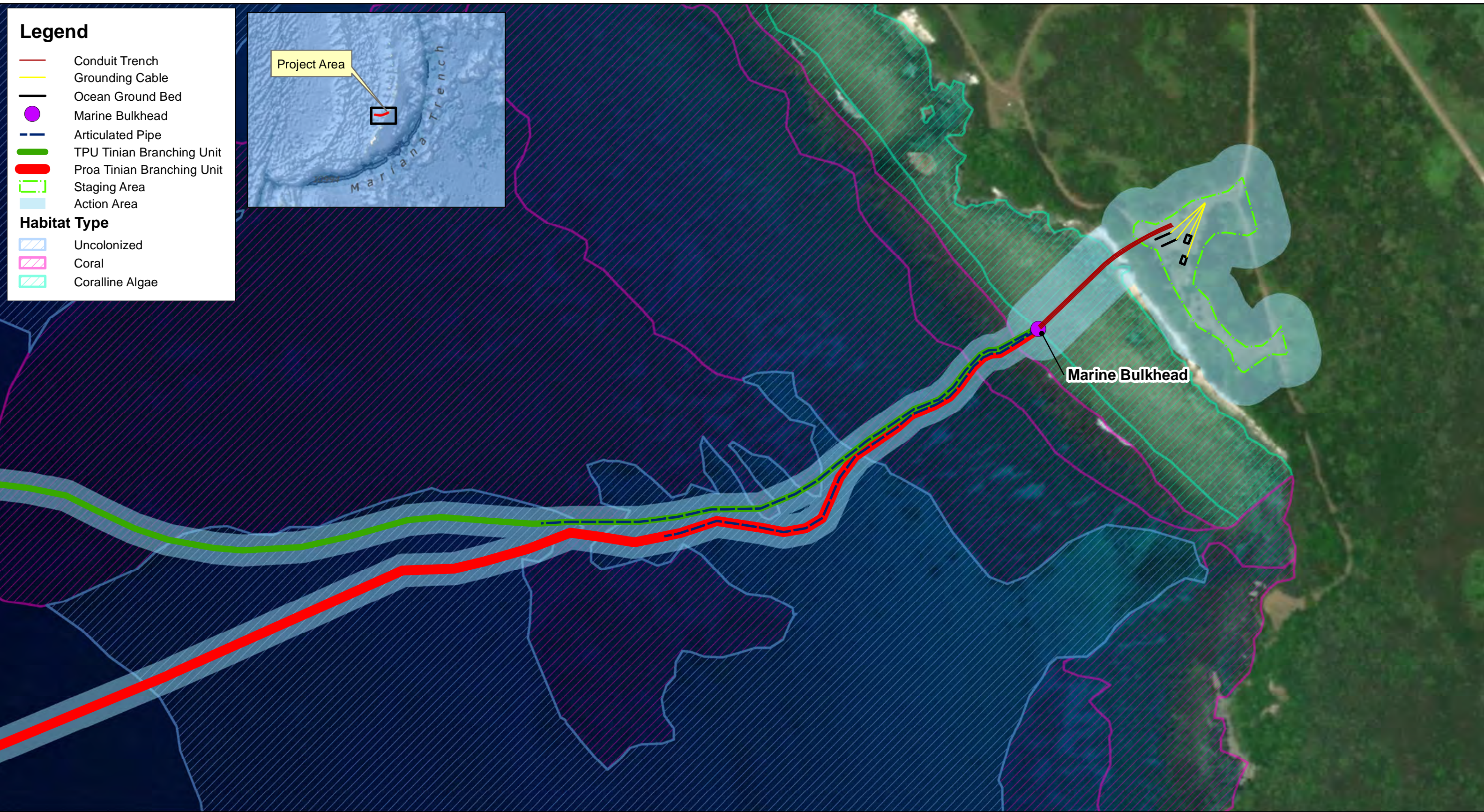


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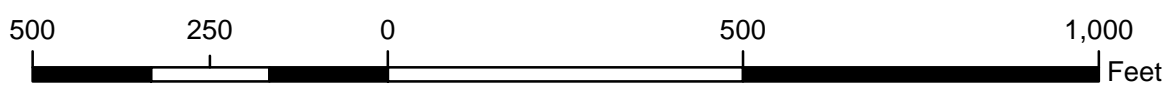
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Figure 2
Project Pika Subsea Cable System

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	<p>Figure 3 Project Pika Action Area</p>		
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1.4. Species Addressed and Eliminated from Consideration

Section 7 of the ESA (16 U.S.C. 1536) requires federal agencies (in this case, the USACE) to ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any federally endangered or threatened species or result in the destruction or adverse modification of critical habitat. Marine biological surveys for benthic habitat and corals were conducted at Lasarino Beach in February 2025 and April 2025 (Appendix A). A terrestrial biological survey for threatened and endangered species was conducted in the Action Area and nearby vegetation in January 2025 (Appendix B).

Marine Species

Table 1 lists marine species identified by NOAA as protected under their jurisdiction by the endangered species act in the Mariana Islands (NOAA 2024a). Those species noted with “Not Considered” either have not been observed in the Mariana Islands region or are candidate species that were not observed at the site and will not be listed prior to project completion.

Nearshore species that may be affected by the proposed action include the Central West Pacific green sea turtle (*Chelonia mydas*), hawksbill sea turtle (*Eretmochelys imbricata*), Indo-West Pacific scalloped hammerhead sharks (*Sphyrna lewini*), and the coral *Acropora globiceps*.

The pelagic species listed in Table 1, including marine mammals, giant manta ray, and the oceanic whitetip shark, could be encountered when the cable ship is laying cable on the seafloor between Tinian and the junction with the Proa or TPU trunk cables.

In addition to listed species, critical habitat is proposed for corals and the green sea turtles in the waters around Tinian (88 Federal Register 83644, NOAA 2023b).

Table 1. Threatened and Endangered Species Under NOAA Jurisdiction with Potential to Occur in Mariana Islands Region

Common Name	Scientific Name	Status	Included in Analysis
Marine Mammals			
Blue Whale	<i>Balaenoptera musculus</i>	Endangered	Considered
Fin Whale	<i>Balaenoptera physalus</i>	Endangered	Considered
Western North Pacific DPS Humpback Whale	<i>Megaptera novaeangliae</i>	Endangered	Considered
Sei Whale	<i>Balaenoptera borealis</i>	Endangered	Considered
Sperm Whale	<i>Physeter macrocephalus</i>	Endangered	Considered
Reptiles			
Central West Pacific DPS Green Turtle	<i>Chelonia mydas</i>	Endangered	Considered
Hawksbill Turtle	<i>Eretmochelys imbricata</i>	Endangered	Considered
Leatherback Turtle (Western Pacific)	<i>Dermodochelys coriacea</i>	Endangered	Considered
North Pacific DPS Loggerhead Turtle	<i>Caretta caretta</i>	Endangered	Considered
Olive Ridley Turtle	<i>Lepidochelys olivacea</i>	Threatened	Considered
Fish			
Indo-West Pacific Scalloped Hammerhead Shark	<i>Sphyrna lewini</i>	Threatened	Considered
Giant Manta Ray	<i>Manta birostris</i>	Threatened	Considered

Common Name	Scientific Name	Status	Included in Analysis
Oceanic Whitetip Shark	<i>Carcharhinus longimanus</i>	Threatened	Considered
Invertebrates			
Staghorn Coral	<i>Acropora globiceps</i>	Threatened	Considered
Giant Clams	<i>Tridacna derasa</i>	Proposed	Not Considered
Giant Clams	<i>Tridacna squamosa</i>	Proposed	Not Considered
Giant Clams	<i>Tridacna gigas</i>	Proposed	Not Considered
Giant Clams	<i>Hippopus hippopus</i>	Proposed	Not Considered

Source: NOAA 2024a

In 2024, NOAA proposed listing seven species of giant clams as endangered or threatened under the ESA (NOAA 2024b). These species of giant clam occur in the reef environment to a depth of about 18 meters. Giant clams were not considered since the project will be completed prior to their listing.

Terrestrial Species

Table 2 lists the terrestrial species identified by the USFWS as protected under their jurisdiction within the Action Area at the site. The list was obtained from the USFWS Information for Planning and Consultation (IPaC) website (USFWS 2024). Mobile species that may occur in the Action Area include the Mariana fruit bat (*Pteropus mariannus mariannus*), Micronesian megapode (*Megapodius laperouse*), and short-tailed albatross (*Phoebastria (=Diomedea) albatrus*). The short-tailed albatross prefers pelagic habitats and is not known to come as far south as the Marianas Islands or near shore and is not considered further. Green sea turtles (*Chelonia mydas*) regularly nest on Lasarino beach and are frequently observed in the nearshore reef environment. Hawksbill sea turtles (*Eretmochelys imbricata*) are much rarer in the Marianas and nesting has not been observed at Lasarino beach.

Humped tree snails (*Partula gibba*) can be found in a variety of habitats, including on plants identified in the Action Area, however none were identified during field surveys of the project footprint during biological surveys of the site in January 2025 (Appendix B). None of the four listed plant species, *Solanum guamense*, *Dendrobium guamense*, *Heritiera longipetiolata*, or *Cycas micronesica* were observed either. Since the humped tree snail and the four species of ESA-protected plants do not occur within the project area and are unlikely to move into the project area prior to or during construction, the proposed action would have no effect and they are not considered further.

Table 2. Threatened and Endangered Species Under USFWS Jurisdiction with Potential to Occur in the Action Area

Common Name	Scientific Name	Status	Included in Analysis
Mammals			
Mariana Fruit Bat	<i>Pteropus mariannus mariannus</i>	Threatened	Considered
Birds			
Micronesian Megapode	<i>Megapodius laperouse</i>	Endangered	Considered
Short-tailed Albatross	<i>Phoebastria (=Diomedea) albatrus</i>	Endangered	No effect, not considered

Common Name	Scientific Name	Status	Included in Analysis
Reptiles¹			
Green Sea Turtle	<i>Chelonia mydas</i>	Endangered	Considered
Hawksbill Sea Turtle	<i>Eretmochelys imbricata</i>	Endangered	Considered
Invertebrates			
Humped Tree Snail	<i>Partula gibba</i>	Endangered	No effect, not considered.
Plants			
Berenghenas Halomtano	<i>Solanum guamense</i>	Endangered	No effect, not considered
No common name	<i>Dendrobium guamense</i>	Threatened	No effect, not considered
Ufa-halomtano	<i>Heritiera longipetiolata</i>	Endangered	No effect, not considered
Fadang	<i>Cycas micronesica</i>	Threatened	No effect, not considered

Source: USFWS 2024

¹Green and hawksbill sea turtles fall under the USFWS jurisdiction on land and NOAA jurisdiction at sea.

No terrestrial critical habitat has been designated in the Action Area, however green sea turtle habitat has been proposed by the USFWS for Lasarino beach.

1.5. Consultation History

The details of this project have not been discussed with the USFWS or NOAA.

2. Project Description

2.1. Overview

The Project components include improvements in the terrestrial and marine environment as follows:

- Cable landing site on Lasarino Beach (Figure 3):
 - Staging area for equipment, and use of an existing dirt road for access.
 - Installation of a marine bulkhead.
 - Installation of four 4-inch buried conduits from marine bulkhead to two beach manholes (BMHs).
 - Installation of four ocean ground beds (OGBs).
- Two subsea cables, surface laid on ocean floor (Figure 2):
 - Approximate diameter up to 1.1 inches.
 - Each cable encased in 6-inch articulated pipe from outer reef to marine bulkhead.

Further details on Project components are provided below.

2.2. Cable Landing Site

The cable landing site, inclusive of a staging area for equipment, will be approximately 34,000 square feet or .80 acre (Figure 3). This area will be used to stage equipment and store materials, as well as installation of Project facilities. The site will be accessed utilizing existing dirt roads, but some road improvement may be necessary to accommodate equipment. Additionally, a 10-foot wide access path will be developed to the beach for the installation of the marine bulkhead and conduits.

Prior to installation of the subsea cable facilities, two beach manholes (BMHs) will have been installed at the site by Citadel Pacific. The BMHs will be installed first.

2.2.1. Marine Bulkhead and Articulate Pipe Corridors

The project will install a marine bulkhead on the reef flat, landward of the reef break and approximately 360 feet from the beach. The marine bulkhead will be approximately 3.5 feet wide by 10 feet long. Prior to the start of construction, a 10-foot-wide containment system will be installed around the marine work area. At this time it is not known the exact system that may be used but could include silt curtains, sheet piles, or geotube. Equipment mats may be installed along the access route to limit impacts to the reef. The bulkhead installation location will then be excavated to a depth of 3 to 4 feet using a small backhoe and the marine bulkhead will be installed and buried to the top of the reef flat. A 3-foot wide trench for the four conduits will then be excavated and the conduits buried in the substrate such that they are installed along the previously disturbed route from the bulkhead to the BMHs. After burial, the conduit trench may be covered with concrete to the level of the reef to secure the infrastructure. Trenching in the marine environment will be approximately 360 feet to the beach and then an additional approximately 170 feet of trenching on land to reach the BMHs.

Four 1-foot-wide corridors for articulated pipe installation through the reef margin will be surveyed to avoid corals to the extent practicable. Some clearing and coral relocation will be required along the 630-foot corridors through the reef edge. Two corridors will be used for the cable installations included in this project, and two will be used for future cable installations.

2.2.2. Ocean Ground Beds

Two OGBs will be installed at the cable landing site over the course of the Project, with one OGB installed per cable system installation. The OGB design consists of an electrode array of 4 to 6 anodes to provide an earth ground for the electricity that powers the subsea cable repeaters/amplifiers.

Installation of the anodes will require drilling a hole 12 inches in diameter and approximately 50 feet deep, into which each anode will be installed. A trench across the top of the anodes approximately 2 feet wide, 4 feet deep, and 75 feet long will be needed to connect the anodes to each other. All excavated soils will be temporarily stockpiled within the cable landing staging area.

Each of the OGBs will connect to the BMH (installed by others) with one 1.25-inch, high-density polyethylene conduit installed via open-cut trenching. Once the OGB to BMH conduit is installed, the trenches will be backfilled with native soil.

2.3. Post Construction Restoration

During excavation native soil will be stockpiled and, where appropriate, used to backfill the trenches. Once excavations are backfilled, the areas will be compacted to reduce the likelihood of erosion and soil settlement. Surface restoration will involve returning the impacted areas to preconstruction contours and elevations, as required by local ordinances.

2.4. Subsea Cable Installation

2.4.1. Cable Landing Tie-In and Cable Pulling

The shore-end landing typically is a one-day operation where a winch situated at the cable landing site is used to pull the cable from the cable ship stationed offshore through the marine bulkhead conduit to the BMH.

Prior to the day of the landing, divers will locate the end of the marine bulkhead conduit selected for the specific cable being installed and install a bell-mouth adaptor. On the day of the cable landing, the cable vessel will position itself approximately 2,500 to 3,000 feet seaward of the reef face. The vessel will not anchor and instead will use engine thrusters to maintain position. On the day of the landing, divers will attach the cable to the pre-installed pipe messenger wire in the marine bulkhead conduit. The cable vessel will apply floats to the cable to help facilitate controlled and proper cable transition from the vessel to the marine bulkhead conduit. The vessel will pay out the cable and the cable will be moved into position with the use of divers and small support vessels. The winch, located onshore and adjacent to the BMH, will then pull the cable

through the conduit between the marine bulkhead and the BMH. Once through the conduit, the cable will be anchored in place behind the BMH.

2.4.2. Offshore Subsea Cable Installation

The subsea cable will be installed by cable ship through CNMI, territorial, federal, and international waters. The nearshore portion of the cable, from the marine bulkhead to approximately 3,400 feet off shore from the high tide line (at 40-meter water depth), will be encased in 6-inch articulated piping or polyethren duct, secured to the sea floor with clamps, which will provide protection and weighting so that the cable can be laid directly on the seafloor without burial. The remainder of the offshore cable will be laid on the seafloor and protected by the cable's built-in armor. The cable, at this point, will be between 0.9 and 1.1-inch in diameter. Once laid, the cable maintains position on the seafloor due to the installation methods that manage slack in the cable and the weight of the cable itself.

Following the cable landing tie-in and pulling, the cable lay vessel will still be positioned offshore with the cable paid out and floated between the nearshore patch reefs and reef edge. Divers will then verify the position of the cable along the proposed nearshore route, between the patch reefs, and will remove the floats one at a time to slowly lower the cable to the seafloor avoiding coral to the extent practicable. Following the installation of the cable, the divers will install the articulated piping or polyethren duct, and the saddle clamps which will require drilling holes for two studs into the hard-bottom substrate for each clamp. A total of 1,150 feet of articulated pipe will be installed for each cable with 630 feet through the reef margin and 520 feet on the outer reef to a depth of 66 feet (20 meters). Installation of the articulated pipe takes approximately 2 to 3 days.

Divers will be utilized to install the entire nearshore portion of the cable, including articulated piping and saddle clamps, to the marine bulkhead to reduce potential impacts to the coral reefs. The cable lay vessel will then move seaward, continuing to pay out the cable for the remainder of the offshore cable route. The vessel will move slowly (4 to 6 knots) toward international waters, laying the cable on the seafloor. A post-lay inspection will take place immediately following completion of the cable installation for each cable.

2.4.3. Construction Schedule

Construction is scheduled to begin in March 2026 for the installation of the marine bulkhead and conduits and is expected to take several months. Following this, the subsea cables will be installed in August 2026.

On-shore construction hours will be limited to approximately 30 minutes after sunrise (6:15am) and 30 minutes before sunset (6:15pm). No nightwork is anticipated during installation of the onshore facilities.

Cable lay through CNMI submerged lands is expected to take 2 to 5 days for each cable. The vessel will enter territorial waters at less than 5 knots and slow speed further as it approaches land. The lay vessel will be positioned offshore for 1 to 2 days, with in-water cable landing

activities occurring for 3 to 4 days. Coral relocation would occur ahead of the onshore facilities being constructed and again prior to the cable landing. Each event is expected to take 1 to 2 weeks.

2.5. Operation and Maintenance

There are no routine operations or maintenance associated with submerged cables. The cable would only be accessed for emergency repairs in the event of a cable failure.

3. Avoidance and Minimization Measures

The following best management practices (BMPs) and avoidance measures are specific to the action and promote the continued existence of all protected and local species. Avoidance and minimization measures are part of the Proposed Action.

Marine Species

1. For in-water work where ESA corals may occur, structures and substrate that could be affected by the proposed activity must be surveyed by personnel qualified to identify ESA-listed corals. Where divers are to be used, before entering the water, all divers shall be made aware of ESA-listed corals, and the requirement to avoid contact with the corals while performing their duties. This shall include taking measures to avoid kicking corals with fins and to secure dive and survey equipment in a manner that will prevent the equipment from being dragged across the substrate.
2. To minimize impacts to coral larvae the permittee shall avoid in-water work during mass-coral spawning times or peak coral spawning seasons June 1 to September 30 if practicable. The Permittee must consult with local NMFS HCD biologist to determine the period and dates when coral spawning will occur for the given year.
3. Where feasible, micro-routing around coral colonies will be implemented.
4. During all aspects of the proposed action, constant vigilance shall be maintained for the presence of ESA-listed marine species (sea turtles, marine mammals, sharks, rays).
5. A responsible party (i.e., permittee/site manager/project supervisor) shall designate an appropriate number of competent, trained observers to survey the areas adjacent to the authorized work area (i.e., proposed action) for ESA-listed marine species. The competent observer will not be simultaneously engaged in any other activity (e.g., captaining, operating equipment, etc.).
6. Surveys shall be made prior to the start of work each day and prior to resumption of work following any break of more than one-half hour. Additional periodic surveys throughout the workday are strongly recommended.
7. All work shall be postponed or halted when ESA-listed marine species are within 164 feet of the proposed work, and will only begin/resume after the animals have voluntarily departed the area.
 - a. If ESA-listed marine species are noticed within 164 feet after work has already begun, that work may continue only if, in the best judgment of a biologist, the activity will not adversely affect (i.e., disturb or harm) the animal(s). For example, divers performing underwater work (excluding the use of toxic chemicals), such as surveys, would likely be permissible, whereas operation of heavy equipment is not.
8. Project-related personnel shall NOT conduct activities resulting in a take of an ESA-listed species, a species proposed for listing or degradation of listed or proposed critical habitat. "Take" as defined under the ESA means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct".

9. Sensitive resource areas, such as corals, coral reefs, and seagrass beds known to occur within a project area must be identified on project figures. Project staff must be instructed to avoid the sensitive resource areas to the greatest extent practicable, including avoiding anchoring in these areas, flagging the areas if appropriate, and securing all in-water equipment in a manner that will prevent the equipment from being dragged across the substrate.
10. Project construction must cease under unusual conditions, such as large tidal events and high surf conditions, except for efforts to avoid or minimize resource damage. Installation of the cable will occur in good, calm weather conditions and during daylight hours.
11. When a diver is involved in the action, the diver will do their best to avoid ESA-listed species. If an animal traverses within 164 feet, however, the diver will take into account his/her own personal safety. The diver will report the interaction.
12. If an ESA-listed species is adversely affected as a result of the project, all work must stop until coordination with the Corps and NMFS has been completed.
13. Reporting
 - a. Observer logs. All non-take interactions with listed species (e.g., a species entering the shut-down zone and work is shut down correctly) must be documented and reported to the Corps and NMFS in monitoring logs.
 - i. Monitoring logs shall be completed daily. If no ESA-listed species are observed, the observer will record "0" in the daily report.
 - ii. The monitoring logs will be submitted in a digital and queryable to the NMFS reporting contact(s) in the Permit.
 - total hours and dates of monitoring
 - identification of which ESA species were observed and in what location and circumstances, including date, number of individuals of species observed, the outcome of the species observance relative to the authorized project, and any factors which may have affected visibility
 - if applicable, observed ESA species behaviors and movement types relative to the project activity at the time of observation.
 - iii. All monitoring logs must be submitted to the NMFS within 90 days of the completion of the project. The Corps will provide final reports to NMFS as part of the annual report. The final report will be comprised of summaries of monitoring efforts.
14. An erosion control plan for the project site and adjacent areas must be prepared and carried out. Erosion controls must be installed appropriately before any alteration of the project area may take place.
15. A pollution control plan for the project site and adjacent areas must be prepared and implemented. At a minimum, this plan shall include:
 - a. Proper installation and maintenance of equipment diapers or drip pans.
 - b. A contingency plan to control and clean spilled petroleum products, hydraulic leaks, and other toxic materials.

- c. Appropriate materials to contain and clean potential spills will be stored at the work site and be readily available.
 - d. All project-related materials and equipment placed in the water will be free of pollutants. All project-related materials and equipment placed in the water will be free of pollutants. Equipment will be inspected prior to beginning work each day to ensure the equipment is in good working condition, free of pollutants and there are no contaminant (e.g., oil, fuel) leaks. Work will be stopped until leaks are repaired, and equipment is cleaned. Equipment will be stored in an appropriate staging area designed to be preventative in terms of containing unexpected spills when equipment is not in use or during fueling.
 - e. Fueling of land-based vehicles and equipment shall take place at least 50 feet away from the water, preferably over an impervious surface.
 - f. All construction discharge water (e.g., concrete washout, pumping for work area isolation, vehicle wash water, drilling fluids) must be treated before discharge.
 - g. Debris and other wastes will be prevented from entering or remaining in the marine environment during the project.
16. Temporary access roads and drilling pads must avoid steep slopes where grade, soil types, or other features suggest a likelihood of excessive erosion or failure; existing access routes must be utilized or improved whenever possible, in lieu of construction of new access routes.
 17. All disturbed areas must be immediately stabilized following cessation of activities for any break in work longer than 4 days.
 18. Before any equipment, anchor(s), or material enters the water, a responsible party, i.e., permittee/site manager/project supervisor, shall verify that no ESA-listed marine animals are in the area where the equipment, anchor(s), or materials are expected to contact the substrate. If practicable, the use of divers to visually confirm that the area is clear is preferred.
 19. All objects lowered to the bottom shall be lowered in a controlled manner. This can be achieved using buoyancy controls such as lift bags, or the use of cranes, winches, or other equipment that affect positive control over the rate of descent.
 20. Temporary in-water tethers, such as mooring lines for vessels and marker buoys, shall be kept taut to the minimum length necessary and shall remain deployed only as long as needed to properly accomplish the required task.
 21. Mooring systems shall employ the minimum line length necessary to account for expected fluctuations in water depth due to tides and waves.
 22. Mooring systems shall be designed to keep the line as tight as possible, intending to eliminate the potential for loops to form.
 23. Mooring lines shall consist of a single line connected to the buoy float. No additional lines or material capable of entangling marine life may be attached to the mooring line or to any other part of the deployed system.
 24. Mooring systems shall be designed to keep the gear off the bottom, using a mid-line float when appropriate.

25. Mooring systems, including those used for temporary markers, scientific sensor buoys, or vessel moorings, shall be removed entirely from the marine environment immediately at the completion of the authorized work or the end of the mooring's service life. The only exceptions to this rule shall be mooring anchors such as eyebolts that are epoxied into the substrate and which pose little or no risk to marine life.
26. When piloting vessels, vessel operators shall alter course to remain at least 328 feet from whales, and at least 164 feet from other ESA-listed marine animals.
27. Reduce vessel speed to 10 knots or less when piloting vessels near ESA-listed marine mammals, sharks, and rays.
28. Reduce vessel speed to 5 knots or less when piloting vessels in areas of known or suspected sea turtle activity.
29. If, despite efforts to maintain the distances and speeds described above, a marine mammal or turtle approaches the vessel, the vessel operator will put the engine in neutral until the animal is at least 50 feet away, and then slowly move away to the prescribed distance.
30. Marine mammals, sea turtles, and other ESA-listed motile species shall not be encircled or trapped between multiple vessels or between vessels and the shore.
31. The Corps and NMFS will be notified within 48 hours of a vessel grounding or abandonment during the proposed action.
32. Utility line placement location and method must be designed to avoid to the greatest extent practicable, impacts to live corals, submerged aquatic or marine vegetation and other benthic organisms, and wetlands.
33. Familiarize divers, dive support, and vessel crew with underwater terrain features including shallow areas where there is a potential for vessel hull, propellers and divers to be in contact with the shallow reef areas such as near the trench walls.
34. Develop and implement a dive work plan detailing procedures for no-anchor zones, diver ingress/egress, deployment and recovery of pipe, tools, and equipment; and handling and use of gear, tools, and equipment underwater to avoid or minimize damage to existing corals.
35. Require divers to avoid contact with corals by maintaining neutral buoyancy and proper positioning and placement of fins whilst underwater. Hand tools used during the installation process should be in personal tool bags and not placed on top corals. This will also minimize re-suspension of sediments that can lead to potential smothering of corals.
36. If saddle clamps are used to secure the cable, these will be installed where minimal or no corals occur.
37. Cable will be laid to avoid coral wherever feasible, particularly in the patch reef where coral density is low.
38. Familiarize divers and dive support with seabed features, including generic coral characteristics (i.e., branching and encrusting), which are likely to be encountered during cable installation.
39. Familiarize divers and dive support crew with the location of the ESA-listed *A. globiceps* coral colony.

40. Mark the location of the *A. globiceps* colony and establish a 3-foot no-go zone for the duration of cable installation. Cable will be installed a minimum of 3 feet beyond *A. globiceps*, and further if feasible.
41. When working within 10 feet of the *A. globiceps* colony, require divers to avoid contact by establishing the work area on the opposite side of the cable alignment and placing tools, materials, and equipment away from the no-go zone (3-foot buffer).
42. While working within the section of alignment, monitor (visual inspection) the *A. globiceps* coral before, mid-day, and after construction activities within 10 feet of the coral.
43. If needed, the choice of marine epoxy will be assessed based on the product safety data sheet (SDS). Marine epoxy with lower category of hazard to the environment (i.e., reef-safe) will be specified. Prior to use, the SDS of the selected epoxy will be provided to NMFS for review and approval. More than one epoxy type and SDS may be provided for consideration. If a low hazard epoxy cannot be agreed to, the cable installer will instead use single expansion anchors to secure the rods.
44. A Category 3 Aquatic Toxicity epoxy will be mixed in small, manageable batches to reduce risk of spills. Once mixed, the epoxy is in a putty form. If excess epoxy escapes the clamp hole during installation it will be immediately captured, placed in a pouch, and removed from the aquatic environment when the diver returns to the surface.
45. Green sea turtles (*Chelonia mydas*) may occur on or near beaches at the project site. Proposed green sea turtle critical habitat occurs within the Action Area at Lasarino Beach. If construction is scheduled to occur during green sea turtle (*Chelonia mydas*) nesting season between April and August in or near proposed green sea turtle critical habitat, beach surveys will be conducted by a qualified biologist to document if any turtle nesting activity has occurred. If any nesting is documented the site will be avoided until the turtles have hatched and left the nest. All project related activity will stay at least 164 feet (50 meters) from any active nest.
46. Prior to start of construction each day, a qualified biologist will conduct a visual survey of the project site to ensure no basking sea turtles are present. If a basking or swimming sea turtle is found within the project area, cease all mechanical or construction activities within 164 feet (50 meters) until the animal voluntarily leaves the area. Cease all activities between the basking turtle and the ocean.
47. Remove any project-related debris, trash, or equipment from the beach or dune if not actively being used.
48. Do not stockpile project-related materials in the intertidal zone, reef flats, sandy beach and adjacent vegetated areas, or stream channels.

Terrestrial Species

1. Prior to the start of construction, the Contractor will implement an education program for all site workers to ensure that construction personnel are informed of the biological resources in the project area, including Tinian and federally protected species, invasive species, special-status species, avoidance measures, and reporting requirements. The measure is intended to

prevent inadvertent effects to terrestrial biological resources due to lack of awareness of resource presence, habitat requirements, and protective measures. All workers will be given a presentation on how to identify the tree snails, megapodes, sea turtles, and bats and instructed to notify the construction management team if sighted at or near the site. New workers will undergo an abbreviated awareness orientation as they come onto the job site.

2. The Contractor will ensure that all construction activities will occur within the limits of construction shown in the plans and specifications. This measure is intended to prevent unanticipated habitat loss and adverse effects to protected species. Any excursions outside the limits of construction will be reported to the prime contractor.
3. All equipment will be inspected prior to beginning work each day to ensure the equipment is in good working condition, and there is no contaminant (oil, fuel, etc.) leaks or invasive species. All equipment found to be leaking contaminants must be removed from service until repaired.
4. Fueling of project-related vehicles and equipment will occur at least 50 feet (15 m) away from the water and within a containment area, preferably over an impervious surface. All fuel spilled will be cleaned immediately.
5. The contractor will develop and implement an approved stormwater pollution prevention plan approved by CNMI and have spill clean-up kits on site during construction.
6. The contractor will scan for presence of protected species prior to construction work at the start of each day and record presence/absence. The contractor will delay the start of construction until the species has left the area under their own volition.
7. Construction will stop if a protected species is observed within 492 feet (150 meters) of the project area until the species has voluntarily left the area.

4. Status of Species and Critical Habitat in the Action Area

4.1. Marine Species

4.1.1. Marine Mammals

Five mammals listed as potentially occurring within the Mariana Islands are protected under the ESA by NOAA: blue whale (*Balaenoptera musculus*), fin (or finback) whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), sei whale (*Balaenoptera borealis*), and sperm whale (*Physeter macrocephalus*). All five whales have been classified as endangered under the ESA since the Act was passed in 1973 (USFWS 2023). As described below, a few whale species have been observed in the Mariana Islands, but several are particularly rare based on extensive surveys between 10°-18° N around the Mariana Islands in January to April 2007 (Fulling et al. 2011).

In the North Pacific, the blue whale ranges from Kamchatka to southern Japan in the west, and from the Gulf of Alaska and California to at least Costa Rica in the east; whales have been sporadically reported within several hundred kilometers of the Hawaiian Islands. The blue whale is considered rare in the waters of the Mariana Islands; no whales were observed during extensive surveys in these waters in 2007 (Fulling et al. 2011).

The fin whale is a cosmopolitan species (a species whose range extends across most of the world within its appropriate habitats) that has a generally anti-tropical distribution centered in the temperate zones. This species is considered rare in the Mariana Islands; no fin whales were observed during extensive surveys in these waters in 2007, however they have been identified during acoustic surveys on occasion (Fulling et al. 2011, DON 2019).

The humpback whale was the second most common whale sighted during the 2007 surveys in the Mariana Islands. Subsequent sightings of cow-calf pairs suggest that breeding occurs in the CNMI and that the Mariana Islands are a breeding ground for western North Pacific humpback whales (Fulling et al. 2011).

The sei whale is a highly mobile and cosmopolitan species, but tends to avoid polar and tropical waters, preferring temperate and subtropical zones. A total of 16 sei whale sightings were documented during surveys around the Mariana Islands in 2007 (Fulling et al. 2011).

Sperm whales were the most frequently sighted species during the surveys around the Mariana Islands in 2007. The observations ranged from individuals to a mixed sighting of 25 sperm whales (including calves) near the surface south of Guam (Fulling et al. 2011).

4.1.2. Reptiles- Sea Turtles

Sea turtles that are more likely to be encountered in the nearshore environment (green and hawksbill sea turtles) are described in detail in Section 4.1.2.1 and 4.1.2.2 and the other three species are described in Section 4.1.2.3.

4.1.2.1. Green Sea Turtle (*Chelonia mydas*) Status and Description

Regulatory Status

The green sea turtle has a circumglobal distribution in mainly tropical and subtropical waters. The green sea turtle was listed as threatened in 1978 (USFWS 2016). In 2015, NMFS conducted a status review of the global population of green sea turtles and grouped the species into 11 distinct population segments (DPS) based on genetic, ecological and behavioral factors. In 2016, USFWS reclassified the 11 green sea turtle DPS, with 8 reclassified as endangered and 3 as threatened (USFWS 2016). The Central West DPS that encompasses Guam, CNMI, Palau, Yap, and Marshall Islands, was reclassified from threatened to endangered (USFWS 2016). This reclassification supersedes the 1978 listing. A Recovery Plan for the green sea turtle was completed in 1998 (NMFS and USFWS 1998a). In July 2023, NOAA proposed critical habitat for the green sea turtle including all marine waters around Tinian to a depth of 20 meters, which includes the project area (NOAA 2023b).

Environmental Baseline

Green sea turtles spend most of their time foraging in coastal waters feeding mainly on sea grasses and algae, but their food source is dependent on what is found regionally (Seminoff et al. 2015). The limited time green sea turtles spend on land includes nesting and basking (NMFS and USFWS 1998a). Hatchlings and juveniles are mainly carnivorous and feed on invertebrates and fish eggs in the pelagic zone (NMFS and USFWS 1998a). Green sea turtles nest and bask on sand beaches with natural sand dunes and coastal vegetation without artificial lighting and that are safe from humans and non-native predators (Seminoff et al. 2015).

Green sea turtles (*Chelonia mydas*) utilize beaches on the islands of Tinian for nesting, with peak nesting activity occurring from March to August. However, nesting may occur year-round across the Mariana Islands (Martin et al. 2016). A typical green sea turtle nesting period lasts about 14 days, during which females may lay between four and ten clutches of eggs. On average, each clutch contains approximately 100 eggs, with a hatching timeline of 60 days (National Marine Fisheries Service and U.S. Fish and Wildlife Service 1998a).

Successful nesting requires specific beach characteristics, including a gently sloping sandy profile with appropriate sand compaction to facilitate nest excavation and egg incubation. Stable dune systems with native vegetation, such as grasses and shrubs, are important for dune integrity and nest protection.

Lasarino Beach has had historical green sea turtle nesting observations reported in 2009, 2013, and 2024 although surveys have been intermittent (C. Demapan, personal communication, December 17, 2024). Figure 4 shows the location of past green sea turtle nesting locations at Lasarino Beach. Two green sea turtles were observed in the water during the benthic and coral surveys at the site in April (Appendix B)

Threats

Primary threats to green sea turtles include illegal hunting, nest predation, increased human presence, construction along coastal habitats, and habitat degradation. The destruction of coastal habitat and foraging habitat degradation is mainly due to an increase in tourism (NMFS and USFWS 1998a). Tourism has fueled development of coastal habitat that has led to direct disruption of nesting locations and created more sedimentation that damages coral reefs used as foraging areas for green sea turtles. Illegal hunting of green sea turtles by residents for traditional purposes still occurs. Additional illegal take of green sea turtles is from bycatch of fishing crews and immigrants not aware of federal law prohibiting the take of green sea turtles (NMFS and USFWS 1998a).

4.1.2.2. Hawksbill Sea Turtle (*Eretmochelys imbricata*) Status and Description

Regulatory Status

Hawksbill sea turtles (*E. imbricata*) were listed as endangered under the precursor of the ESA in 1970 (NMFS and USFWS 2013). The listing of hawksbill sea turtles as endangered extends to independent states (Federated States of Micronesia, Republic of the Marshall Islands, Palau). The recovery plan for U.S. Pacific populations of the hawksbill turtle was established in 1998 (NMFS and USFWS 1998b). The historic records for hawksbill turtles in the U.S. Pacific population are minimal but observers note that the number of individuals are far fewer than in the past (NMFS and USFWS 1998b). Hawksbill sea turtles are globally protected under the International Union for the Conservation of Nature Red Data Book (NMFS and USFWS 1998b).

Environmental Baseline

Hawksbill sea turtles are found throughout the tropics in the Pacific, Atlantic, and Indian Oceans within the latitudes of 30°N to 30°S. The nesting of the hawksbill sea turtle tends to be in more remote areas and low in numbers throughout the Central Pacific. Hawksbill sea turtles nest in remote and rocky beaches in the near-shore vegetation (NMFS and USFWS 1998b).

There were estimated to be less than 10 nesting females in the Mariana Archipelago of Guam and the CNMI (NMFS and USFWS 2013). Based on a green sea turtle study in the Pacific from 2006-2014, approximately 6% of the 642 sea turtle captures were hawksbill sea turtles. No hawksbill nesting was observed around CNMI during the study period (Dutton et al. 2014).

Threats

The following threats to the species contributed to its regulatory protection and continue to be factors that limit recovery of the species. Overhunting on remote beaches for meat consumption, use of shell for trade, and the use of high-tech fishing gear are the main threats to hawksbill sea turtles (NMFS and USFWS 1998b). The traditional harvesting of hawksbill sea turtles for food is also a threat in the Marianas Islands (NMFS and USFWS 2013).

4.1.2.3. Other Turtle Species

The leatherback sea turtle (*Dermochelys coriacea*) was listed as endangered in 1973 throughout its range. In January of 1998 a recovery plan was published for the Pacific populations of the leatherback sea turtle. In 2012, critical habitat was established for Pacific leatherback sea turtles along the West Coast of the U.S. No critical habitat was designated in the Western Pacific (NOAA 2021). Leatherback turtles are rarely observed in the waters in the Marianas Islands. Aerial sea turtle surveys recorded 2.6% of the total observations around Guam as leatherback turtles (GDAWR 2006). This species is uncommon in the Mariana Islands region, and nesting is not known in the CNMI, but individuals are sometimes encountered in deep water near prominent archipelagoes (USFWS 2023).

The loggerhead sea turtle (*Caretta caretta*) was listed as threatened in 1978 throughout its range. In 2011, the species was split into nine distinct population segments with the North Pacific DPS, which includes the Mariana Islands, listed as endangered. The species breeds around Japan and the South China Sea, with no reports of breeding and infrequent sightings offshore of the Mariana Islands (USFWS 2023, DON 2022).

The olive ridley sea turtle (*Lepidochelys olivacea*) was listed in 1978 as endangered for breeding populations along the Mexican coast and as threatened elsewhere. The species is not known to breed in the Mariana Islands and is rare in the central Pacific. Observations within the U.S. EEZ have been limited to Hawaii and the west coast of the continental U.S (USFWS 2023).

4.1.3. Fish

The Indo-West Pacific DPS of the scalloped hammerhead shark was listed as threatened in July 2014 along with three other DPS populations. Critical habitat has not been designated since no marine areas within the Indo-West Pacific DPS meets the definition for critical habitat. A recovery plan has not been prepared. Scalloped hammerhead sharks are rare visitors to the waters of Guam with few sightings (mostly unconfirmed) in the past few decades. However, there are no records of scalloped hammerhead sharks sighted or caught around Tinian (DON 2022).

The giant manta ray (*Manta birostris*) was listed as threatened in 2018 and is a pelagic (open sea), migratory and solitary species that commonly occurs on offshore reefs, sea mounts, pinnacles and oceanic islands, and locations in close proximity to deep water, such as outer atoll edges near drop-offs (USFWS 2023). There have only been unconfirmed sightings near Guam and none in the CNMI as documented in the Joint Region Marianas Integrated Natural Resource Management Plan (DON 2022).

The oceanic whitetip shark (*Carcharhinus longimanus*) was also listed as threatened in 2018 and is a pelagic species, generally remaining offshore in the open ocean or around oceanic islands in water depths greater than 600 feet (183 meters, NOAA 2018). The oceanic whitetip shark will make short dives to the mesopelagic and bathypelagic zones; however, over 99% of the time is spent shallower than 200 meters (Howey-Jordan et al., 2013). Although identified as a target species in the shark trade and as incidental bycatch for fisheries in the western Pacific, there were no observations reported in the Mariana Islands in the literature reviewed.

4.1.4. Invertebrates- Coral (*Acropora globiceps*)

Regulatory Status

A. globiceps was one of 20 coral species NOAA listed as threatened under the ESA in 2014. Fifteen of the species occur in the Indo-Pacific region, and four were originally identified as occurring on Guam (DON 2022). A 5-year review was announced by NOAA on 7 January 2021 but has not been published yet (NOAA 2024c). A critical habitat rule was proposed in 2020 for seven Indo-Pacific species including *A. globiceps* and, based on public comment and new information, the rule was revised, and a new critical habitat rule was proposed for five coral species in November 2023 (NOAA 2023a). Based on a review of new information regarding species occurrence on Guam and the CNMI, the revised critical habitat rule found that only *A. globiceps* was reasonably certain to occur in the CNMI (NOAA 2023a).

Environmental Baseline

A. globiceps usually occurs on shallow upper reef slopes and occasionally in reef flats, pools, or lagoons at depths to 12 meters. *A. globiceps* is particularly sensitive to sedimentation and poor water quality and is not found in areas with poor water quality (NOAA 2023a).

A. globiceps has been commonly observed during surveys of the reefs around Tinian (DON 2022). The initial benthic and coral survey at Lasarino Beach identified 46 colonies of *A. globiceps*, resulting in a second survey to develop a route through the reef that would minimize their occurrence (Burdick 2025). The second survey observed 12 colonies along the proposed cable route that avoids them to the extent practicable (Benavente 2025, Appendix B).

Critical habitat for *A. globiceps* has been proposed for the reef at Lasarino Beach for depths between 0 and 12m (0 to 39 feet; NOAA 2023a).

Threats

Global threats include warming ocean temperatures and ocean acidification, and local threats include low resilience to disturbance (including storms, bleaching events, recreational activities), sensitivity to sedimentation, and pollution (NOAA 2023a).

4.2. Terrestrial Species

Green and hawksbill sea turtles are described under the Marine Species section 4.1.2.

4.2.1. Mariana Fruit Bat (*Pteropus mariannus mariannus*) Status and Description

Regulatory Status

The Mariana fruit bat was listed as endangered on Guam on August 1984 (49 FR 33881). On January 6, 2005, USFWS down-listed the Mariana fruit bat from endangered to threatened on Guam and as threatened throughout its range, including the CNMI. This was based on research indicating that *Pteropus mariannus mariannus* is not a subspecies endemic only to Guam and that the Guam population is part of a subspecies including bats on other islands that interact with

each other (USFWS 2005). The subspecies is endemic to the Mariana Islands archipelago. A Draft Revised Recovery Plan was completed for the Mariana fruit bat in 2009 (USFWS 2009).

Environmental Baseline

Physical and biological features preferred by the Mariana fruit bat include plant species used for foraging, remote locations within 100 meters of cliff lines, and mature trees used for roosting. Bat populations on Tinian and Saipan have declined over the last century due to loss of habitat due to agriculture, military infrastructure, and warfare. Bats are only occasionally seen on Tinian and there are no known permanent colonies. Since the 1990's there have only been a handful of observations on Tinian despite surveys conducted periodically (DON 2022).

Threats

Primary threats to the Mariana fruit bat are illegal hunting, habitat loss and degradation by human and ungulate disturbances, and fragmented populations. Populations are not expected to recover until habitat loss, illegal hunting, ungulate populations, and brown tree snake populations are reduced. Small, fragmented populations are also vulnerable to stochastic events such as typhoons and volcanic eruptions (USFWS 2017).

4.2.2. Micronesian Megapode (*Megapodius laperouse*) Status and Description

Regulatory Status

The Micronesian megapode (*Megapodius laperouse*) was listed as endangered on June 2, 1970 (35 FR 8491). A recovery plan was prepared and finalized on April 10, 1998 (USFWS 1998). Five-year reviews were conducted in 2010, 2016, and 2020 and recommended no change in status of the species from endangered since it remains in danger of extinction throughout its range (USFWS 2020).

Environmental Baseline

Megapodes have been recorded in upland cliff line forest in areas that are least disturbed by storms and anthropogenic forces; however, sightings are not common on Tinian. Occasional surveys from 1970 to 2000 detected 7 megapodes, and ongoing transect and playback surveys from 1999 to 2014 detected 1 to 2 megapodes every few years. Most sightings were on the military portion (northern) portion of the island, where most of the surveys were conducted (DON 2022). The five-year reviews estimated less than 10 megapodes on Tinian based on a 2008 study (USFWS 2020).

Threats

Threats to the species on Tinian include habitat loss and degradation, overgrazing by feral ungulates, predation by introduced species (rats, feral dogs and cats, and monitor lizards), human disturbance (possibly including poaching), stochastic events (tropical storms/typhoons and drought), and climate change (USFWS 2020).

4.3. Critical Habitat

Marine

There is currently no critical habitat designated in the Mariana Islands for marine species. On November 29, 2023, a rule was proposed to designate critical habitat for seven threatened corals that occur in the Indo-Pacific in U.S. jurisdictions, including Guam and the CNMI, pursuant to Section 4 of the ESA (88 Federal Register 83644). The critical habitat designation would protect *A. globiceps* habitat that occurs in the Mariana Islands, including Lasarino Beach, to a depth of 12 meters.

In July 2023, NOAA proposed critical habitat for the green sea turtle including all waters around Guam and CNMI, including Lasarino Beach, to a depth of 20 meters. The proposed listing included Department of Defense submerged lands (NOAA 2023b, 88 FR 46572).

Terrestrial

There is currently no critical habitat designated on Tinian for terrestrial species. Proposed rules designating critical habitat for the green sea turtle, including the Central West DPS, were published on July 19, 2023 by the USFWS (88 FR 46376). The proposed USFWS critical habitat for the green sea turtle on Tinian occurs within the Action Area at Lasarino Beach. The designated critical habitat includes beach and sandy shoals from the Mean High Water Line to the line indicating the beginning of dense vegetation, cliff, or hardened or developed structures.

5. Effects of the Action and Cumulative Effects

This section analyzes the potential effects on threatened and endangered species from the implementation of the Proposed Action. As they relate to the species considered in this Biological Assessment, consequences of the Proposed Action have been evaluated based upon activities that are reasonably certain to occur. A conclusion of reasonably certain to occur is based on clear and substantial information, using the best scientific and commercial data available.

5.1.1. Marine Species

Installation of the Marine Bulkhead and Conduit (Nearshore Species)

The reef flat will be contained between the beach and the marine bulkhead following a path that avoids coral colonies to the extent practicable (Table 3). The marine bulkhead location will be excavated to a depth of 3 to 4 feet below the surface of the reef. A trench will be excavated through the reef between the marine bulkhead and the beach to install the four conduits. The trench will be filled in and covered with concrete. Construction of the marine bulkhead and conduits is expected to take several months.

Stressors from the marine bulkhead installation include:

- Localized disturbance of aquatic habitats in and near the containment area
 - Coral and back reef where the installation will occur
 - Reef impacts at the installation site
- Localized and temporary increases in activity, noise, and disturbance at the installation site, particularly in the nearshore environment between the marine bulkhead and the shore
- Underwater noise
 - Tools and machinery used to excavate
 - Boat engines (if used)
 - Pumps, if used, to dewater the containment site
- Potential sediment, turbidity, or pollution from construction

Table 3. Installation Summary- Nearshore

Activity	Location	Length (feet)	Width (feet)	Total Area (square feet)	Total Area (Acres)
Buried pre-cast marine bulkhead	Reef Flat	10	4.0	40	0.001
Access corridor/buried conduit	Reef Flat	360	20	7,200	0.165
Prepare path for articulated pipe (4 cables)	Fore Reef	630 feet x 4	1.0	2,520	0.058

Placement of articulated pipe (2 cables)	Patch Reef	520 feet x 2 cables	0.5 feet	520	0.012
Total				10,280	0.236

Subsea Cable Installation (Pelagic Species)

The areas of disturbance and lengths of each type of cable to be installed within jurisdictional waters are summarized in Table 4. In addition to the cable lengths described below, there may be temporary disturbances at the underwater end of the bulkhead where the cable will be attached to the messenger wire and pulled landward to the beach manhole through the marine bulkhead conduit.

Table 4. Installation Summary – Pelagic

Activity	Location	Length (miles)	Width (inch)	Acres	Nature/Duration of Activity
Install Proa Tinian Branch Cable ¹	Marine bulkhead to junction with Proa Japan-Guam trunk	53	1.1	0.59	Land cable/2 to 5 days
Install TPU Tinian Branch Cable ¹	Marine bulkhead to junction with TPU trunk	44	1.1	0.49	Land cable/2 to 5 days
Total	Total	97	1.1	1.08	

Notes:

¹ Cable type within each segment can vary within a segment and will include single or double armor.

Stressors from the cable installation include:

- Localized disturbance of aquatic habitats along the cable route
 - Direct and indirect impacts to coral where the articulated pipe, bulkhead, and conduit will be installed
 - Seafloor where the cable lands
- Localized and temporary increases in activity, noise, and disturbance at the cable installation site, particularly in the nearshore environment between the conduit and the end of the articulated pipe
- Underwater noise
 - Hand tools used to install articulated pipe clamps
 - Boat engines
- Use of low-toxicity adhesive to anchor the articulated pipe clamps, if needed.

5.1.2. Effects on Nearshore Species

5.1.2.1. Green Sea Turtle (*Chelonia mydas*) and Hawksbill Sea Turtle (*Eretmochelys imbricata*)

Potential stressors of the Proposed Action may include effects on sea turtles from temporary increases in noise, pollution, and activity on the reef and on the beach from installation of the marine bulkhead and conduit; from underwater activity during the installation of the cable and

articulated pipe; and from increased vessel traffic in the vicinity. Installation of the ocean ground beds will occur in the area away from the beach where green sea turtles nest, although noise and activity associated with the excavation could disturb sea turtle nesting efforts on the beach. Hawksbill sea turtles are not known to nest at this site. Prior to and during construction, the beach will be surveyed for sea turtle nesting activity and construction will stop if sea turtles are observed within 164 feet (50 meters) of the construction site. No construction will occur at dawn, dusk, or at night. Conservation measures for sea turtles are described in Section 3.

During the subsea cable installation, trained observers will survey before the start of each day and during activities. Work will stop if a turtle comes within 164 feet (50 meters) of the work site and will resume when the turtle has voluntarily left the area. Vessel collision measures will be followed. The cable installation to the marine bulkhead in the nearshore environment will only take a few days and minimal habitat will be disturbed. Noise from hand tools during underwater drilling to install the articulated pipe clamps will be less than typical outboard boat motors. Low-toxicity (reef safe) adhesive or expansion anchors without adhesive will be used to anchor the articulated pipe clamps. Each articulated pipe is 6 inches wide and 1,150 feet in length, resulting in approximately 0.07 acres of disturbance on the seafloor. Once the articulated pipe is installed, coral and plant life will start to colonize the pipe as was observed on the other cables in the region. Therefore, the Proposed Action **may affect, not likely to adversely affect** the green sea turtle and the hawksbill sea turtle.

5.1.2.2. Scalloped Hammerhead Shark (*Sphyrna lewini*)

Scalloped hammerhead sharks are rarely observed around CNMI. Stressors for the scalloped hammerhead shark include temporary increases in noise, underwater activity during the installation of the cable and articulated pipe, and vessel traffic. Conservation measures to control spills and sediment releases are described in Section 3 and include trained observers surveying before the start of each day and during nearshore activities. Work will stop if a scalloped hammerhead shark comes within 164 feet (50 meters) of the work site and will resume when the shark has voluntarily left the area. The speed of the cable-laying ship is slower than commercial ships, reducing the likelihood of vessel strikes during cable laying in the pelagic environment. Vessel collision measures will be followed. Due to the low probability of encountering a shark near Lasarino Beach during the short installation period and due to the improbability of a vessel strike during cable laying, potential impacts are discountable and insignificant. Therefore, the Proposed Action **may affect, not likely to adversely affect** the scalloped hammerhead shark.

5.1.2.3. Coral (*Acropora globiceps*)

A. globiceps typically occurs on the outer reef slope in areas with minimal sedimentation or pollution. Twelve *A. globiceps* colonies were documented within the 10-meter survey corridor between the marine bulkhead and the outer reef (Benevente 2025, Figure 4). During micro-routing it may be determined that some can be avoided and left in place. For any that remain, risk of injury and tissue damage can result from divers (i.e. physical contact from fins, hands and SCUBA equipment) and by tools, equipment and materials placed near the proposed alignment. Any colonies that cannot be avoided will be relocated following the coral transplant methods described in Section 4.3 of the Coral Mitigation Plan (NEC Corporation 2025, Appendix C).

The following measures will be followed in addition to the conservation measures described in Section 3:

- *A. globiceps* that cannot be avoided during routing will be relocated.
- Familiarize divers and dive support crew with the location of ESA-listed *A. globiceps* coral colonies within 10 feet of the cable corridor.
- Mark the location of *A. globiceps* colonies and establish a minimum 3-foot buffer for the duration of cable installation.
- When working within 10 feet of an *A. globiceps* colony, the divers will be required to avoid contact by establishing the work area on the opposite side of the cable alignment and placing tools, materials, and equipment beyond the 3-foot buffer.
- While working within 10 feet of an *A. globiceps* colony, monitor (visual inspection) the condition of the coral before, mid-day, and after construction activities.

For *A. globiceps* that can be avoided, the conservation measures would result in impacts that would be discountable and insignificant for the colonies occurring along the cable installation routes. For *A. globiceps* that would need to be relocated, adverse effects and incidental take could occur from the handling and transplanting process if they are damaged during the transplantation process or do not survive at their new location. Therefore, the Proposed Action **may affect, is likely to adversely affect** *A. globiceps*.

5.1.3. Effects on Pelagic Species

Of the five whale species listed by NOAA in the Mariana Islands, three species have been observed more frequently (humpback, sei, and sperm whales), and two species have been observed infrequently (blue whale, fin whale). During a four-month intensive survey of the Mariana Islands in 2007, the most frequently observed whale was the sperm whale with 25 individuals documented (Fulling et al. 2011).

Giant manta rays, oceanic whitetip sharks, and leatherback, loggerhead and olive ridley sea turtles may also occur in the waters around the Mariana Islands but have seldom been observed in the region and there have been no observations near shore (DON 2022).

The cable ship will slowly traverse the proposed route reeling out the cable, which is less than 1-inch wide for most of its length. Potential stressors from the cable installation include vessel strikes, noise, surface water disturbance, contaminant spills, and turbidity. Since the ship will be moving slowly during cable installation, generally less than 6 knots, vessel strikes, noise, and surface water disturbance will be minimal, especially when compared to commercial cargo ships. The cable ship will have a contingency plan and materials to contain any contaminant spills. There may be localized turbidity associated with disturbed sediment when the cable is laid on the ocean floor, depending on local conditions. The turbidity would be temporary, dispersed by benthic currents, and will occur at a depth greater than 1000 meters for most of the route.

Cable laying activities in the pelagic environment would be temporary, only lasting a few days during cable installation as the cable ship follows the proposed route reeling out the cable. In the pelagic environment, compliance with conservation measures would result in impacts that are

discountable and insignificant. Therefore, the Proposed Action **may affect, not likely to adversely affect** the blue whale, fin whale, humpback whale, sei whale, sperm whale, giant manta ray, oceanic whitetip shark, and the leatherback, loggerhead, and olive ridley sea turtle.

5.2. Terrestrial Species

Construction at the project site includes trenching and installation of the four ocean ground beds and grounding wires, connection to the beach manhole, and trenching and installation of the conduit from the beach manhole to the marine bulkhead on land and across Lasarino Beach. No construction will occur at dawn, dusk, or at night and no lights would be used. The construction footprint, including laydown areas, is expected to be about 0.8 acres (Figure 4). Once the components are installed, the land surface would be returned to original contours and reseeded with native seeds where appropriate. Most of the terrestrial project footprint is grassy, with the remaining area in shrubs, low trees, and vines, which is not considered high-quality habitat. Two mobile ESA protected species were considered; the Mariana fruit bat and the Micronesian megapode. Neither species are frequently observed on Tinian, and there are no records of either species at the project site. Sea turtles are considered in Section 5.1.2.1.

Potential stressors from construction of the ocean ground beds and conduit trench on terrestrial species include:

- Localized and temporary disturbance of terrestrial habitats in the construction footprint including
 - Noise and human activity from construction
 - Potential sediment, turbidity, or pollution from construction
 - Temporary loss of habitat at the construction site

Avoidance and minimization measures for both the Mariana fruit bat and Micronesian megapode include employee training, pre-construction surveys, and BMPs to control erosion and pollution. With the implementation of the measures listed in Section 3 and the low likelihood of either species using the proposed Action Areas, the Proposed Action **may affect, not likely to adversely affect** the Mariana fruit bat and the Micronesian megapode.

5.3. Critical Habitat

There is no currently designated critical habitat in the Action Area. However, critical habitat is proposed by NOAA for the green sea turtle including all marine waters around Tinian to a depth of 20 meters, which includes the nearshore project area (NOAA 2023b). The USFWS has proposed critical habitat on non-military beaches for the green sea turtle, including Lasarino Beach. In addition, critical habitat is proposed for corals including *A. globiceps* in the waters around Lasarino Beach.

Potential stressors from the cable installation were described in Section 5.1.1 and may include effects on sea turtles and habitat from temporary increases in noise, underwater activity during the installation of the cable and articulated pipe, vessel traffic, and adverse effects from chemical adhesives.

Conservation measures are described in Section 3. Trained observers will survey before the start of each day and during activities. Work will stop if a turtle comes within 164 feet (50 meters) of the work site and will resume when the turtle has voluntarily left the area. Vessel collision measures will be followed. The installation in the nearshore environment will only take a few days. Noise from hand tools during underwater drilling to install the articulated pipe clamps will be less than typical outboard boat motors. Low-toxicity (reef safe) adhesive or expansion anchors without adhesive will be used to anchor the articulated pipe clamps.

Potential long-term stressors include disturbance to reef structure and foraging habitat from marine bulkhead, cable, and articulated pipe installation across the reef. The April 2025 survey of the reef flat determined that it was a turf-dominated benthic habitat with moderate live coral presence and low sedimentation (Appendix A). Turf algae accounted for 60% of the total benthic cover with 15% coral, 14% non-calcifying substrates, and the remainder calcifying algae and macroalgae. Two green sea turtles were observed to be foraging in the nearshore reef habitat during the 2-day habitat surveys.

The area potentially affected by the project during installation would be approximately 10,280 square feet in the reef flat for construction of the marine bulkhead, access corridor, and articulated pipe pathways (Table 3). These areas would be disturbed for a period of several months during construction with habitat features slowly returning after construction had been completed.

Potential impacts to proposed critical green sea turtle habitat on Lasarino beach include temporary disturbance of the beach during installation of the conduits across the reef and the beach to the beach manhole. No night construction would occur. After construction is complete, the beach will be restored to its original contours. Long-term activity associated with the project at the site will be minimal, resulting in negligible impacts to physical and biological features on the beach.

The project will affect a small area of the physical and biological features of proposed green sea turtle critical habitat in the Action Area; however, the project includes measures to minimize and offset temporary and permanent impacts to coral and foraging habitat. The primary physical and biological features of proposed critical habitat in the Action Area will not be altered or destroyed to the extent that the survival and recovery of the federally listed green sea turtle would be appreciably reduced.

As described in the coral mitigation plan (Appendix C), the articulated pipe pathways will be placed to avoid *A. globiceps* where feasible and corals impacted by the installation would be relocated and mitigated to offset impacts. An area of up to 2,520 square feet where *A. globiceps* typically occur on the reef would be impacted by the creation of the four 1-foot-wide articulated pipe pathways through the reef (Table 3, Figure 4). Since the area is small relative to the overall habitat available at this site and around the Pacific, the amount of proposed critical habitat in the Action Area altered or destroyed would not appreciably reduce the survival and recovery of the federally listed *A. globiceps*.

5.4. Cumulative Effects

Cumulative effects include the effects of future territorial, local, or private actions that are reasonably certain to occur in the Action Area considered in this report.

Other known actions that are reasonably certain to occur in the vicinity of the Action Area include installation of other cables at the site, connected through the conduit and beach manhole in a similar fashion. The process would be almost identical to this project and would use the two conduits unused by this project. Long-term impacts are expected to be minimal as the cables are colonized by marine life similar to the older cables at other locations. There are limited number of conduits remaining for new cable installations, so the cumulative impact of more cable installations would be limited.

Future federal actions that are unrelated to the Proposed Action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA.

6. Conclusion and Determination of Effects

During marine coral surveys in April 2025 along the proposed cable route at Lasarino Beach, 12 colonies of *A. globiceps* were observed within the corridor for the proposed cable routes. Green sea turtles were observed in the back reef at Lasarino Beach during terrestrial surveys in January 2025 and during marine surveys in April 2025.

Hawksbill and green sea turtles may occur in the nearshore marine environment at Lasarino Beach during installation of the marine bulkhead, conduits, cables, and articulated pipe. With so few observations around CNMI, scalloped hammerhead sharks are unlikely to be present or affected by the proposed action. The leatherback, loggerhead, and olive ridley sea turtles, marine mammals, giant manta ray, and oceanic whitetip shark occur in very low densities around the Mariana Islands and are unlikely to be observed or affected by the slow-moving cable ship during installation in the pelagic environment.

No terrestrial threatened or endangered species were observed within the Action Area during surveys in January 2025. Protected plants and invertebrates such as the humped tree snail are not very mobile and are unlikely to occur in the Action Area prior to or during construction. Mariana fruit bats and the Micronesian megapode are rare on Tinian, but the species are mobile and could move into the area prior to or during construction. Seven days prior to the commencement of construction activities, a qualified biologist will survey the construction limits and adjacent areas with the potential for protected species to ensure that none are present and the conservation measures have been properly implemented. If any terrestrial protected species are observed within 492 feet (150 meters) of active project construction, work will stop until the species has left the area of their own accord.

The only federally listed species that may be adversely affected is the *A. globiceps* along the proposed cable route since some of the 12 colonies will need to be translocated to suitable locations nearby. Therefore, the project **may affect, likely to adversely affect** the translocated *A. globiceps*.

With the conservation measures described in Section 3 to avoid and minimize potential impacts to the federally protected species, potential effects from the project are discountable and unlikely to be significant enough to harm or harass the other protected species listed in Table 5. The Proposed Action **may affect, not likely to adversely affect** the other species listed in Table 5.

The project will affect some of the physical and biological features of proposed green sea turtle and coral critical habitat in the marine portion of the Action Area; however, the project includes measures to minimize and offset temporary and permanent impacts to coral and foraging habitat. Beach critical habitat for the green sea turtle will be temporarily impacted during the construction of the conduits and marine bulkhead, but would be restored upon completion of construction. There would be no long-term impacts or activity at the site to disrupt future green sea turtle nesting at Lasarino Beach. For *A. globiceps*, an area of up to 2,520 square feet of reef where the coral typically occurs on the reef would be impacted by the creation of the articulated

pipe pathways through the reef. Once the articulated pipe has been installed, the reef will slowly recover as seen with other subsea cables in the region.

The primary physical and biological features of proposed critical habitat in the Action Area will not be altered or destroyed to the extent that the survival and recovery of the federally listed green sea turtle and *A. globiceps* would be appreciably reduced.

Table 5. Summary of Determination of Effects

Common Name	Scientific Name	Status	Effects Determination
Marine Mammals			
Blue Whale	<i>Balaenoptera musculus</i>	Endangered	May affect, not likely to adversely affect
Fin Whale	<i>Balaenoptera physalus</i>	Endangered	May affect, not likely to adversely affect
Western North Pacific DPS Humpback Whale	<i>Megaptera novaeangliae</i>	Endangered	May affect, not likely to adversely affect
Sei Whale	<i>Balaenoptera borealis</i>	Endangered	May affect, not likely to adversely affect
Sperm Whale	<i>Physeter macrocephalus</i>	Endangered	May affect, not likely to adversely affect
Sea Turtles			
Central West Pacific DPS Green Turtle	<i>Chelonia mydas</i>	Endangered	May affect, not likely to adversely affect
Hawksbill Turtle	<i>Eretmochelys imbricata</i>	Endangered	May affect, not likely to adversely affect
Leatherback Turtle (Western Pacific)	<i>Dermochelys coriacea</i>	Endangered	May affect, not likely to adversely affect
North Pacific DPS Loggerhead Turtle	<i>Caretta caretta</i>	Endangered	May affect, not likely to adversely affect
Olive Ridley Turtle	<i>Lepidochelys olivacea</i>	Threatened	May affect, not likely to adversely affect
Fish			
Indo-West Pacific Scalloped Hammerhead Shark	<i>Sphyrna lewini</i>	Threatened	May affect, not likely to adversely affect
Giant Manta Ray	<i>Manta birostris</i>	Threatened	May affect, not likely to adversely affect
Oceanic Whitetip Shark	<i>Carcharhinus longimanus</i>	Threatened	May affect, not likely to adversely affect
Invertebrates			
Staghorn Coral	<i>Acropora globiceps</i>	Threatened	May affect, likely to adversely affect
Mammals			
Mariana Fruit Bat	<i>Pteropus mariannus mariannus</i>	Threatened	May affect, not likely to adversely affect
Birds			
Micronesian Megapode	<i>Megapodius laperouse</i>	Endangered	May affect, not likely to adversely affect

7. Essential Fish Habitat

The MSFCMA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), requires federal agencies to consult with NOAA Fisheries on activities that may adversely affect EFH.

The objective of this EFH Assessment is to determine whether or not the proposed action “may adversely affect” designated EFH for relevant commercially, federally managed fisheries species within the Action Area. It also describes conservation measures proposed to avoid, minimize, or otherwise offset potential adverse effects to designated EFH resulting from the Proposed Action.

7.1. Regulatory Status

Congress established the EFH mandate in 1996 to improve the nation’s main fisheries law, namely the MSFCMA to highlight the importance of healthy habitat for commercial and recreational fisheries (NOAA 2023c). In the CNMI, EFH is defined as the marine water column from the surface to the 1,000-meter depth from the shoreline to the outer boundary of the EEZ, and the seafloor from the shoreline out to a depth of 700 meters around the islands. This EFH designation includes the surrounding waters and submerged lands that support various life stages for the Management Unit Species (MUS) identified under the Western Pacific Regional Fishery Management Council (WPRFMC) *Fishery Ecosystem Plan for the Mariana Archipelago* (2009a). In addition to EFH, the WPRFMC identified Habitat Areas of Particular Concern (HAPC) within EFH for all Fishery Management Plans. HAPCs are specific areas within EFH that are essential to the life cycle of important coral reef species. The plan was amended in 2018 to remove the Mariana Island Coral Reef Ecosystem MUS (WPRFMC 2018).

MUS in the project area include Bottomfish and Pelagic (Table 4). The Bottomfish MUS is located within the water column that goes from the shoreline to the to a depth of 400 meters. Pelagic MUS designation around CNMI includes all life stages of shallow-water and deep-water complexes, which is the water column from shoreline to the outer limit of the EEZ to a depth of 1,000 meters (WPRFMC 2009b). The MUS and life stages found in these waters include eggs, larvae, juveniles, and adults of Bottomfish and Pelagic MUS. Specific types of habitats considered as EFH include coral reef, patch reefs, hard substrate, artificial substrate, seagrass beds, soft substrate, mangrove, lagoon, estuarine, surge zone, deep-slope terraces, and pelagic/open ocean (WPRFMC 2009a; 2009b).

Table 6. EFH and HAPC Designations

Management Unit	Species Complex	EFH	HAPC
Bottomfish and Seamount Groundfish	Shallow-water species (0-100 meters): thicklip trevally (<i>Pseudocaranx dentex</i>), lunartail grouper (<i>Variola louti</i>), ambon emperor (<i>Lethrinus amboinensis</i>), redgill emperor (<i>Lethrinus rubrioperculatus</i>), giant trevally (<i>Caranx ignobilis</i>), taape (<i>Lutjanus kamsira</i>)	Eggs and larvae: the water column extending from the shoreline to the outer limit of the EEZ down to a depth of 400 meters Juvenile/Adult: the water column and all bottom habitat extending from the shoreline to a depth of 400 meters	All slopes and escarpments between 40-280 meters

Management Unit	Species Complex	EFH	HAPC
	<p>Deep-water species (100-400 meters): ehu (<i>Etelis carbunculus</i>) onaga (<i>Etelis coruscans</i>), opakapaka (<i>Pristipomoides filamentosus</i>), yellowtail kalekale (<i>P. auricilla</i>), yelloweye opakapaka (<i>P. flavipinnis</i>), kalekale (<i>P. sieboldii</i>), gindai (<i>P. zonatus</i>), hapuupuu (<i>Epinephelus quernus</i>), lehi (<i>Aphareus rutilans</i>)</p> <p>Seamount groundfish species (100-400 meters): amorhead (<i>Pseudopentaceros richardsoni</i>), ratfish/butterfish (<i>Hyperglyphe japonica</i>), alfonsi (<i>Beryx splendens</i>)</p>	<p>Eggs and larvae: the water column extending from the shoreline to the outer limit of the EEZ down to a depth of 400 meters</p> <p>Juvenile/Adult: the water column and all bottom habitat extending from the shoreline to a depth of 400 meters</p> <p>No EFH in the Mariana Islands</p>	<p>All slopes and escarpments between 40-280 meters</p> <p>No HAPC designated for seamount groundfish</p>
Pelagic	<p>Temperate species: striped marlin (<i>Tetrapturus audax</i>), bluefin tuna (<i>Thunnus thynnus</i>), swordfish (<i>Xiphias gladius</i>), albacore (<i>Thunnus alalunga</i>), mackerel (<i>Scomber</i> spp.) bigeye (<i>Thunnus obesus</i>), pomfret (family Bramidae).</p> <p>Tropical species: yellowfin (<i>Thunnus albacares</i>), kawakawa (<i>Euthynnus affinis</i>), skipjack (<i>Kastuwonus pelamis</i>), frigate and bullet tunas (<i>Allothunnus fallai</i>), black marlin (<i>Makaira indica</i>), dogtooth tuna (<i>Gymnosarda unicolor</i>), spearfish (<i>Tetrapturus</i> spp.), sailfish (<i>Istiophorus platypterus</i>), mahimahi (<i>Coryphaena hippurus</i>, <i>C. equiselas</i>), ono (<i>Acanthocybium solandri</i>), opah (<i>Lampris</i> spp.). Sharks: pelagic thresher shark (<i>Alapias pelagicus</i>), bigeye thresher shark (<i>Alopias</i>), common thresher shark (<i>Alopias vulpinus</i>), silky shark (<i>Carcharhinus falciformis</i>), oceanic whitetip shark (<i>Carcharhinus longimanus</i>), blue shark (<i>Prioace glauca</i>), shortfin mako shark (<i>Isurus oxyrinchus</i>), longfin mako shark (<i>Isurus paucus</i>), salmon shark (<i>Lamna ditropis</i>); Squid: neon flying squid (<i>Ommastrephes bartamii</i>), diamondback squid (<i>Thysanoteuthis rhombus</i>), purple flying squid (<i>Sthenoteuthis oualaniensis</i>)</p>	<p>Eggs and larvae: the (epipelagic zone) water column down to a depth of 200 meters from the shoreline to the outer limit of the EEZ.</p> <p>Juvenile/adults: the water column down to a depth of 1,000 meters from the shoreline to the outer limit of the EEZ</p>	<p>The water column from the surface down to a depth of 1,000 meters above all seamounts and banks with summits shallower than 2,000 meters within the EEZ</p>

Notes:

EEZ = Exclusive Economic Zone

EFH = Essential Fish Habitat

HAPC = Habitat Areas of Particular Concern

7.2. Environmental Baseline

7.2.1. Background

A study in 2004 mapped the shallow-water benthic habitats around Tinian and Lasarino Beach (NOAA 2004). The atlas uses a classification scheme that includes the following elements in the vicinity of the landing:

1. Structure (examples: aggregate reef, pavement, rubble, spur and groove)
2. Zones (examples: back reef, fore reef, reef crest, bank/shelf)
3. Biological cover type (examples: coral, macroalgae, turf).

According to the study, the structure at the project site consists of rubble, pavement, spur and groove, and sand moving from the shore out through the reef. Zones at the site include reef flat, reef crest, fore reef, and bank/shelf. Biological cover consists of coralline algae (10% to 50%), coral (10% - 50%), and sand moving from the shore out through the reef (Figure 3). Coralline algae consists of at least 10 percent coverage of numerous species of encrusting or coralline algae.

The conduit trenches and marine bulkhead would be constructed in the rubble and pavement portion of the back reef that has 10% - 50% coralline algae cover. The articulated pipe would be placed through the pavement and spur portion of the reef with 10% - 50% coral cover. As the cable proceeds south and west, coral decreases and sand dominates the ocean floor.

7.2.2. Benthic Habitat Survey Results

Benthic habitat and coral surveys were conducted at the project site in February and April 2025. The report for the first survey described the reef as follows:

“The fringing reef system occurring in the nearshore waters off Lasarino Beach is characterized by an approximately 80 100 m-wide, shallow (<1.5 m, or 5 ft) reef flat platform and a seaward slope comprised primarily of aggregate reef that transitions to a gently inclined sandy slope. The shallowest (<10 m, or 33 ft depth) extent of the seaward slope is primarily comprised of moderate-to-high- relief aggregate reef bisected by surge channels. The moderately steep aggregate reef slope offshore of the central and southern portion of Lasarino Beach abruptly transitions to a more gently sloping, primarily sandy seafloor at a depth of 12 m (40 ft), while the aggregate reef slope offshore of the northern part of the beach transitions to a gently sloping mix of low-to-moderate relief hardbottom and sand to a depth of at least 40 m (130 ft). An analysis of 2020 lidar bathymetry data indicates the presence of an aggregation of variably-sized patch reefs (to ~100 m in longest dimension) near the center of the sandy flat between depths of approximately 18 m (60 ft) and 30 m (100 ft), as well as numerous smaller (< 15 m diameter), more isolated patch reefs scattered across much of the sand flat to a depth of at least 37 m (120 ft).” (Burdick 2025).

The April 2025 survey of the reef flat determined that it was a turf-dominated benthic habitat with moderate live coral presence and low sedimentation (Appendix A). Turf algae accounted for

60% of the total benthic cover with 15% coral, 14% non-calcifying substrates, and the remainder calcifying algae and macroalgae (Benevente 2025).

7.3. Essential Fish Habitat Conservation Measures

The conservation measures described in Section 3 for threatened and endangered species will be followed and will also protect species managed under the MSFCMA. The general conservation measures would be applied during cable installation in the near shore marine environment, and the vessel strike mitigations would apply during both cable installations in deeper pelagic environments between Tinian and where they join the main cable. The cable alignment will be adjusted as it is installed to avoid coral colonies to the extent feasible, which will be easier closer to the conduit where coral colonies are fewer. In areas of higher coral density, the cable will be placed to avoid branching corals where feasible. Where impacts to coral cannot be avoided, the coral impact minimization and mitigation plan described below and in Appendix C will be implemented.

1. Equipment, anchors, structures, or fill shall not be deployed in project areas containing live corals, seagrass beds, or visible benthic organisms. Perform pre-deployment reconnaissance (e.g., divers, drop cameras, etc.) to ensure these resources are avoided.
2. Minimize direct impact (direct or indirect contact causing damage) by divers and construction related tools, equipment, and materials with benthic organisms, regardless of size, especially corals and seagrass.
3. Prevent trash and debris from entering the marine environment during the project.
4. Maintain all structures, gear, instrumentation, mooring lines, and equipment to prevent failures.
5. Project operations must cease under unusual conditions, such as large tidal events, storms, and high surf conditions.
6. Conduct intertidal work at low and/or slack tide to the greatest extent feasible.
7. Conduct work during the dry season when possible; stop work during storms or heavy rains.
8. Prevent discharges into the water.
9. Prior to in-water work, sanitize equipment or dive gear that has been previously used in an area known to contain invasive species.
 - In-water tool and dive gear (e.g., wetsuit, mask, fins, snorkel, BC, regulator, weight belt, booties) shall be disinfected by one of the following ways: a 1:52 dilution of commercial bleach in freshwater, a 3 percent free chlorine solution, or a manufacturer's recommended disinfectant-strength dilution of a quaternary ammonium compound in "soft" (low concentration of calcium or magnesium ions) freshwater.
 - Small boats that have been deployed in the field will be cleaned and inspected daily for organic material, including any algal fragments or other organisms. Organic material, if found, will be physically removed and disposed of according to the ship's solid-waste disposal protocol or in approved secure holding systems. The internal and external

surfaces of vessels will be rinsed daily with freshwater and always rinsed and be allowed to dry before redeployment.

- The crew of the vessel should try to minimize the amount of detergents and other noxious substances that might be washed overboard as part of an effort to clean instruments or equipment used during the cruise or in day-to-day operation of the vessel.

7.4. Coral Impact Minimization and Mitigation Plan

Installation of the cable will intersect coral colonies. The route was modified to minimize impacts to corals based on two in-water surveys (Burdick 2025; Benevente 2025). Prior to construction, coral colonies located within the footprint of the marine bulkhead, conduit corridor, and articulated pipes will be relocated. Relocation is anticipated to be conducted in two phases. Coral relocation from the reef flat in support of the conduit and bulkhead would occur first, with coral removal in support of cable installation within the articulated pipes through the fore reef occurring later in the year. This minimization and mitigation plan is based on the report in Appendix C.

The relocation of branching colonies is feasible. However, removal of encrusting corals is unlikely to be successful. To minimize impacts to corals, relocation of branching corals will be implemented where the cable alignment cannot be adjusted to avoid the coral.

Phase 1 Reef Flat (Bulkhead and Conduit)

For coral relocation on the reef flat, priority is placed on removing and staging the coral for re-attachment along the same corridor after construction. However, coral mortality increases when coral is staged for an extended period of time. In addition, the corals on the reef are accustomed to a high-energy environment. Temporary staging typically occurs in a deeper, calmer environment. Together, these two stressors may increase mortality.

If extended coral staging cannot occur either due to marine conditions or length of construction, recovered coral colonies will be relocated to an adjacent area within the reef flat with similar depth and substrate characteristics as the original location.

Phase 2 Fore Reef (Articulated Pipe)

Ahead of the cable landing, coral will be relocated from four, 1-foot paths located along the fore reef and reef crest, to the bulkhead (Table 3). Corals removed from both the fore reef and reef crest will be relocated to areas along the fore reef with similar characteristics. It may not be suitable to relocate corals to other areas of the reef crest as it could be difficult to secure and monitor in this high energy area.

To mitigate direct impacts to encrusting corals that cannot be relocated, compensatory mitigation may take the form of stabilizing and enhancing coral colonies along the Tinian shoreline, removal of man-made debris within the marine environment, opportunistic removal of crown of thorns, or other methods agreed to in coordination with NFMS. During the marine surveys it was confirmed that there is little to no stabilization or enhancement opportunities at Lasarino Beach. However, westerly swells caused by a recent tropical disturbance in the CNMI have likely

caused fragmentation to colonies either within the vicinity of Lasarino Beach or Reef areas around Tachogna Beach (to the South). It is anticipated that the stabilization of fragmented “corals of opportunity” could be utilized for the mitigation. The mitigation is anticipated to be implemented during and immediately after installation of each phase of the project.

7.4.1. Pre- and Post-Construction Survey

A pre-construction survey will be prepared to document baseline conditions, identify relocation areas, and coordinate with the contractor to establish the final cable alignment with the goal of selecting the optimal route and reducing coral impacts. When a cable is laid adjustments in alignment are not uncommon. Therefore, to quantify the exact impact to coral from cable installation, a pre and post installation survey will be conducted to document coral habitat conditions, relocated coral, and unavoidable impacts to coral. The quantity of relocated coral and impacted coral requiring compensatory mitigation will be verified through this process.

The alignment will be laid out using markers connected by a tape or the 1-inch cable itself prior to installing the articulated pipe. Corals within a 3-inch distance from both sides of the line will be tagged and identified and measured for accounting of final impacts. The following information will be collected on each coral colony to be intersected by the cable:

- a. Coral colony species and identification number
- b. Morphology (i.e. encrusting, plate, tabular, columnar, domed / hemi-spherical, branching and digitate)
- c. Dimensions (i.e. length, width, height and/or circumference)
- d. Coral health and condition

For encrusting and plate coral types, the length and width of the area to be impacted will be measured. For impacted corals with columns (thickly branched), the length, width, and height will be noted. Dimensions for massive (domed), branching, and columnar types, the circumference will be taken.

Coral information will be presented in a tabular format (See Example Table 1 in Appendix C). Additional morphology or observations may be added as needed, depending on the site conditions.

The post-construction survey will include an inspection of the installed cable, articulated pipe, relocated coral, and stabilized coral one day after completion of site activities (i.e. construction, relocation, and stabilization). A Post-Construction Survey report will be prepared to provide post cable installation impact summary, quantifying actual impacts (See Example Tables 2, 3, and 4 in Appendix C). In addition, baseline conditions, coral relocated, coral stabilized or enhanced, and control sites to compare health will be documented, quantified, and mapped. The surveys will be conducted by divers with experience in working in biologically sensitive areas.

Each coral within the cable alignment will have been catalogued and identified for relocation, partial removal, or leave in place during the pre-construction survey. These will be verified during the post-construction survey and will comprise the final coral relocation (minimization efforts) and unavoidable coral impact requiring mitigation. It is envisaged that the Pre- and Post-

Construction Survey Report will present the following information for comparison and accounting:

- a. Corals within final alignment and 3-inch offset (from pre-construction survey) which will include photographs of each coral and estimates of area to be intercepted.
- b. Corals removed and relocated (from post-construction survey) which will include photographs of each coral with tags following removal and relocation to mitigation area.
- c. Impacted corals / unavoidable coral loss (from post construction survey) which will include photographs of each coral with tags following placement of the cable and armor.
- d. Control sites for comparison of relocated coral colony health during monitoring.

7.4.2. Removal and Relocation of Coral (Minimization)

The reef flat consists of approximately 15% coral cover. All coral will need to be relocated from the bulkhead footprint and conduit corridor. The reef margin consists of between 5% and 25% coral cover, depending on location. Priority in the reef margin will be placed on adjusting the articulated pipe to avoid corals, particularly within the less dense areas. Those that cannot be avoided will be removed and relocated. Following tagging, identification, and measurement, corals will be assessed if they can be relocated, either through removal of the intersected area (where possible) or relocation of the whole colony.

Small Corals (<12 inches)

For small corals (<12 inches) intersecting the cable alignment, removal of the whole colony will be considered. It is anticipated that small corals will be removed following marking of the alignment or after deployment of the cable and prior to installation of the articulated pipe.

Large Corals (>12 inches)

For large corals (>12 inches) intersecting the cable alignment, removal of the intersected area will be assessed based on its relative size to the whole coral. The following will be used to assess corals for removal:

- Intercepted areas up to 40% of the total area of the coral will be cut and removed from the coral colony. It is expected that the remaining part of the impacted coral (~60%) will be able to thrive based on relative size and establishment of the colony. These remaining sections of the cut corals will be included for coral monitoring in proposed subsequent surveys. The cut portion of the colony will be relocated to the mitigation area and treated the same as small corals (<12 inches).
- If the intercepted area of the coral is greater than 40%, full removal will be considered provided the coral is less than 20 inches in diameter and can be easily dislodged from the bottom.
- If the intercepted area of the coral cannot be easily dislodged or removed from the bottom, the colony will be left in place. This will be included for future coral survivorship monitoring in proposed subsequent surveys and factored into mitigation/offset requirements, if necessary.

Once identified for removal, colonies will be removed by chipping the living portion of the colony from the point of attachment or by removing a portion of the substrate along with the attached organism(s). Selected colonies will be removed using a hammer and masonry chisel, or

similar approach. As the coral is moved, the tags will remain with the coral colony for accounting and monitoring.

For coral relocation on the reef flat, priority is placed on removing and staging the coral for re-attachment along the same corridor after construction. However, coral mortality increases when coral is staged for an extended period of time. In addition, the corals on the reef are accustomed to a high-energy environment. Temporary staging typically occurs in a deeper, calmer environment. Together, these two stressors may increase mortality. If extended coral staging cannot occur either due to marine conditions or length of construction, recovered coral colonies will be relocated to either an adjacent area within the reef flat with similar depth and substrate characteristics as the original location, or elsewhere offshore of Tinian if there is not enough space at Lasarino Beach. Preliminary locations are currently under investigation.

For cable installation, it is anticipated the coral removal divers will coordinate with the installation divers to define the exact route and avoidance once the cable has been floated from the ship, with coral removal occurring ahead of installation of the articulated pipe. As many coral colonies as are suitable to do so, will be relocated to the reef flat to fill in gaps along the concrete capped conduit corridor.

The corals will be placed in perforated collection baskets then transported underwater to the relocation area. Coral colonies may be staged for a period of time offshore. Locations for relocation will have been pre-identified, tagged, and mapped during the pre-construction survey and reconnaissance.

Coral reattachment sites will be selected based on relative proximity, open substrate availability, and similarity to original attachment site, including water depth, substrate type, and presence of healthy corals. Coral colonies will be reattached with a spatial distribution that mimics the surrounding benthic habitat.

Reattachment surfaces will be prepared by removing any loose sediment and surficial biota. A concrete mixture will be used to reattach the coral. A sufficient amount of concrete will be placed directly on the pre-cleaned substrate, and organisms to be reattached will be pressed firmly into the mixture until stable and secure. Reattached specimens will be intermittently checked during reattachment operations to ensure their stability, address the aesthetic quality of the reattachment matrix, and dissipate cement residue that may have settled on adjacent biota. Each relocated coral will be numbered and tagged for reference during monitoring.

7.4.3. Stabilization and Enhancement of Coral (Mitigation)

To mitigate direct impacts to corals that cannot be relocated, compensatory mitigation will take the form of stabilizing coral rubble and enhancing coral colonies in the project vicinity. During the pre-construction survey, opportunities to stabilize or enhance coral colonies will be identified, tagged, and mapped. The following rubble stabilization and enhancement of corals will be considered.

To mitigate direct impacts to corals that cannot be relocated, compensatory mitigation may take the form of stabilizing and enhancing coral colonies along the Tinian shoreline, specifically areas impacted by recent weather disturbances in which large westerly swells will have likely fragmented or dislodged entire colonies along the reef flat and fore-reef (Barcinas Bay, Jones Beach, Tachogna Beach, Tinian Breakwater).

During the pre-construction survey, opportunities to stabilize or enhance coral colonies will be identified, tagged, and mapped in Lasarino Bay or will be identified elsewhere along Tinian in coordination with the local government. Stabilization will consider utilization of or a combination of the following (Ceccarelli *et al.*, 2020):

- Cement to bond unconsolidated substrates (applicable to large-sized rubble).
- Loose coral substrate that is large enough to be laid over a layer of smaller fragments. This involves smaller fragments laid over an approximate 4 square-foot area and overlain with large hard materials (i.e. coral substrate).
- Metal stakes providing stabilization over a layer of smaller loose coral rubble. If the rubble has stabilized by the last monitoring event (24 months) the stakes will be removed.
- Organic coir net / reef bags of up to 6 square feet providing substrate stabilization and habitat structure. Loose rubble will be placed inside the bags and secured on to the seabed.
- Detail of the stabilized rubble piles including distance and position relative to the cable, photograph, and coverage area will be recorded and factored into the final offset calculation.
- Corals of opportunity may also be identified for enhancement in place. Coral information (i.e. species, morphology, size, etc) will be recorded for corals of opportunity and will be factored into the final offset calculation. Corals of opportunity will be monitored for survivorship and included as part of the monitoring surveys.

The goal will be to identify larger, clustered areas to reduce the spatial footprint of the mitigation sites within the broader mitigation area, for ease of monitoring and future tracking.

Areas identified for stabilization and enhancement will be ranked and prioritized. Coral colonies and loose rubble that have been utilized as part of the mitigation (i.e. stabilization, enhancement, and opportunistic relocation out of the cable corridor) will be identified, assessed and monitored using the same information and parameters for impacted corals.

7.4.4. Debris Removal (Mitigation)

Areas for man-made debris removal immediately offshore of Tinian may be identified as part of the mitigation plan. In coordination with the local government, potential areas with undesirable marine debris will be identified and investigated. In July swells on the west side of Tinian were larger than normal, potentially resulting in debris being deposited in the nearshore waters of San Jose Village. Areas where removal will measurably lift the benthic environment will be prioritized. This could include removing toxic debris such as tires and plastic.

7.4.5. Opportunistic Removal of Crown of Thorns (Mitigation)

During the initial marine dive at Lasarino Beach, it was noted that coral predation by the crown-of-thorns sea star (COTS) appeared to have had a significant influence on the composition of the condition of the coral communities of the reef system particularly at depths greater than 33 feet. Though unlikely to occur due to timing constraints when mitigation would be needed, opportunist removal of COTS off the shore of Tinian is included in this mitigation plan, in the event the opportunity arises. If an outbreak were detected, they would either be physically removed from the ocean or injected with a lethal solution such as oxbile. The GHD Team is aware that the Navy has a response team that could potentially assist with eradication dives.

Actual impact and mitigation requirements will be calculated and confirmed during the post-construction survey. The total mitigation requirement will be based only on the sum of unavoidable coral loss, when a coral cannot be relocated (Equation 1).

7.4.6. Mitigation Ratios

Total offset mitigation planned will comprise the resulting credits for enhancement of corals of opportunity and removal of man-made debris using a 3:1 ratio and stabilization of rubble using a 4:1 ratio (Equation 2).

Eq 1: Total offset requirement = Sum of unavoidable coral loss

Eq 2: Total offset mitigation planned = $(A_{co} / CR_{co}) + (A_r / CR_r)$

A_{co} = Total area for corals of opportunity (sq ft)

CR_{co} = 3:1 credit ratio

A_r = Total area for stabilized rubble (sq ft)

CR_r = 4:1 credit ratio

Final mitigation requirements, activities, and sites will be discussed in coordination with NMFS prior to implementation to verify the proposed mitigation is sufficient.

7.4.7. Monitoring and Reporting

Relocated and stabilized coral will be monitored for survival and compared with select 'reference' corals located approximately 10 to 20 feet from the project area. The overall goal of

monitoring is to determine the relative success of coral relocation, stabilization, and enhancement. In addition, the installed cable will be monitored for any displacement in the first 6 months.

Coral health monitoring (i.e., color, and size) will be undertaken at 6, 12, and 24 months after relocation and stabilization, with a monitoring report prepared for each of the three monitoring events. Monitoring will assess the status of relocated corals and focus on success of the minimization and mitigation efforts and any corrective actions needed. Success criteria will be established at 70% survivorship relative to the nearby control or reference site.

Direct observations concerning attachment status and relative health of reattached organisms will be made by an experienced scientist. Relative health of reattached organisms will be based primarily on assessment of color (e.g., normal, pale, or bleached), tissue condition (e.g., degree of accretion/regression, or presence of disease), interspecific events (e.g., clionid intrusion), and algal overgrowth. The stability and relative health of the reference sites will be compared to the relocation and stabilization groups and between monitoring events. Reattached organisms will be monitored in situ for stability of cement bond by gently pulling on the colony edge (i.e., tactile census). Any loose organisms will be reattached at the monitoring site during monitoring activities.

Removal of man-made debris and removal of COTS will only require pre and post survey. Success will be measured by the removal of the derelict debris and elimination of COTS within the marine environment and does not necessitate require long-term monitoring.

Each of the three monitoring reports will be submitted to the requesting agencies.

7.5. Potential Adverse Effects on Essential Fish Habitat

7.5.1. Cable installation in the pelagic environment

Most of the cable would be installed in the pelagic environment where water depths would be greater than 400 meters and the cable would encounter generally low-density communities of sponges and corals. Potential stressors from the cable installation include vessel strikes, noise, surface water disturbance, contaminant spills, and turbidity. Since the ship will be moving slowly during cable installation, generally less than 6 knots, vessel strikes, noise, and surface water disturbance will be minimal, especially when compared to commercial ships. The cable ship will have a contingency plan and materials to contain any contaminant spills. There may be localized turbidity associated with disturbed sediment when the cable is laid on the ocean floor, depending on local conditions. The turbidity would be temporary and dispersed by benthic currents.

Cable laying activities in the pelagic environment would be temporary, only lasting a few weeks during cable installation when the cable ship follows the proposed route reeling out the cable. In the pelagic environment, compliance with conservation measures would collectively serve to minimize likelihood of affecting essential fish habitat resulting in no more than minimal adverse effects.

7.5.2. Cable installation in the nearshore environment

Cable installation in the nearshore environment would involve more activity and localized disturbance from divers installing the cable and articulated pipe in coral habitat. Stressors include boat traffic and construction in shallow environments, including noise, surface disturbance, and the potential for contaminant spills and vessel or equipment strikes. The conservation measures relating to vessel movement and contaminant spills described in Section 3 would minimize impacts from these stressors. In-water work by divers could introduce invasive species, stir up turbidity on the ocean floor, or directly damage corals, macroalgae, or other sensitive species. Conservation measures for these stressors will also minimize potential impacts from these activities. Other than direct damage to corals, the potential adverse effects would be temporary.

Stressors and impacts to coral from installation of the temporary access corridor, marine bulkhead, and articulated pipe were based on a benthic habitat survey conducted at the site that estimated the percent coral cover in the reef flat and fore reef (Appendix A). Detailed coral surveys will be conducted before and after cable installation to determine the coral composition, likely impacts, and extent of mitigation required.

Based on the 15% percent coral cover estimate on the reef flat and the 7,240 square feet of estimated disturbance for the marine bulkhead and temporary access corridor (Table 3), approximately 1,086 square feet of coral would be impacted. The remaining disturbed area consists of turf algae, non-calcifying substrates, calcifying algae, and macroalgae.

For the four 1-foot-wide articulated pipe pathways through the fore reef, the benthic survey found 30% coral cover in the upper fore reef, and 5% or less coral cover in the mid- and lower-fore reef. Using estimated 210 feet length for each segment with a 1-foot wide corridor yields approximately 336 square feet of impacted coral within the four pathways. The remaining area consists of non-calcifying coralline algae, macroalgae, and turf algae. The most abundant transplantable (i.e. non-encrusting coral) observed were:

- *Goniastrea retiformis* (28% of total),
- *Porites* sp. massive (26%),
- *Dipsastrea* sp. (10.5%),
- *Astreopora myriophthalma* (5%),
- *Platygyra pini* (4.5%)(Appendix A).

At the base of the fore reef, three routes were surveyed where patch reefs in a sandy substrate dominated. The three routes had 166, 82, and 87 observed coral colonies within the 98-foot (10-meter) wide survey corridor. A percent coral cover was not estimated, and the report recommended micro-rerouting around the colonies to the extent feasible. For colonies that cannot be avoided, translocation would be used.

There is also the potential to impact coral immediately outside the direct impact areas that could be at risk for injury or damage from activities associated with the installation of the cable. These activities include vessel (in shallow waters) and diver movements; use, handling and placement of tools, equipment, and materials; and potential re-suspension of sediments.

Since adverse effects on coral colonies are anticipated, coral impact minimization and mitigation efforts would be implemented (Sections 7.4). It is expected that corals will recover and colonize the cable structure that will be placed on top, as observed in adjacent cables. On average, massive coral colonies can grow at a rate of 0.1 to 0.8 inches while branching coral can grow up to 3.9 inches per year (NOAA 2024d).

7.6. Conclusion

EFH within the Action Area for the project includes the Bottomfish and Pelagic management unit species. The Bottomfish MUS is located within the water column that goes from the shoreline to the to a depth of 400 meters. Pelagic MUS designation around CNMI includes all life stages of shallow-water and deep-water complexes, which is the water column from the shoreline to the outer limit of the EEZ to a depth of 1,000 meters. Over 90% of the cable would be placed at depths greater than 1,000 meters. The cable is less than an inch wide for most of the installation, and with the conservation measures applied, would have no more than a minimal adverse effect on EFH and MUS.

Effects of installation in the near-shore environment are more significant and are not avoidable. Approximately 7,240 square feet of reef flat benthic habitat and 1,086 square feet of coral would be directly affected by installation of the marine bulkhead and access corridor. The four articulated pipe pathways would affect 2,520 square feet of fore reef habitat and 336 square feet of corals. Coral colonies in the sandy substrate below the fore reef would also be affected, although the number and area of corals is difficult to estimate prior to installation since they will be avoided where possible during installation. Most coral species were encrusting types with some branching corals noted (Appendix A). In addition to the conservation measures described in Section 3 and 7.3, efforts will prioritize avoiding coral impacts by routing the cable and articulated pipe around colonies to the extent practicable. Surveys conducted before and after the installation will determine the actual amount of coral impacted, and minimization and mitigation efforts would be implemented as described in Section 7.4. It is expected that coral will colonize the articulated pipe over time as has been observed in adjacent cables and that the habitat will recover.

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Appendix A

Final Report for NEC Tinian Cable Project

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BENTHIC AND CORAL SURVEYS IN DESIGNATED CABLE
ROUTING AREA AT LASARINO (LEPROSARIUM) BEACH,
TINIAN, COMMONWEALTH OF THE NORTHERN MARIANA
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BENTHIC AND CORAL SURVEYS IN DESIGNATED CABLE ROUTING AREA AT
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Figure 4: Percent Benthic Cover of the identified route for Task 1.

Figure 5: Percent Coral Cover by Genus of the identified route for Task 1.

Figure 6: Map of cable route and corals within the 10m corridor. Note that the cable route appears to be further east than the actual route, due to the current and wind pushing the PAM float off course, which was attached to the divers.

Figure 7: Three cable routes with 10m buffer and coral points. Note, ESA** is an *Acropora sp.* colony, most likely to be *A. humilis*, but exhibits similar morphology as a known *A. globiceps* species. More detail provided in Route 3 results section.

Figure 8: Individual *Pocillopora versipora* colony that is not on a patch reef

Figure 9: Coral patches on sandy bottom. Across all three routes, most of the individual colonies were observed on these patches.

Figure 10: Coral distribution by size and abundance of families.

Figure 11:(left) Photo of *Acropora sp.* colony in question, but likely *Acropora humilis*. (right) Known *Acropora globiceps* species exhibiting morphology similar to *A. humilius* in coral nursery on Saipan.

Figure 12: Top left, *Acanthaster planci* (COTS); Top right, *Chelonia mydas*, the green sea turtle, an ESA listed species; Bottom left, *Charonia tritonis*, natural predator of COTS; Bottom right, *Tridacna sp.*

Figure 13: Map of Task 3 route from the reef crest extending onto the reef flat to the proposed bulkhead.

Figure 14: Percent benthic cover for cable landing corridor to the BHM (Task 3)

Figure 15: Photo of the reef crest habitat at Lasarino Beach, Tinian.

Figure 16: Top left, cable landing entry route into the lower fore reef. Top right, sandy bottom channel that the cable landing will cross over. Bottom left, cable route through the upper reef flat. Bottom right, cable landing route through the upper fore reef.

Introduction and Background

The activities summarized within this report represent Phase II of biological surveys undertaken at Lasarino (Leprosarium) Beach, Tinian, Commonwealth of the Northern Mariana Islands (CNMI). As part of NEC's proposal to land four fiber-optic telecommunication cables at Lasarino Beach, biological assessments are required to evaluate the potential environmental impacts of the project (Figure 1). These assessments are necessary to comply with federal permitting processes under various environmental laws, including the National Environmental Policy Act (NEPA), the Magnuson-Stevens Fishery Conservation and Management Act (MSA), the Clean Water Act (CWA), and the Endangered Species Act of 1973, as amended (ESA). In addition to federal requirements, the project must also comply with local regulations, including Public Law No. 20-79 and Executive Order 2025-001, which designate coral reefs as critical infrastructure and establish mitigation measures to protect these resources.

In compliance with these regulatory requirements, surveys were conducted for the development of a biological assessment associated with Phase I of this project. Field surveys occurred in February 2025 and were conducted by David Burdick, an independent consultant from Guam and Kylie Hasegawa, a biologist sub-contractor and co-author of this report. The surveys and reporting by D. Burdick provided comprehensive baseline data on the benthic communities associated with an initially proposed landing corridor at Lasarino Beach (Figure 2, green line). Phase I survey activities provided data needed to assess the presence and general abundance of ESA-listed corals, other sessile organisms (e.g., *Tridacna sp.*), hard and soft corals, seagrass, and non-coral benthic cover (e.g., coralline algae) along the proposed NEC cable landing site in Tinian. Additionally, this data was used to inform recommendations for a feasible cable corridor and appropriate installation method (surface lay or HDD), to minimize ecological impacts. The findings of his work highlighted the presence of ESA-listed coral species, *Acropora globiceps* ($n=46$ colonies), at higher abundances at the upper fore reef and extending onto the reef crest of the cable landing route surveyed in Phase I. As a result, NEC requested additional site surveys to identify alternative routes that would minimize negative effects to coral colonies, especially the ESA-listed species, *Acropora globiceps*. Duenas, Camacho Associates, Inc. (DCA) provided the following scope of work to Mr. Benavente of Tasi Research & Consulting to address these needs.

- Task 1: Conduct a visual survey of the blue-outlined Coral Survey Channel (Figure 2) to identify a 10-meter-wide corridor with the fewest ESA and general corals. Once selected, perform a detailed survey to map ESA coral locations and identify other coral species, estimating how many non-ESA corals may require relocation.
- Task 2: Identify and map/route three pathways through the purple outlined area, the Cable Routing Survey (Figure 2), to avoid coral patch reefs to the extent feasible while minimizing sharp bends.
- Task 3: Perform a coral survey along a 10 meter-wide corridor in a straight line between the corridor identified in Task 1 and the beach manhole (BMH) for placement of the bulkhead and impacts from the cables and conduits.

Survey Design

Benthic surveys were conducted by a team of marine biologists using either Self-Contained Underwater Breathing Apparatus (SCUBA) methods, snorkeling, or a combination of both. Surveys were completed within the polygons and area mapped out in Figure 2. The specific methods for each task are outlined below.

Task 1

Objective:

Do a visual survey of the blue outlined area (the Coral Survey Channel). Find a 10 meter wide area with the least amount of ESA corals and general corals. Once the 10 meter wide corridor is identified, conduct a more detailed survey to count and map the coordinates for each ESA coral in that corridor. Additionally, identify the other corals present and estimate how many of those general corals would need to be moved.

Methods:

Using a handheld GPS, the author and the marine technician, Deanna Kapileo, delineated the edges of the blue polygon while snorkeling. The survey team then began by identifying suitable routes near the reef crest while taking note of areas where ESA-listed coral species were observed. When cable landing sites at the reef crest were identified, the survey team moved to the mid and lower fore reef to connect potential landing sites to possible routes and entry/exit routes towards deeper habitat (~15-33 meters)

Once the 10-meter-wide corridor within the Coral Survey Channel was identified, a transect line was laid along the substrate, extending from the southwestern end of the designated blue polygon to the reef margin. The max depth was ~15m at the southwestern end of the corridor up to the surface at the reef margin.

Using SCUBA, benthic photo documentation was conducted along the transect line for a benthic substrate survey. Top-down photographs using an Olympus TG-6 camera were taken at 1-meter intervals along the transect line, with the camera positioned approximately 1 meter above the reef surface to capture consistent imagery of the benthos. These images were later analyzed using Coral Point Count with Excel extension (CPCe) software (Kohler & Gill, 2006). For each photo, the program randomly generated 10 points, and the substrate type beneath each point was identified and recorded to assess benthic composition. For analyzing benthic data, the author elected to divide the identified route in Task 1 into three different zones (Figure 3): upper (0-4m depth), mid (4-8m depth), and lower (8-12 m depth). This zonation allows us to take further account of the variability of reef composition relative to depth.

In addition to the benthic photo analysis, divers surveyed both sides of the transect line, each covering a 5-meter-wide swath perpendicular to the line, for a total survey width of 10 meters. Each diver towed a PAM float equipped with a GPS unit to track the survey path in real time. Divers recorded all coral colonies ≥ 11 cm in diameter that were considered suitable for translocation, as well as all colonies of ESA-listed coral species regardless of size. The ≥ 11 cm threshold aligns with local regulatory guidance for identifying coral colonies eligible for mitigation

or translocation. Photographs were taken of all recorded coral colonies and later geotagged using the GPS data.

Task 2

Objective:

Identify and map three pathways through the purple outlined area (the Cable Routing Survey) to avoid coral patch reefs to the extent feasible, without making extreme bends to the cables.

Methods:

From a boat, surface marker buoys were dropped at strategic points and corners along the purple polygon to provide guidance and a point of reference for divers and surface support (boat captain and snorkelers). The buoys allowed the divers and surface support to maintain a general knowledge of the correct direction and angle of the polygon to ensure minimal harsh angles in the cable routes.

A team of two marine biologists, using SCUBA and snorkeling methods, began the survey at the western end of the polygon and swam towards shore (northeast), ending the survey at the eastern corner of the blue polygon, where the survey route for Task 2 began. Both the diver and snorkeler towed a PAM float with a GPS attached and swam along the route. The snorkeler provides visual guidance to the diver to ensure an optimal path within the polygon. Along the route, the diver searched in a 10 meter-wide corridor for reef patches, large coral colonies, and ESA listed species. Reef patches were photographed and any coral greater than or equal to 11cm was identified, measured, and recorded. ESA-listed species of any size were also measured and recorded.

Photographs of reef patches and large individual colonies were later geotagged with GPS data from the GPS to provide a visual representation of patches or colonies that will potentially need to be translocated or removed.

Task 3

Objective:

Perform a coral survey along a 10 meter-wide corridor in a straight line between the corridor identified in Task 1 and the beach manhole (BMH) for placement of the bulkhead and impacts from the cables and conduits.

Methods:

Beginning at the shallow end of the corridor identified in Task 1 (at the reef margin) and ending at the BMH, an additional transect was established across the reef flat. At 1-meter intervals along this transect, a 0.25m² quadrat with 10 pre-marked points was placed to assess benthic composition. At each quadrat placement, the substrate type directly beneath each of the 10 points was identified and recorded. Due to the low tide and shallow water conditions, the transect was deployed via snorkeling or by wading along the reef flat. Additionally, a GPS unit was towed along the transect path to document spatial positioning of the survey.

Results

Task 1

Benthic Surveys

Results of the benthic substrate surveys indicate notable differences in benthic community composition by depth (Figure 4). In the upper fore reef, coral cover was highest, averaging approximately 30%, with an additional 15% cover by calcifying organisms. Other notable components included non-calcifying coralline algae (~30%), macroalgae (~15%), and turf algae (~15%), while sand cover was minimal (<5%). The mid fore reef exhibited a more balanced composition throughout the spur and groove reef structure, where sandy bottom surge channels dominated substrate cover (~40%), followed by non-calcifying coralline algae (~20%), macroalgae (~20%), and turf algae (~20%). Coral and calcifying substrate cover were notably low (<5%) within the mid fore reef. In the lower fore reef, benthic cover was primarily composed of macroalgae (~30%), turf algae (~25%), and non-calcifying coralline algae (~20%). Coral and calcifying substrate cover were minimal, averaging below 5%, while sand cover was also relatively low (~10%).

These findings are similar to those of the previous surveys in D. Burdick's report, which indicate that the upper fore reef hosts the highest coral density and diversity of calcifying organisms, while the mid and lower fore reef zones are more dominated by algae, non-calcifying organisms, and sand.

When specifically looking at coral cover (Figure 5), we again see that abundance and diversity were greatest at the upper fore reef, where coral cover was dominated by the genera *Montipora* and *Goniastrea*, each averaging approximately 8% cover. Other contributing genera included *Pavona*, *Pocillopora*, *Porites spp.* (both rus and massive forms), *Favia*, and *Astreaopora*, though all with lower individual contributions (<3%). A broader variety of coral genera was present in this zone compared to mid and lower depths.

The mid fore reef showed markedly lower overall coral cover, a factor of a sand channel within the survey site. The most common species were *Porites rus* and massive *Porites sp.*, each contributing less than 2% average cover. Minor occurrences of *Leptastrea*, *Favia*, and *Montipora* genera were also observed. The lower fore reef exhibited the lowest coral cover and diversity, with only trace amounts (<1%) of massive *Porites sp.*, *Porites rus*, *Leptastrea*, *Goniastrea*, *Favia*, and *Astreaopora*. These findings align with overall benthic data that show a decrease in percent coral cover at deeper depths.

Coral Surveys: 10 meter belt

The survey team recorded a total of 600 individual coral colonies across the surveyed fore reef zones, representing a high diversity of 50 different scleractinian coral genera and species. It is important to note that while encrusting species such as *Montipora spp.* were found to be dominant in the preceding benthic surveys, they were not included in the coral colony survey due to their growth form being unsuitable for translocation. The coral survey focused specifically on colonies

that were viable for relocation, primarily those with upright, massive, or branching morphologies that could be safely removed and reattached elsewhere. The most abundant taxa were:

- *Goniastrea retiformis* with 168 individuals (28% of total),
- *Porites sp.* massive with 156 individuals (26%),
- *Dipsastrea sp.* with 63 individuals (10.5%),
- *Astreopora myriophthalma* with 31 individuals (5%),
- *Platygyra pini* with 27 individuals (4.5%).

Other commonly observed species included *Acropora globiceps* (n=12, or 2.17%), *Acropora serculosa* (n=12), and *Pavona duerdeni* (n=10). The genus *Acropora* was represented by at least 10 distinct species or morphotypes, indicating moderate species richness within this ecologically important group. ESA-listed species observed during the surveys included *Acropora globiceps*, though it occurred at relatively low abundance and primarily within the upper fore reef zone (Figure 6).

Task 2

The team identified three routes (Figure 7) to navigate the cable landing through the provided polygon. One route is in the Northern Corridor, while two additional routes are in the Southern Corridor. Several other routes were visually assessed; however, they passed through multiple patch reefs and did not present themselves as viable options for cable placement.

In Route 1, the abundance of individual colonies is about 2 times greater compared to Routes 2 and 3 in the southern corridor, with the most abundant species being massive *Porites sp.* (Table 1). Most individual colonies were observed in a patch reef with other corals (Figure 8). However, there are a few individual colonies that were not near any other colonies (Figure 9). Coral colonies from the families Acroporidae and Poritidae showed the greatest abundance and size compared to other families. Three individual colonies from the Poritidae family are greater than or equal to 50cm. Lobophyllidae and Merulinidae were the next most abundant families, followed by Euphylliidae, Plesiastreidae, and Pocilloporidae (Figure 10). No ESA-listed corals were observed in Route 1.

Route 2 has the least number of individual colonies within the corridor (Table 1). Similar to Route 1, massive *Porites sp.* was the most commonly observed, with over half the observations belonging to this species (Table 1). Most of the individual colonies were observed in a patch reef with other corals; however, there are a few individual colonies that were not near any other colonies. Additionally, Route 2 has a relatively even distribution of coral sizes across families like Acroporidae, Faviidae, Merulinidae, and Helioporidae. Poritidae displays the largest sizes, with several colonies greater than 50cm. Poritidae, Acroporidae, and Lobophyllidae were the most commonly observed species while no colonies from Helioporidae or Pocilloporidae families were observed (Figure 10). No ESA-listed corals were observed in Route 2.

Route 3 has a similar number of colony observations as Route 2, with massive *Porites sp.* being over half of the observed colonies (Table 1). Most of the individual colonies were observed in a

patch reef with other corals; however, there are a few individual colonies that were not near any other colonies. The most abundant families in Route 3 are Poritidae, Acroporidae, and Merulinidae, and there are no observations of Faviidae or Pocilloporidae. Like Route 2, Poritidae has the largest average colony size, with two colonies greater than 100cm (Figure 10). No ESA species were observed; however, one Acropora colony observed during the survey was morphologically consistent with *Acropora humilis*, but bore similarities to *Acropora globiceps*, a species listed under the ESA (Figure 11). A comparable colony currently growing in a coral nursery on Saipan was initially identified as *A. humilis* based on appearance but was later confirmed through genetic testing to be *A. globiceps*. The colony encountered during the survey was relatively small (approximately 11 cm in diameter) and exhibited shorter branch morphology than typically observed in confirmed *A. humilis* colonies, raising the possibility that it may be *A. globiceps*. Because of its smaller size, the branches may have not yet fully grown. While it is likely this colony is *A. humilis* based on morphology, as a precaution, this colony should be avoided during project activities or translocated if feasible. For purposes of data analysis, this colony was treated as *A. humilis*. In Figure 7, this colony is starred to denote its location within the Route 3 corridor.

Although the scope of Task 2 was limited to surveying coral colonies, several other ecologically and culturally significant invertebrates and megafauna were observed along the surveyed routes (Figure 12). Notably, four crown-of-thorns starfish (*Acanthaster planci*) were recorded. This species is a known coral predator, and in large numbers, can significantly reduce live coral cover. Encouragingly, one Triton's trumpet snail (*Charonia tritonis*) was also observed. This species is a natural predator of *A. planci* and plays an important role in regulating its population. Additionally, two green sea turtles (*Chelonia mydas*), a species listed under the ESA, were sighted in the area, highlighting the ecological value of the surveyed habitat. Several individuals of burrowing clams (*Tridacna sp.*) were also documented along the transect line, however geospatial coordinates were not taken. These clams are not only ecologically important as reef filter feeders but also hold cultural significance. They are traditionally used as a food source and have historical and cultural value in carving and jewelry-making practices. While these observations were incidental, they underscore the broader biodiversity of the area and may warrant consideration during project planning and impact mitigation.

Task 3

Benthic surveys across the Lasarino reef flat and shallow lagoon (Figure 13) were conducted. Results found the reef flat to be composed primarily of turf algae, which accounted for approximately 60% of total benthic cover. Turf algae is defined as mats of juvenile algae less than 2cm in height. Coral cover was the second most abundant category at roughly 15%, followed by non-calcifying substrates (14%), calcifying algae (8%), and macroalgae (~6%). Sand was nearly absent, comprising less than 1% of the area surveyed (Figure 14).

This distribution indicates a turf-dominated benthic habitat with moderate live coral presence and low sedimentation. The relatively high coral cover at the reef margin, compared to the reef flat, suggests a tide-dominated ecosystem where corals present on the reef flat have adapted to extreme low tides. Additionally, when conducting coral surveys for Task 3, the authors found no ESA-listed species or other coral colonies that could potentially be translocated within the project area. Although corals were present, due to their placement in a high wave energy environment and their

morphologies, primarily encrusting or compacted (Figure 15) make them less likely to survive translocation activities.

ESA-Listed Species

Surveys conducted as part of Tasks 1 and 2 documented the presence of two species listed under the Endangered Species Act (ESA): the Green Sea Turtle (*Chelonia mydas*) and the coral species *Acropora globiceps*.

Two individual green sea turtles were observed during field activities. The first was sighted on April 27, 2025, within the Task 1 survey area during the initial assessment of the proposed cable corridor. The second was observed on April 28, 2025, during surveys for Task 2, specifically within Route 2 in the southern corridor of the Task 2 site. Both individuals were observed to be foraging in the nearshore reef habitat and exhibited no signs of disturbance from survey activities.

A. globiceps colonies were identified within the broader project area during coral assessments conducted for Task 1. These twelve colonies were primarily located in the upper fore reef and northern reef flat zones. While the selected route for Task 1 was chosen in part to minimize interaction with *A. globiceps*, the species was nonetheless encountered within proximity to the proposed cable landing route. No colonies of *A. globiceps* were confirmed within the three routing options assessed during Task 2; however, one *Acropora* colony observed in Route 3 displayed morphological features similar to *A. globiceps* and should be treated with caution. While conducting surveys for Task 3, no *A. globiceps* were observed.

The presence of these ESA-listed species within or near the project footprint highlights the need for species-specific avoidance and mitigation measures as part of the cable installation process.

Conclusion and Recommendations

Task 1

Phase II's benthic and coral surveys conducted across the identified cable landing route at Lasarino Beach reveal spatial variability in habitat composition, coral cover, and species richness. The upper fore reef exhibited the highest average coral cover, particularly dominated by *Montipora spp.* and *Goniastrea retiformis*. In contrast, the lower and mid fore reef zones were characterized by higher sand and macroalgae cover with minimal coral presence. Although *Montipora spp.* was one of the most prevalent genera observed in the benthic surveys, its predominantly encrusting growth form renders it unsuitable for translocation (Edwards and Clark, 1998) and was therefore excluded from the coral colony survey. Due to the higher abundance and density of corals at this site's fore reef, extra care was taken to delineate a route that would minimize the amount of both ESA species and general coral species that could be affected by the proposed actions. This is especially true for larger colonies (>1 meter) such as massive *Porites sp.* and *Porites rus*, which can be difficult to avoid or translocate (Buckee and Blount, 2022; Rinkevich, 2005).

When identifying a suitable route for the cable landing, the authors based their decisions on the following criteria.

- The route had to avoid major bends or curves.
- The route's substrate needed to gradually ascend throughout the fore reef and up towards the reef flat, avoiding dramatic changes in depth.
- Above all, the route had to minimize the presence of ESA listed coral species within the project footprint (NOAA, 2023a).

Identifying a route that adhered wholly to those criteria within the area specified by NEC was not possible given the spur-n-groove reef structure present at Lasarino Beach. For example, initial visual assessments of the site identified two routes with more gradual approaches onto the reef flat to the north and south of our selected route. Essentially, these would have been better pathways for the cable onto the reef flat. However, the route to the north had greater abundances of the ESA-listed coral *Acropora globiceps*. Comparatively, the route to the south had greater reef rugosity through the mid and lower fore reef zones, resulting in an approach to the reef flat that would require more cutting through reef structure (Jokiel et al., 2015).

The Task 1 route was selected because its entry point from deeper habitat (>12m) would avoid adjacent patch reefs and enter the lower fore reef through a natural groove or surge channel in the reef. The route placement prioritizes avoidance of adjacent *P. rus* and massive *Porites sp.* colonies present at the site. Through the mid fore reef zone, the route runs through a sandy bottom surge channel, minimizing the cables' contact with adjacent coral colonies. The route's path through the upper fore reef is less desirable in that it will have to reconcile crossing over several coral outcroppings before ascending and exiting onto the reef flat (Figure 16). Despite its shortcomings through the upper fore reef, this route had the least abundance of *A. globiceps* colonies within the project footprint compared to other sites within the survey area (NOAA, 2023b). Ultimately, the route identified for Task 1 was selected because it balances all the criteria through various reef zones to minimize the impact the cable landing would have on marine resources in the area.

Recommendations

- Avoidance of ESA-listed Species: Any confirmed ESA-listed coral species (e.g., *Acropora globiceps*) within the route footprint must be avoided through micro-routing adjustments or flagged for potential translocation in coordination with local regulatory agencies (NOAA, 2023b).
- Use of Natural Channels: The route's passage through natural grooves and sandy surge channels should be prioritized and preserved to reduce the need for mechanical alteration of the reef substrate (Spalding et al., 2001).
- Limit Physical Disturbance in Upper Fore Reef: Given the relative increase in coral abundance in the upper fore reef zone, efforts should be made to minimize trenching or anchoring in this area and to employ low-impact installation methods such as horizontal directional drilling (HDD) (Burgess et al, 2021).
- Pre-Construction Marking: Prior to cable installation, a high-resolution in situ verification of the route should be conducted to mark coral colonies for avoidance or relocation and to validate substrate conditions (Edwards & Gomez, 2007).

Task 2

Across all three surveyed routes, massive *Porites sp.* was the most commonly observed and also had the largest individual colonies. Route 1 exhibited the highest density of colonies, with 2 times more individual colonies observed compared to Routes 2 and 3. Routes 2 and 3 had comparable numbers of coral observations, with the Poritidae again comprising more than half of all colonies. Coral sizes in Route 2 were more evenly distributed across families, while Route 3 had several large Poritidae colonies exceeding 100 cm. No ESA-listed coral species were definitively identified in any route; however, one *Acropora* colony in Route 3 displayed morphological characteristics consistent with *A. humilis* but resembling a known *A. globiceps* colony with similar morphology, a species listed under the ESA. While likely *A. humilis*, this colony should be avoided or translocated as a precaution.

The majority of corals observed across all three routes were located within patch reefs—discrete aggregations of coral colonies interspersed throughout a sandy bottom habitat. Only a few individual colonies were found isolated from other corals. These patchy distributions provide opportunities to avoid dense coral areas with minimal realignment of the cable route. Slight deviations around individual patches may help minimize impacts while maintaining overall alignment efficiency.

Overall, the delineations of these three routes of approach for Task 2 are more environmentally conscious as they avoid most major patch reefs associated with this deeper water habitat. In contrast, the surveyed route of Phase I was a single route that would have impacted much more living reef habitat as it would require that the cable landing be placed over a large area of densely packed patch reefs.

Recommendations

- Micro-Rerouting Around Patch Reefs: Slight deviations in the cable route around coral patch reefs should be integrated into the final engineering design to avoid dense coral clusters without compromising alignment efficiency (Jokiel et al., 2015).
- Coral Translocation Protocols: For colonies within the direct impact zone, particularly large or isolated colonies, translocation should be implemented using best practices to maximize survival post-relocation (Shaver et al., 2020).
- Precautionary Management of Ambiguous Colonies: The *Acropora humilis* colony in Route 3, with morphology resembling ESA-listed *A. globiceps*, should be treated with a precautionary approach and either avoided or translocated to eliminate the risk of regulatory non-compliance (NOAA, 2023b).
- Monitoring Plan Development: Post-installation monitoring should be established to assess potential delayed impacts to adjacent coral colonies, including signs of sedimentation, abrasion, or bleaching associated with construction (Burgess et al., 2021).

Task 3

Assessments of benthic cover on the reef flat revealed that turf algae dominate the habitat, comprising approximately 60% of total cover. Coral represented about 15% of the benthic composition, with the remainder distributed among non-calcifying substrates (14%), calcifying algae (8%), macroalgae (6%), and negligible sand (<1%). This turf-dominated habitat with moderate coral presence indicates a relatively stable and low-sediment environment across the reef flat zone.

While turf algae dominance suggests lower overall habitat complexity, the coral cover on the reef flat, particularly when compared to mid and lower fore reef zones, demonstrates ecological value and potential sensitivity to disturbance. Coral colonies in this zone, although smaller and less dense than those in the upper fore reef, still contribute to benthic diversity and reef function. Consequently, cable landing across the reef flat must be carefully executed to avoid damaging live coral, particularly where coral density is highest.

Recommendations

- Prioritize Low-Impact Corridors: Final cable routing across the reef flat should prioritize areas dominated by turf algae or bare substrate, where coral and other sensitive benthic organisms are sparse. These areas offer natural low-impact corridors for cable placement.
- Use Low-Impact Installation Methods: Employ techniques such as diver-assisted placement or HDD where applicable, to reduce physical disturbance to the reef flat, especially in shallow, ecologically sensitive zones (Burgess et al., 2021).
- Monitor Post-Installation Impacts: Establish a post-construction monitoring plan to evaluate any delayed impacts to reef flat benthic communities, including water quality, coral health, algal overgrowth, or sedimentation (Edwards & Gomez, 2007).

ESA-Listed Species

Surveys conducted for Tasks 1 and 2 documented the presence of *Acropora globiceps*, while Task 3 surveys found no colonies within the project area. Although its abundance was relatively low, colonies were observed within or near proposed cable alignment routes, particularly along the northern reef flat and upper fore reef zones. Given the protected status of *A. globiceps*, any direct or indirect impacts on this species must be avoided or mitigated in accordance with federal regulations. It should be noted that when compared to the landing route explored in Phase I, which documented 46 colonies of *A. globiceps*, Phase II activities have identified a route that greatly decreases the occurrence of *A. globiceps* within the project footprint to 13 colonies. Roughly 72 percent less than their occurrence in Phase I.

In addition to ESA-listed corals, multiple sightings of green sea turtles (*Chelonia mydas*), another ESA-listed species, were recorded during fieldwork for both tasks.

The presence of these ESA-listed species highlights the ecological significance of the project area and the importance of integrating protective measures into cable routing, installation, and timing.

Recommendations

- Route Refinement to Avoid ESA Coral: Final cable routing should be adjusted to avoid any direct impact to *A. globiceps* colonies identified during the survey. Where avoidance is not feasible, consultation with NOAA/NMFS should be initiated to determine appropriate mitigation or permitting pathways (NOAA, 2023b).
- Coral Relocation: If unavoidable, translocation of *A. globiceps* colonies should be conducted following approved NOAA protocols to maximize survival and minimize ecological disruption (NOAA, 2017).
- Sea Turtle Protection Measures: To protect *C. mydas*, in-water work should be scheduled to avoid peak turtle activity times where possible. A qualified marine fauna observer should be present during cable installation to halt operations if sea turtles are within the work zone (NMFS & USFWS, 2020).
- Construction Timing Windows: Where feasible, installation should be scheduled outside of known sea turtle nesting or high-foraging periods to further minimize interactions with ESA-listed marine megafauna. Construction should also be scheduled to avoid known *A. globiceps* spawning periods (NOAA, 2023a).
- Regulatory Coordination: Engage early with NOAA/NMFS and USFWS to ensure all necessary consultations (e.g., Section 7 ESA consultation) are completed, and that all mitigation strategies for ESA-listed species are appropriately documented and implemented.
- Post-Construction Monitoring: Implement a post-installation monitoring program to assess the condition of any relocated *A. globiceps* colonies and to evaluate any potential indirect effects on nearby ESA-listed species due to sedimentation or construction activity (Shaver et al., 2020).

Possible Avoidance and Mitigation Measures

Coral translocation is recommended as a primary avoidance measure to minimize impacts on coral resources within the proposed cable corridor. This process involves carefully removing viable coral colonies directly in the cable's path and reattaching them to suitable nearby reef substrate outside the impact zone. Priority should be given to colonies ≥ 11 cm in diameter, in accordance with local regulatory thresholds, as well as any ESA-listed species, regardless of size. Colonies should be handled with care to avoid damage, and relocation sites should be selected based on similar depth, light availability, and water flow conditions to improve survival likelihood. Translocation efforts should be conducted by experienced coral restoration practitioners and monitored over time to assess post-transplant health and stability. Monitoring should be conducted both before and immediately after translocation and continue at regular intervals—typically at 6 months to 1 year—to evaluate long-term survival and inform adaptive management strategies (Rinkevich, 2005; Edwards & Clark, 1998, Shaver et al., 2020).

Given the presence of four COTS observed during the survey and the relatively low abundance of their natural predator, *Charonia tritonis*, proactive culling of COTS is recommended to reduce localized coral predation pressure. Removing COTS from the area can help protect both natural and translocated corals, improving the overall resilience of the reef (Pratchett et al., 2014; Caballes & Pratchett, 2017; Perez, 2022). Culling should be carried out following established protocols (e.g., vinegar injection) and under the guidance of trained personnel to ensure effectiveness and safety.

For impacted coral that can not be relocated, offsetting these impacts through activities that have a direct positive impact on Tinian's marine environment could be a viable form of mitigation. Consulting with local policy makers and environmental managers will provide insight into specific actions that could take place. Activities such as COTS culling, marine debris removal or prevention actions, environmental disaster response funds, and marine ecosystem restoration activities are generally acceptable forms of mitigation.

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Figures and Tables



Figure 1: Location of Lasarino Beach, Tinian, Commonwealth of the Northern Mariana Islands. (Map provided by DCA)

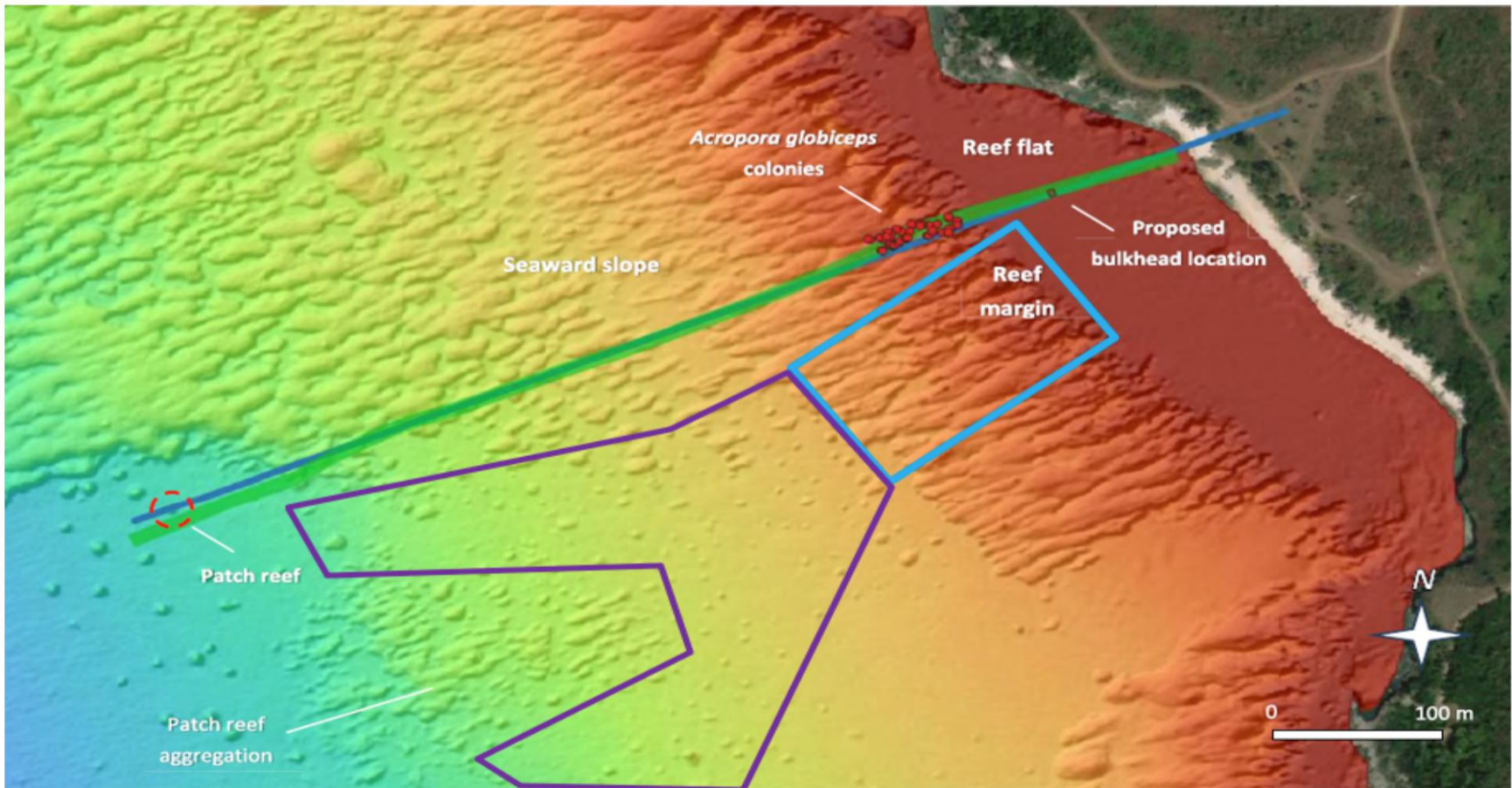


Figure 2: Map showing the survey areas for each task. (Map provided by DCA)

Task 1 Fore-reef Zones

Lower

Mid

Upper

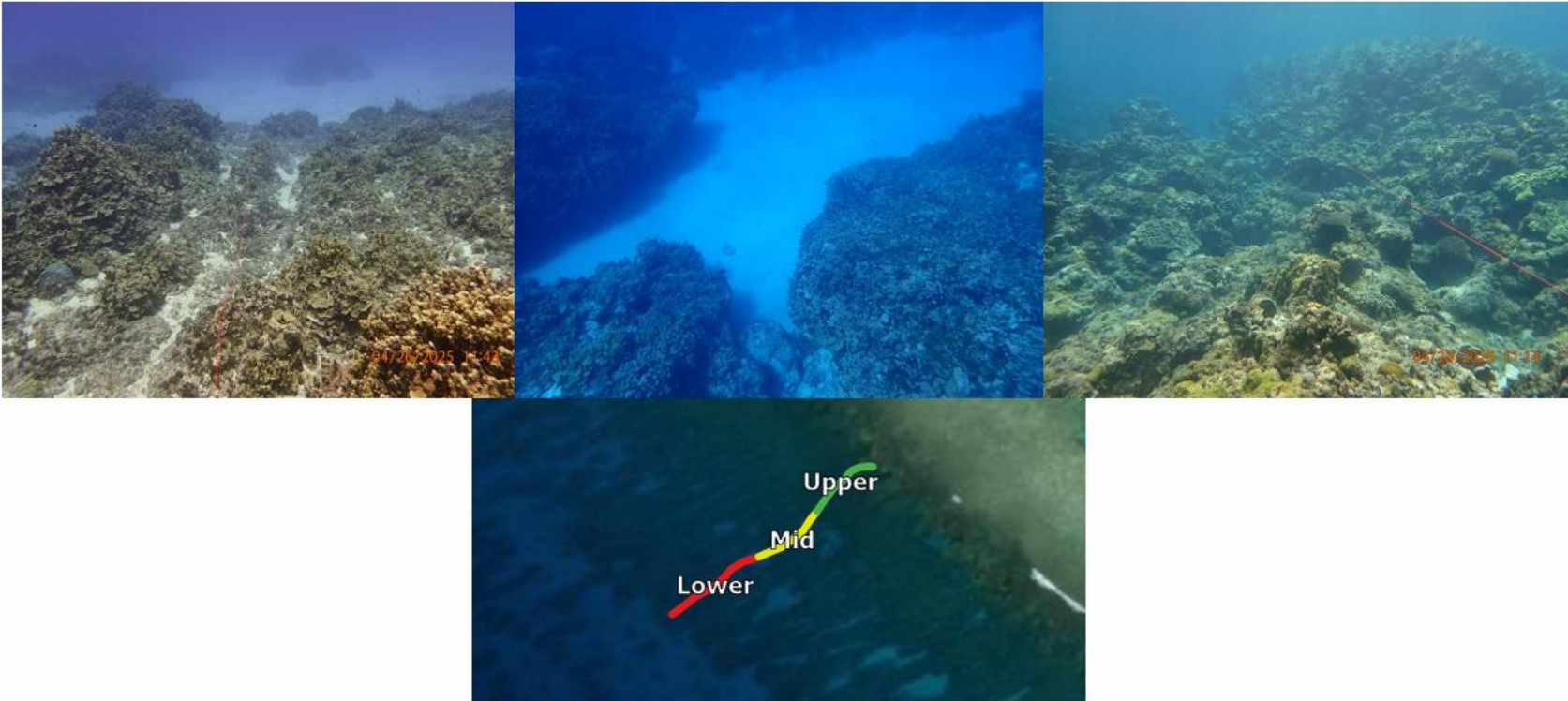


Figure 3: Designation of forereef zones for analysis of benthic substrate data.

Task 1 Forereef Benthic Cover

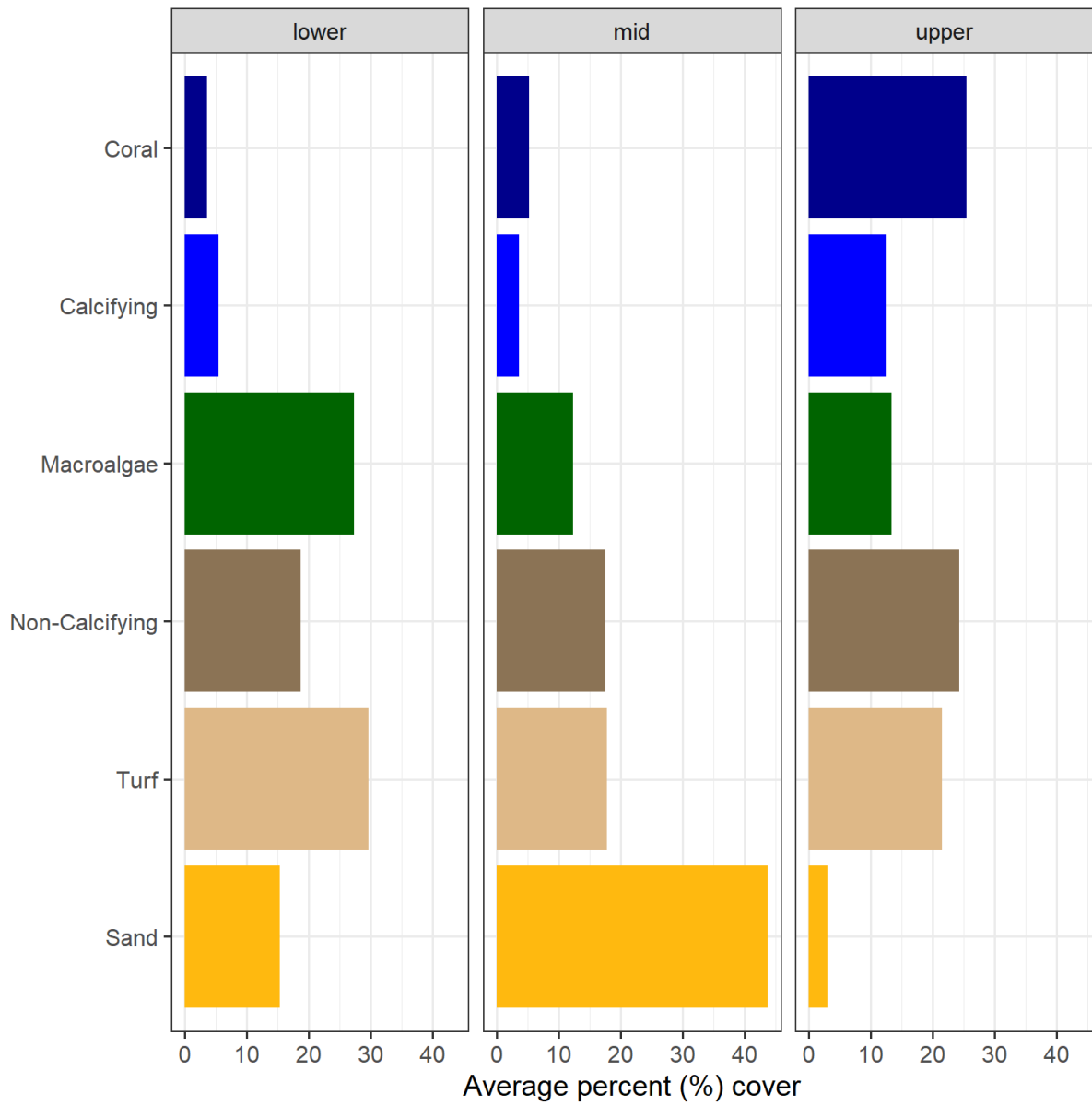


Figure 4: Percent Benthic Cover of the identified route for Task 1.

Task 1 Forereef Coral Cover

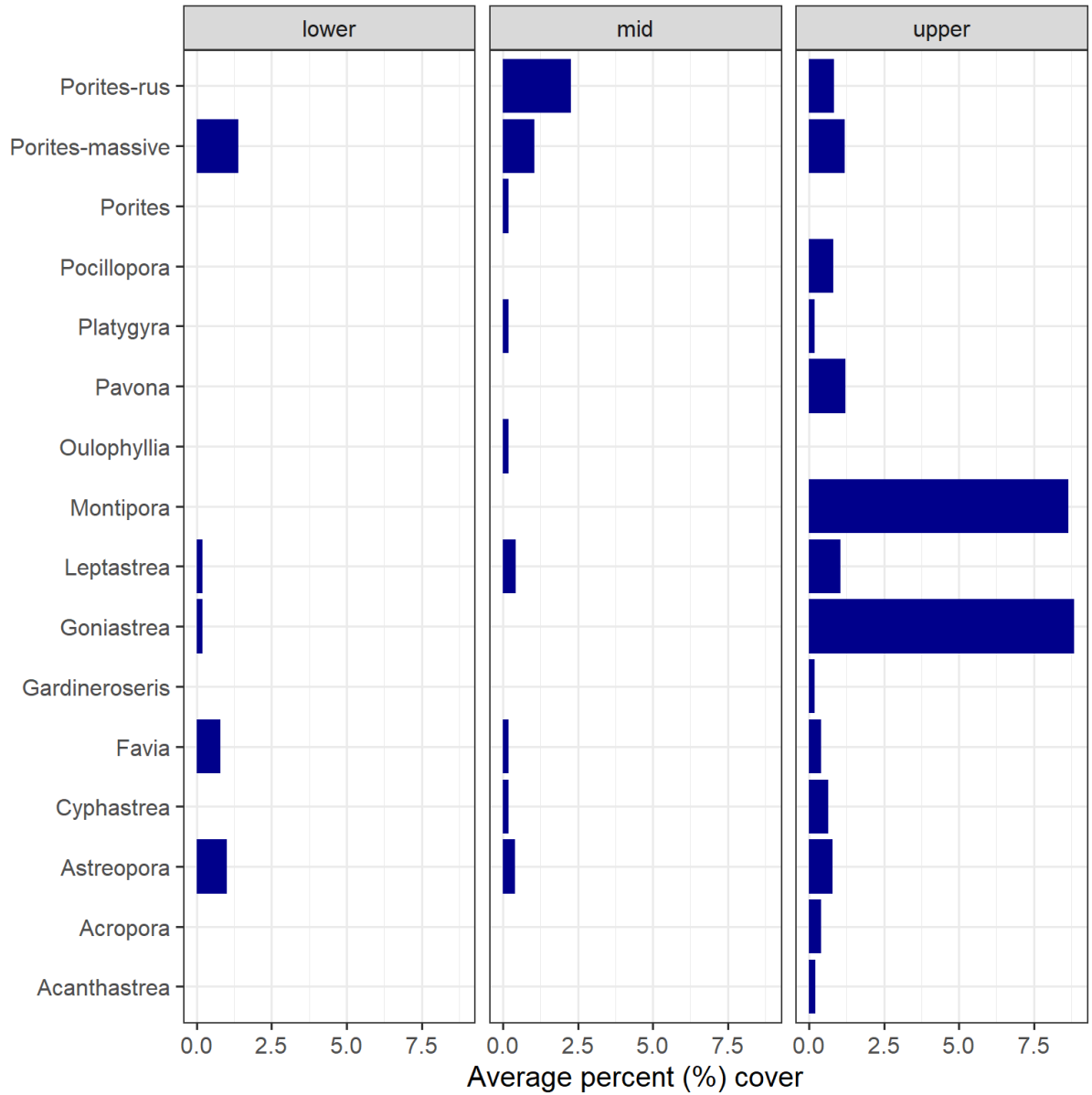


Figure 5: Percent Coral Cover by Genus of the identified route for Task 1.

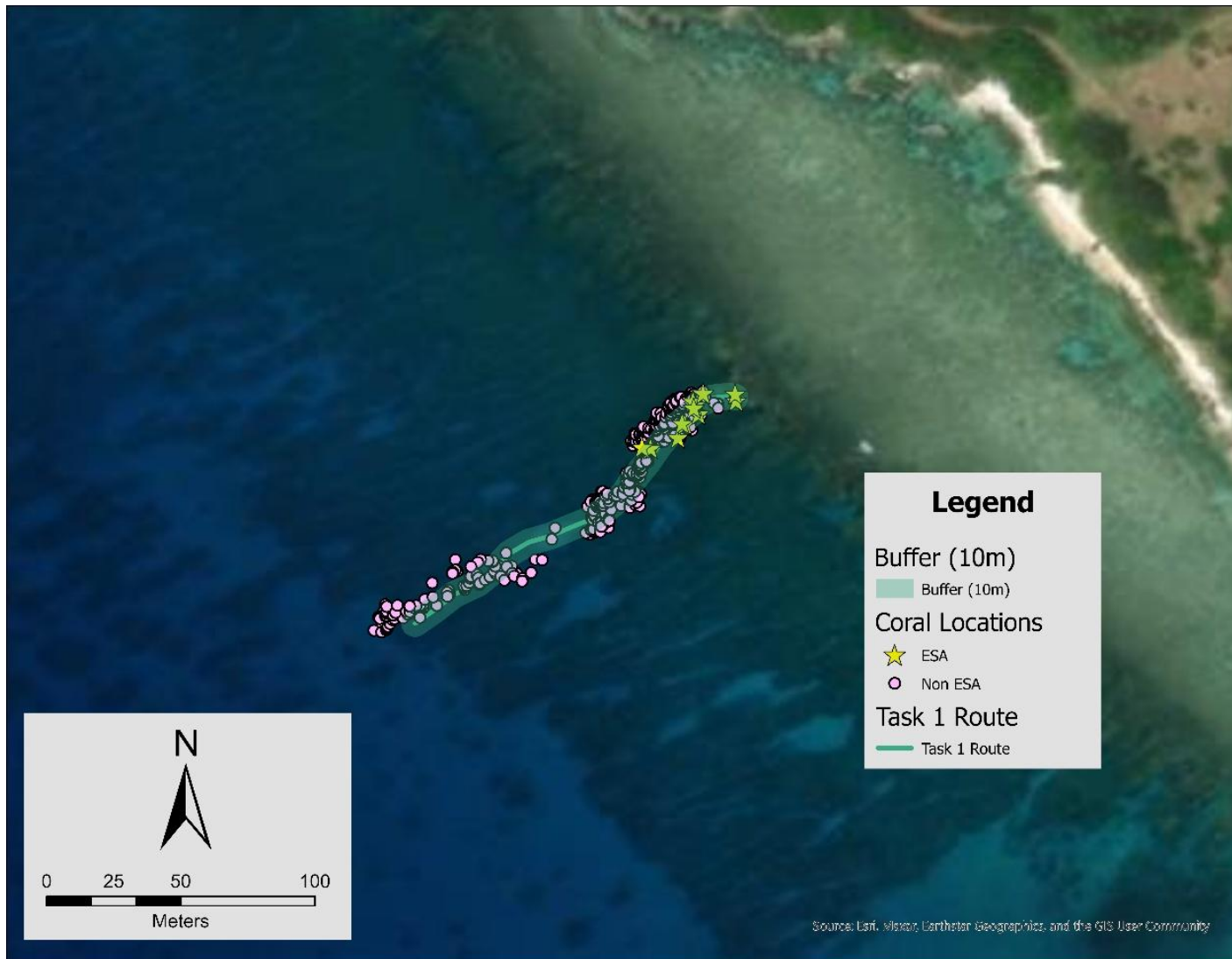


Figure 6: Map of cable route and corals within the 10m corridor. Note that the cable route appears to be further east than the actual route, due to the current and wind pushing the PAM float off course, which was attached to the divers.

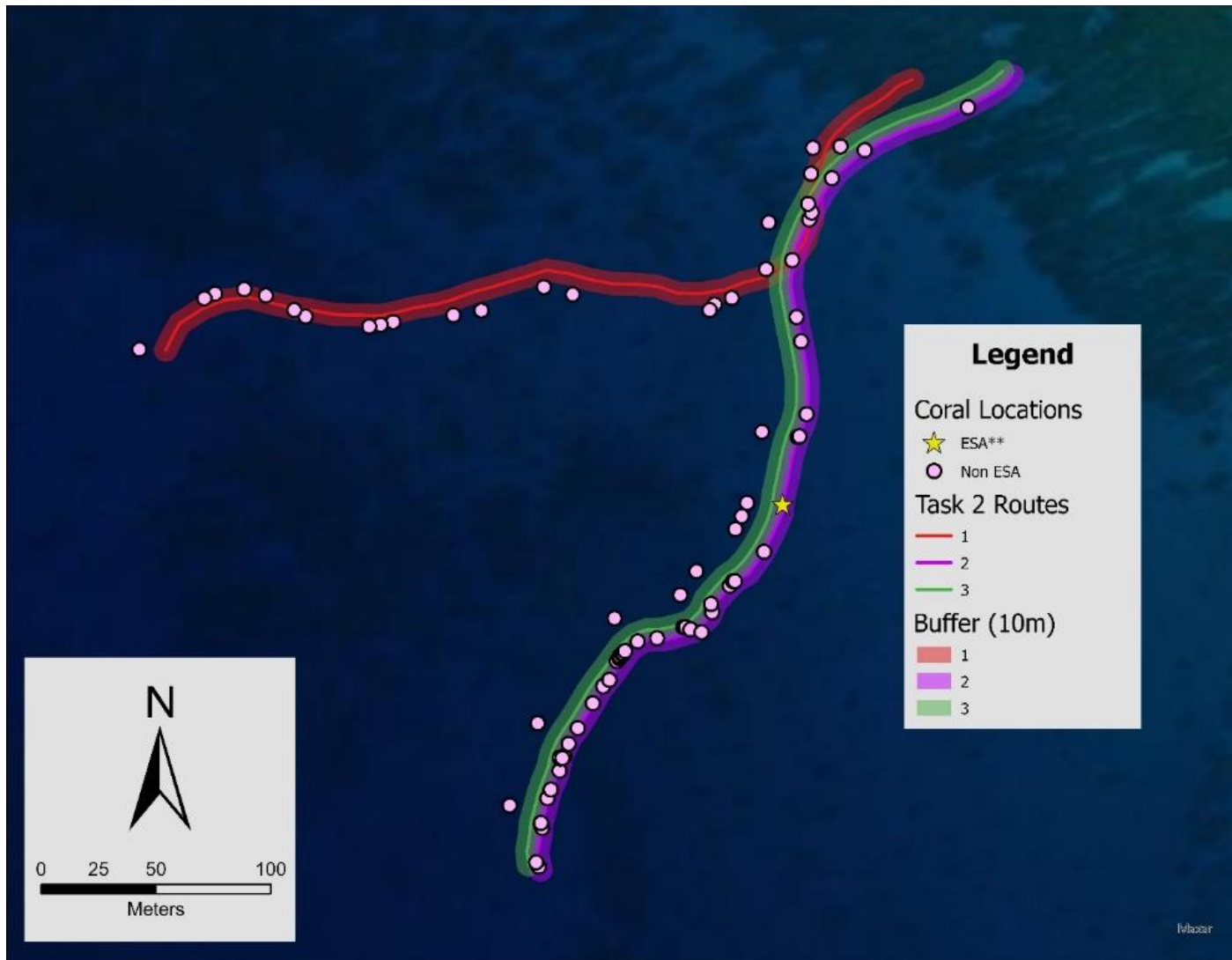


Figure 7: Three cable routes with 10m buffer and coral points. Note, ESA** is an *Acropora* sp. colony, most likely to be *A. humilis*, but exhibits similar morphology as a known *A. globiceps* species. More detail provided in Route 3 results section.

Species	Route 1	Route 2	Route 3
Acropora aculeus	4		
Acropora cf. kimbeensis	1	3	4
Acropora humilis	1		2
Acropora surculosa		1	
Acropora tenuis	1		6
Astrea sp.			1
Astreopora myriophthalma	1	3	1
Astreopora ocellata		2	
Cyphastrea sp.	2		3
Dipsastrea sp.		15	
Favites sp.	7		
Galaxea fascicularis	1		
Goniastrea retiformis	1	2	
Heliopora coerulea			1
Leptastrea purpurea		2	
Leptoria phrygia			3
Oulophyllia crispa	1	1	
Platygyra daedalea	16		8
Plesiastrea versipora	1		
Pocillopora danae	1		
Porites massive	124	49	55
Turbinaria stellulata	4	4	3
Total Colonies Observed	166	82	87

Table 1: List of coral species and the number of observed colonies within each route

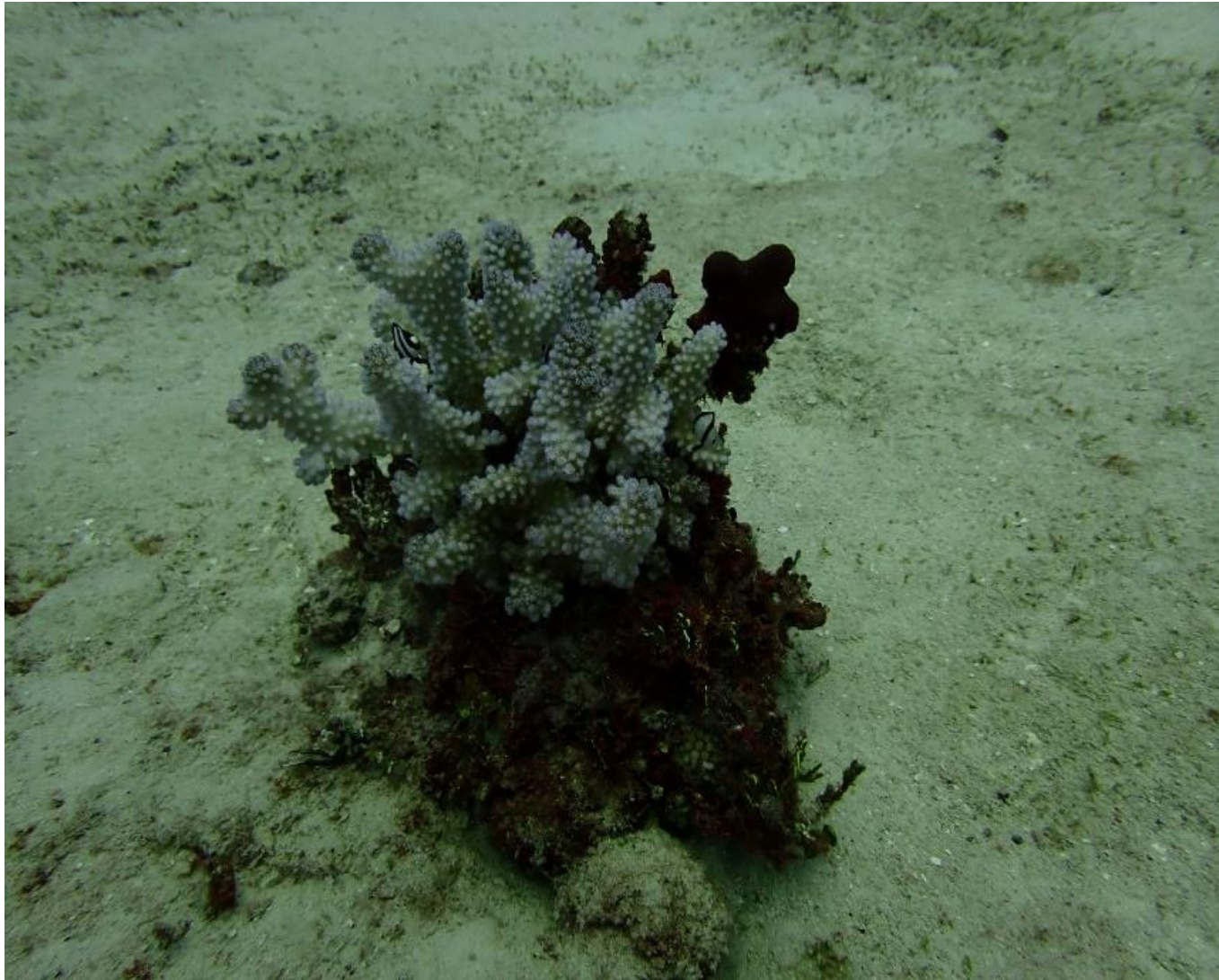


Figure 8: Individual Pocillopora versipora colony that is not on a patch reef



Figure 9: Coral patches on sandy bottom. Across all three routes, most of the individual colonies were observed on these patches.

Task 2 Coral Distribution

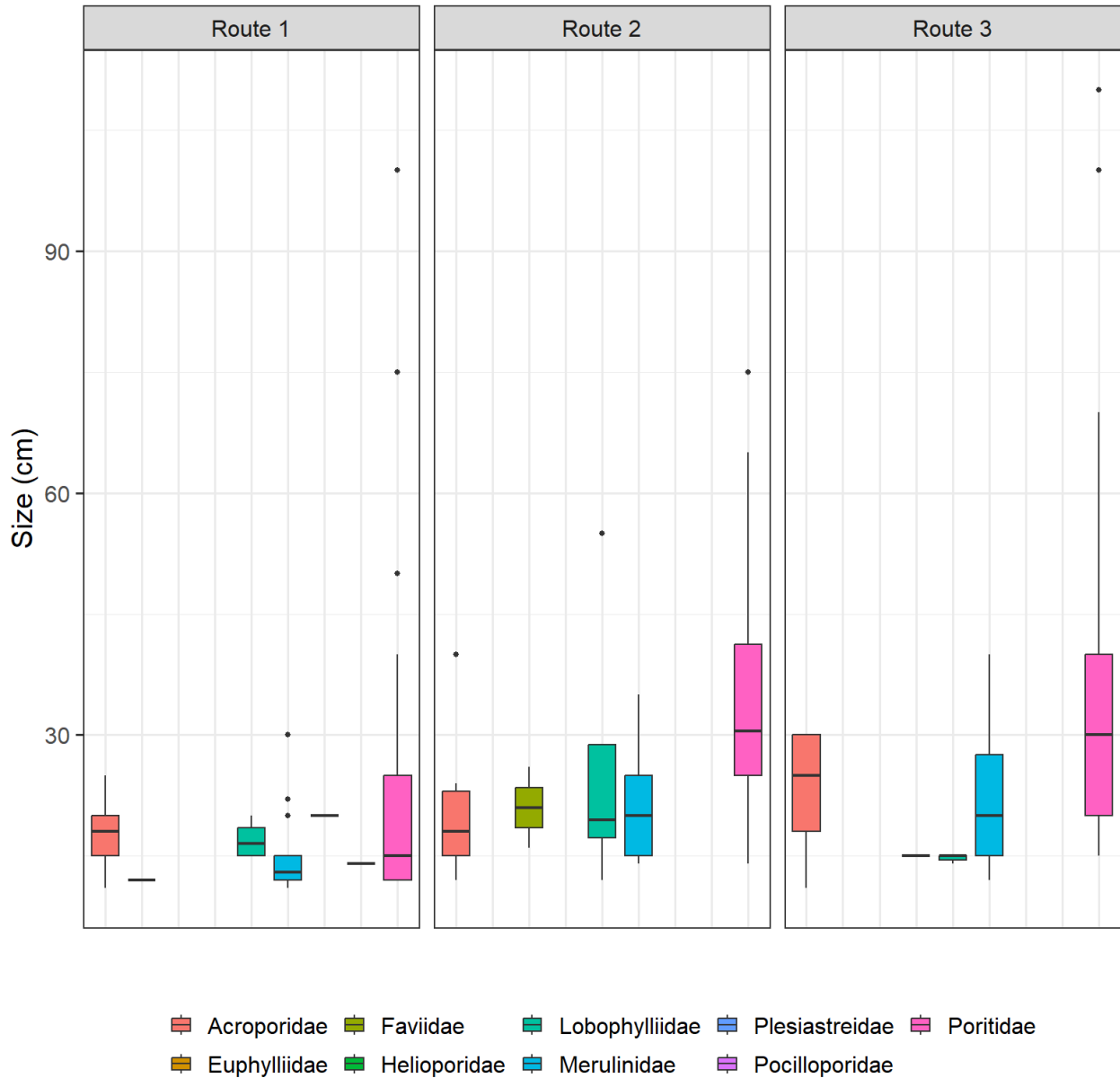


Figure 10: Coral distribution by size and abundance of families.

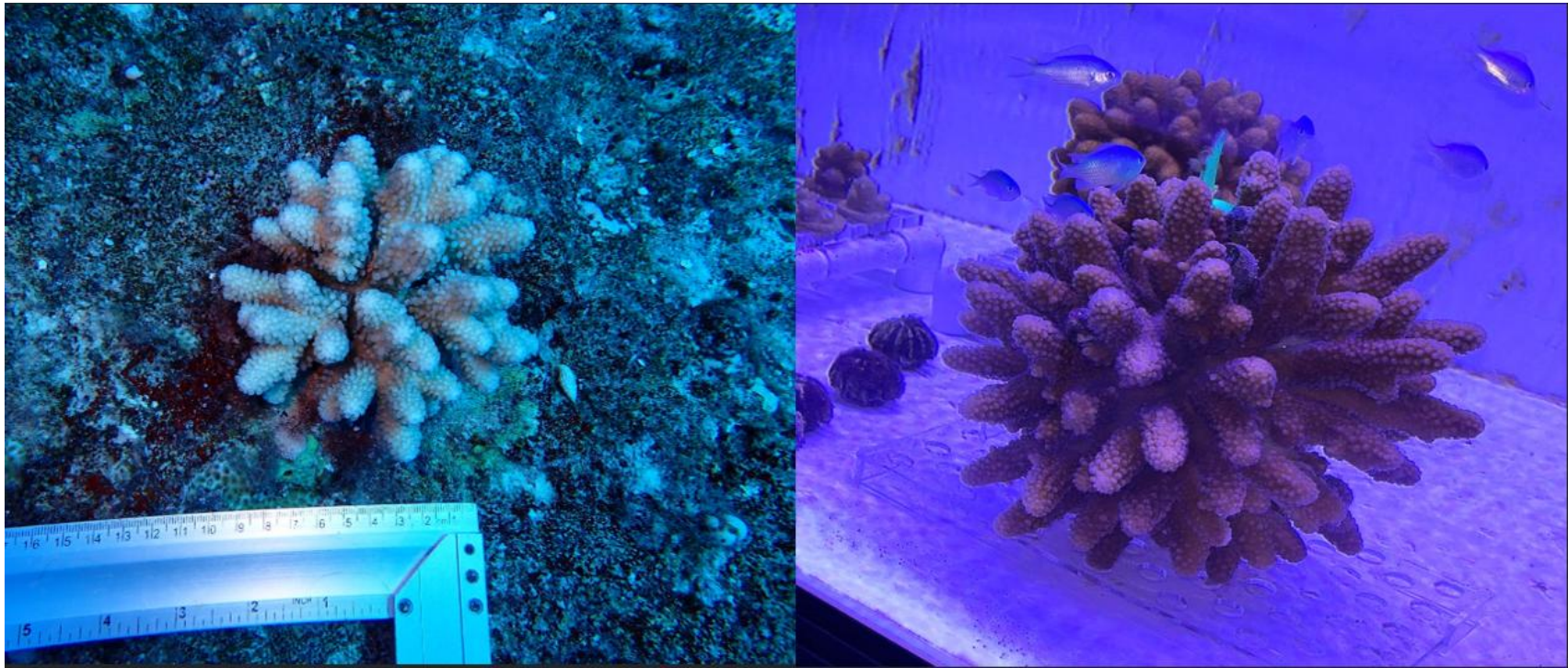


Figure 11: (left) Photo of *Acropora* sp. colony in question, but likely *Acropora humilis*. (right) Known *Acropora globiceps* species exhibiting morphology similar to *A. humilis* in coral nursery on Saipan.



Figure 12: Top left, *Acanthaster planci* (COTS); Top right, *Chelonia mydas*, the green sea turtle, an ESA listed species; Bottom left, *Charonia tritonis*, natural predator of COTS; Bottom right, *Tridacna* sp.



Figure 13: Map of Task 3 route from the reef crest extending onto the reef flat to the proposed bulkhead.

Task 3 Reef Flat Benthic Cover

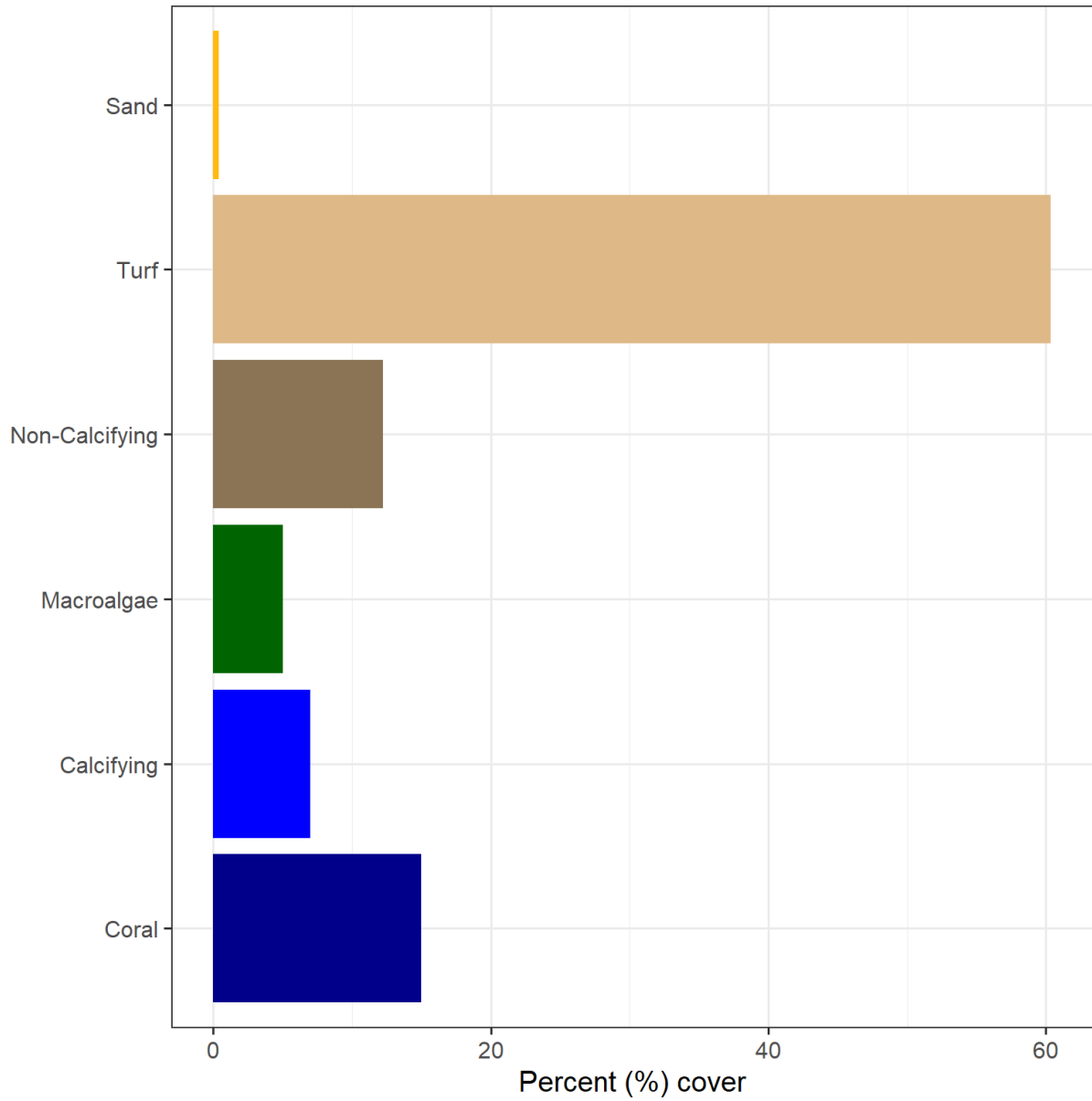


Figure 14: Percent benthic cover for cable landing corridor to the BHM (Task 3)

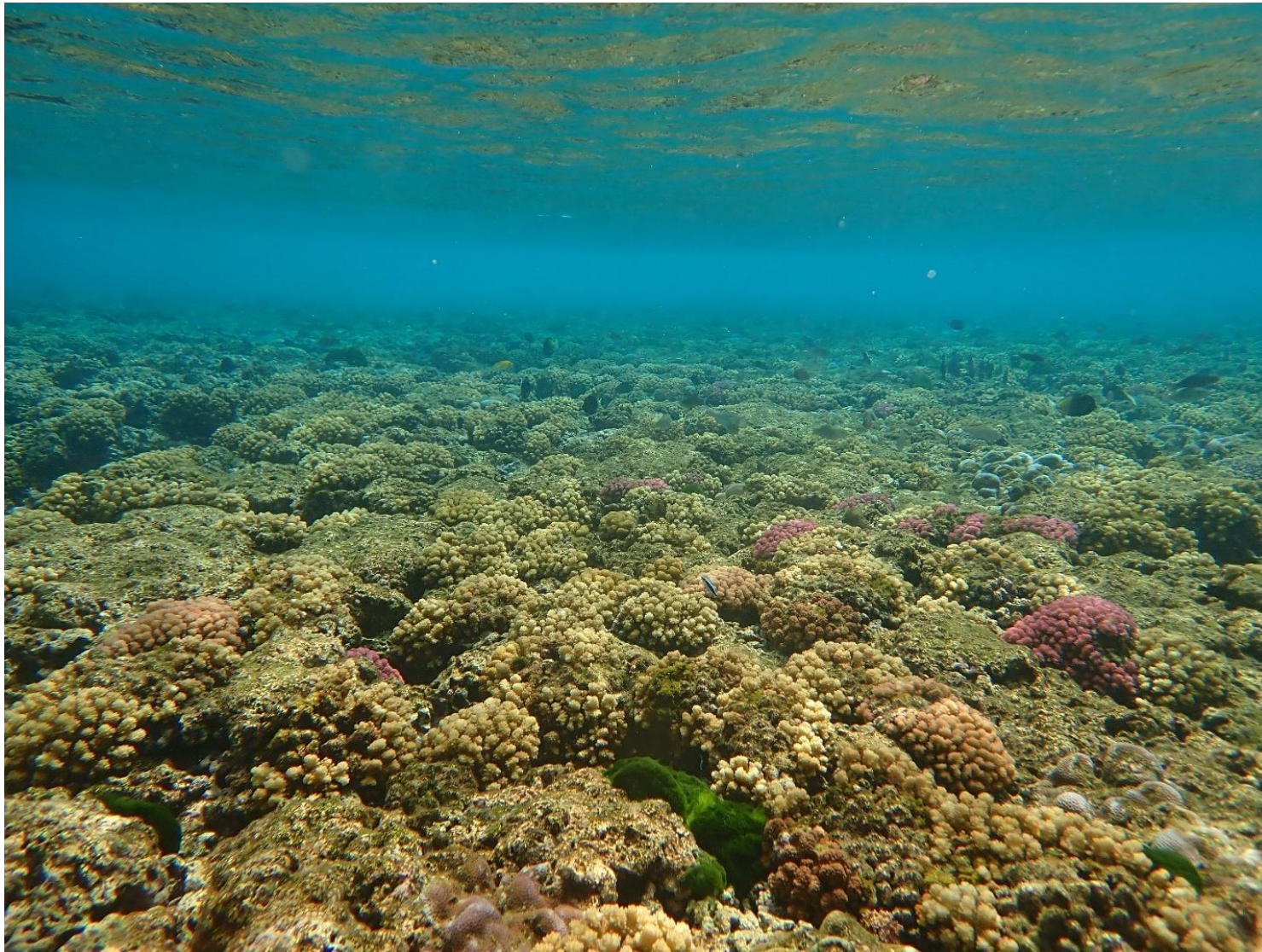


Figure 15: General photo of the reef crest habitat at Lasarino Beach, Tinian. Note that although this is not the specific area to be trenched for the conduit placement, much of the reef crest is comparable to this photo.



Figure 16: Top left, facing SW; cable landing entry route into the lower fore reef. Top right, facing South; sandy bottom channel that the cable landing will cross over. Bottom left, facing NE; cable route through the upper reef flat. Bottom right, facing NE; cable landing route through the upper fore reef

Appendix

Appendix A: List of species and their respective families.

Family	Species
Acroporidae	Acropora aculeus
Acroporidae	Acropora cf. kimbeensis
Acroporidae	Acropora humilis
Acroporidae	Acropora surculosa
Acroporidae	Acropora tenuis
Merulinidae	Astrea sp.
Acroporidae	Astreopora myriophthalma
Acroporidae	Astreopora ocellata
Merulinidae	Cyphastrea sp.
Merulinidae	Dipsastrea sp.
Merulinidae	Favites sp.
Merulinidae	Goniastrea retiformis
Helioporidae	Heliopora coerulea
Faviidae	Leptastrea purpurea
Merulinidae	Leptoria phrygia
Merulinidae	Oulophyllia crispa
Merulinidae	Oulophyllia sp.
Merulinidae	Platygyra daedalea
Merulinidae	Platygyra pini
Pocilloporidae	Pocillopora verrucosa
Poritidae	Porites massive
Poritidae	Porites rus patch reef
Lobophylliidae	Turbinaria stellulata
Euphylliidae	Galaxea fascicularis
Plesiastreidae	Plesiastrea versipora
Pocilloporidae	Pocillopora danae

Appendix B: Task 1 coral list for all transplantable corals within 10 meters of the identified route.

#	Species	Latitude	Longitude
1	Porites massive	14.98173234	145.609289
2	Porites massive	14.98174458	145.6093229
3	Porites massive	14.98174994	145.6093188
4	Porites massive	14.98172698	145.6093151
5	Porites massive	14.98173393	145.6093307
6	Acropora tenuis	14.98173947	145.6093336
7	Porites massive	14.98174558	145.6093357
8	Porites massive	14.98174558	145.6093357
9	Porites massive	14.98175506	145.6093435
10	Porites massive	14.98176805	145.6093509
11	Platygyra pini	14.98177106	145.609358
12	Porites massive	14.98178062	145.6093838
13	Porites massive	14.9817797	145.6093814
14	Psammocora digitata	14.98177391	145.6093868
15	Porites massive	14.98178624	145.6094027
16	Porites massive	14.98179588	145.6093982
17	Porites massive	14.98179428	145.6094093
18	Porites massive	14.98180803	145.6094247
19	Porites massive	14.9818066	145.6094392
20	Porites massive	14.98180677	145.6094529
21	Porites massive	14.98180887	145.609446
22	Porites massive	14.98181096	145.6094402
23	Porites massive	14.98181901	145.6094541
24	Porites massive	14.98181532	145.6094426
25	Porites massive	14.98181549	145.6094306
26	Turbinaria stellulata	14.98181365	145.6094085
27	Porites massive	14.98183586	145.6094597
28	Oulophyllia crista	14.98179378	145.6093214
29	Goniastrea retiformis	14.98177651	145.609304
30	Porites massive	14.98177224	145.6093089
31	Goniastrea retiformis	14.98177869	145.6093302
32	Porites massive	14.98178037	145.6093282
33	Porites massive	14.98178221	145.6093308
34	Porites massive	14.98179311	145.6093384
35	Porites massive	14.98178942	145.609334
36	Porites massive	14.98178942	145.609334
37	Porites massive	14.98179629	145.609332

38	Porites massive	14.98181926	145.6093276
39	Porites massive	14.98181222	145.6093322
40	Porites massive	14.98178305	145.6093542
41	Porites massive	14.98178305	145.6093542
42	Goniastrea retiformis	14.98179177	145.6093615
43	Porites massive	14.98181608	145.6093675
44	Porites massive	14.98189109	145.6094841
45	Porites massive	14.98189109	145.6094841
46	Porites massive	14.98189109	145.6094841
47	Porites massive	14.98196946	145.6095612
48	Porites massive	14.98181515	145.6095001
49	Turbinaria stellulata	14.98184399	145.6094873
50	Turbinaria stellulata	14.98184399	145.6094873
51	Porites massive	14.98186595	145.6095393
52	Porites massive	14.98185438	145.6095423
53	Goniastrea retiformis	14.98186603	145.6095374
54	Goniastrea retiformis	14.98186754	145.6095381
55	Porites massive	14.98185933	145.6095337
56	Porites massive	14.98184583	145.6095359
57	Astreopora myriophthalma	14.98184583	145.6095359
58	Porites massive	14.98186888	145.6095937
59	Porites massive	14.98186888	145.6095937
60	Porites massive	14.98186888	145.6095937
61	Goniastrea retiformis	14.98187651	145.6095923
62	Porites massive	14.9818812	145.6095976
63	Porites massive	14.98188154	145.6095904
64	Porites massive	14.98188187	145.6095999
65	Astreopora myriophthalma	14.98188187	145.6095999
66	Porites massive	14.98189243	145.6096078
67	Porites massive	14.98190702	145.609611
68	Porites massive	14.98191331	145.6096135
69	Goniastrea retiformis	14.98191884	145.6096335
70	Porites massive	14.98190836	145.609639
71	Porites massive	14.9818859	145.6096423
72	Goniastrea retiformis	14.98188967	145.6096434
73	Porites massive	14.98190191	145.6096619
74	Porites massive	14.98190191	145.6096619
75	Porites massive	14.98191146	145.6096779
76	Porites massive	14.98192236	145.6096974
77	Porites massive	14.98193082	145.6096915
78	Goniastrea retiformis	14.98194792	145.6097071

79	Porites massive	14.98194742	145.6096956
80	Turbinaria stellulata	14.98196301	145.6096876
81	Porites massive	14.98196536	145.6096866
82	Porites massive	14.98196544	145.6096715
83	Porites massive	14.9819698	145.6096465
84	Porites massive	14.98196008	145.6096368
85	Porites massive	14.98196008	145.6096368
86	Goniastrea retiformis	14.98194591	145.6096135
87	Porites massive	14.9819304	145.6095685
88	Porites massive	14.9819304	145.6095685
89	Porites massive	14.9819304	145.6095685
90	Porites massive	14.98193468	145.6095614
91	Porites massive	14.98192714	145.6095525
92	Porites cylindrica	14.98192345	145.6095522
93	Platygyra pini	14.98199143	145.609732
94	Porites massive	14.98207591	145.6098958
95	Porites massive	14.98203711	145.6098845
96	Porites massive	14.98191289	145.6097144
97	Porites cylindrica	14.98190006	145.6097263
98	Goniastrea retiformis	14.98190006	145.6097263
99	Porites massive	14.98192362	145.6097673
100	Goniastrea retiformis	14.98192362	145.6097673
101	Porites massive	14.98194667	145.6097393
102	Porites massive	14.98194742	145.6097515
103	Pavona duerdeni	14.98194566	145.6097346
104	Porites massive	14.98192328	145.6097526
105	Porites massive	14.98191423	145.6097589
106	Porites massive	14.98191423	145.6097589
107	Lobophyllia hemprichii	14.98191423	145.6097589
108	Porites massive	14.98190585	145.6097862
109	Porites massive	14.98189721	145.6097854
110	Porites massive	14.98192621	145.6098154
111	Porites massive	14.98197022	145.609829
112	Goniastrea retiformis	14.98196779	145.6098528
113	Porites massive	14.98177534	145.6094433
114	Porites massive	14.98205345	145.6100137
115	Porites massive	14.98205898	145.6099983
116	Goniastrea pectinata	14.98206083	145.6100286
117	Porites massive	14.9820672	145.6100289
118	Lobophyllia hemprichii	14.98206904	145.6100159
119	Goniastrea retiformis	14.98207608	145.6100201

120	<i>Goniastrea retiformis</i>	14.98207198	145.6100243
121	<i>Goniastrea retiformis</i>	14.98206234	145.6100474
122	Porites massive	14.98207617	145.6100743
123	Porites massive	14.98208413	145.610046
124	<i>Goniastrea retiformis</i>	14.98209695	145.6100476
125	Porites massive	14.98211171	145.6100171
126	<i>Platygyra pini</i>	14.98211171	145.6100171
127	Porites massive	14.98210207	145.6100401
128	Porites massive	14.98210081	145.6100365
129	<i>Goniastrea retiformis</i>	14.98211238	145.610023
130	Porites massive	14.98210265	145.6100225
131	Porites massive	14.98210265	145.6100225
132	Porites massive	14.98211908	145.6100305
133	<i>Platygyra pini</i>	14.98212537	145.6100268
134	Porites massive	14.98211288	145.610029
135	Porites massive	14.98211288	145.610029
136	Porites massive	14.98211715	145.6100283
137	<i>Goniastrea retiformis</i>	14.98211011	145.6100525
138	Porites massive	14.98209352	145.6100412
139	Porites massive	14.98209318	145.6100496
140	Porites massive	14.98208229	145.6100544
141	<i>Goniastrea retiformis</i>	14.98208094	145.6100507
142	<i>Turbinaria stellulata</i>	14.98210877	145.610068
143	Porites massive	14.98212319	145.610064
144	Porites massive	14.98210676	145.6100764
145	<i>Pavona duerdeni</i>	14.98209913	145.6100772
146	Porites massive	14.98209955	145.6100773
147	Porites massive	14.98213677	145.6100835
148	Porites massive	14.98213677	145.6100835
149	<i>Pavona duerdeni</i>	14.98213677	145.6100835
150	Porites massive	14.98214976	145.6101171
151	<i>Astreopora myriophthalma</i>	14.98214674	145.6101452
152	Porites massive	14.98214381	145.6101462
153	Porites massive	14.98214381	145.6101462
154	<i>Astreopora myriophthalma</i>	14.9821532	145.6101649
155	Porites massive	14.9821485	145.6101793
156	<i>Astreopora myriophthalma</i>	14.98216133	145.6101696
157	<i>Oulophyllia crista</i>	14.98216812	145.6101511
158	<i>Acropora tenuis</i>	14.98218832	145.6101532
159	Porites massive	14.98219569	145.6101782
160	Porites massive	14.98218823	145.6101828

161	<i>Favia stelligera</i>	14.98218823	145.6101828
162	Porites massive	14.98218002	145.6101763
163	Porites massive	14.98219737	145.6101632
164	<i>Acropora tenuis</i>	14.98219737	145.6101632
165	<i>Goniastrea retiformis</i>	14.98219737	145.6101632
166	<i>lobophyllia hemprichii</i>	14.98220692	145.6101476
167	<i>Astreopora myriophthalma</i>	14.98220692	145.6101476
168	<i>Goniastrea retiformis</i>	14.98223224	145.6101584
169	Porites massive	14.98230541	145.6101922
170	<i>Goniastrea retiformis</i>	14.98228479	145.6101916
171	<i>Goniastrea retiformis</i>	14.98230231	145.6101813
172	<i>Goniastrea retiformis</i>	14.98231262	145.6101885
173	<i>Goniastrea retiformis</i>	14.98231262	145.6101885
174	Porites massive	14.98232016	145.6101958
175	Porites massive	14.98232016	145.6101958
176	<i>Platygyra pini</i>	14.98233005	145.6101926
177	<i>Goniastrea retiformis</i>	14.98233005	145.6101926
178	<i>Goniastrea retiformis</i>	14.98233768	145.6101926
179	Porites massive	14.9823345	145.610199
180	<i>Goniastrea retiformis</i>	14.98230952	145.6102023
181	Porites massive	14.98230952	145.6102023
182	<i>Goniastrea retiformis</i>	14.98232754	145.6102042
183	<i>Acropora serculosa</i>	14.98235051	145.6102016
184	<i>Stylophora pistillata</i>	14.98234715	145.6102084
185	<i>Goniastrea retiformis</i>	14.98234883	145.61022
186	<i>Goniastrea stelligera</i>	14.9823402	145.6102149
187	<i>Acropora globiceps</i>	14.98234179	145.6102158
188	<i>Goniastrea retiformis</i>	14.9823635	145.6102521
189	<i>Dipsastrea</i> sp.	14.9823635	145.6102521
190	<i>Dipsastrea</i> sp.	14.98236719	145.6102605
191	<i>Acropora digitifera</i>	14.98236601	145.6102625
192	<i>Dipsastrea</i> sp.	14.98238051	145.6102599
193	<i>Dipsastrea</i> sp.	14.98238705	145.61027
194	<i>Acropora serculosa</i>	14.98237884	145.6102761
195	<i>Acropora globiceps</i>	14.98237716	145.6103071
196	<i>Acropora digitifera</i>	14.98237523	145.6103142
197	<i>Acropora serculosa</i>	14.98237574	145.6103143
198	<i>Goniastrea retiformis</i>	14.98238068	145.6103149
199	<i>Dipsastrea</i> sp.	14.98238554	145.6102962
200	<i>Dipsastrea</i> sp.	14.98238554	145.6102962
201	<i>Goniastrea retiformis</i>	14.98242678	145.610273

202	<i>Goniastrea retiformis</i>	14.9824236	145.6102896
203	<i>Acropora serculosa</i>	14.98240901	145.6102613
204	<i>Dipsastrea</i> sp.	14.98240901	145.6102613
205	<i>Porites massive</i>	14.98243365	145.6102937
206	<i>Dipsastrea</i> sp.	14.98243935	145.6102933
207	<i>Goniastrea pectinata</i>	14.98243055	145.6103051
208	<i>Goniastrea retiformis</i>	14.98242443	145.6103092
209	<i>Dipsastrea</i> sp.	14.98242812	145.6103108
210	<i>Porites massive</i>	14.98243131	145.6103023
211	<i>Goniastrea retiformis</i>	14.98243039	145.610315
212	<i>Porites massive</i>	14.98241832	145.6103216
213	<i>Acropora globiceps</i>	14.98242234	145.6103302
214	<i>Dipsastrea</i> sp.	14.98240264	145.610355
215	<i>Dipsastrea</i> sp.	14.98240884	145.6103396
216	<i>Goniastrea retiformis</i>	14.98241723	145.6103364
217	<i>Goniastrea retiformis</i>	14.98241723	145.6103364
218	<i>Goniastrea retiformis</i>	14.98241379	145.6103496
219	<i>Acropora globiceps</i>	14.98242494	145.6103215
220	<i>Acropora digitifera</i>	14.98245721	145.6103192
221	<i>Acropora digitifera</i>	14.98245721	145.6103192
222	<i>Goniastrea stelligera</i>	14.98246869	145.6103111
223	<i>Dipsastrea</i> sp.	14.98246869	145.6103111
224	<i>Acropora serculosa</i>	14.98246576	145.6103194
225	<i>Leptoria phrygia</i>	14.98245972	145.6103377
226	<i>Goniastrea retiformis</i>	14.98246324	145.610311
227	<i>Dipsastrea</i> sp.	14.98244732	145.6103621
228	<i>Acropora digitifera</i>	14.98244732	145.6103621
229	<i>Acropora serculosa</i>	14.9824536	145.6103852
230	<i>Acropora globiceps</i>	14.98245595	145.6103759
231	<i>Acropora serculosa</i>	14.98246475	145.6103709
232	<i>Acropora serculosa</i>	14.98247657	145.6103696
233	<i>Acropora serculosa</i>	14.98248571	145.6103623
234	<i>Acropora globiceps</i>	14.98248571	145.6103634
235	<i>Acropora globiceps</i>	14.98249828	145.6103578
236	<i>Acropora globiceps</i>	14.98249828	145.6103578
237	<i>Acropora globiceps</i>	14.98247649	145.6103602
238	<i>Dipsastrea</i> sp.	14.98248847	145.6103467
239	<i>Dipsastrea</i> sp.	14.98248671	145.6103472
240	<i>Dipsastrea</i> sp.	14.98247749	145.6103464
241	<i>Dipsastrea</i> sp.	14.98248034	145.6103469
242	<i>Acropora abrotanoides</i>	14.98249157	145.6104399

243	<i>Acropora abrotanoides</i>	14.9824935	145.6104271
244	<i>Acropora serculosa</i>	14.98247649	145.6104423
245	<i>Acropora serculosa</i>	14.98247649	145.6104423
246	<i>Acropora globiceps</i>	14.98250063	145.6105014
247	<i>Acropora serculosa</i>	14.98250138	145.6105008
248	<i>Acropora digitifera</i>	14.98250406	145.6104962
249	<i>Acropora globiceps</i>	14.98252393	145.610499
250	<i>Porites massive</i>	14.98214599	145.6100041
251	<i>Goniastrea retiformis</i>	14.98213409	145.6100247
252	<i>Coscinaraea exesa</i>	14.98215043	145.6100378
253	<i>Platygyra pini</i>	14.98214951	145.6100455
254	<i>Porites massive</i>	14.98214565	145.6100383
255	<i>Platygyra pini</i>	14.98215236	145.6100331
256	<i>Platygyra pini</i>	14.98215789	145.6100314
257	<i>Porites massive</i>	14.98216962	145.6100209
258	<i>Goniastrea retiformis</i>	14.98216552	145.6100222
259	<i>Goniastrea pectinata</i>	14.98216342	145.6100152
260	<i>Hydnophora microconos</i>	14.98216258	145.6100313
261	<i>Goniastrea retiformis</i>	14.98216501	145.6100374
262	<i>Porites massive</i>	14.98215965	145.6100338
263	<i>Astreopora myriophthalma</i>	14.9821677	145.6100398
264	<i>Goniastrea retiformis</i>	14.98219687	145.6100515
265	<i>Porites massive</i>	14.98219796	145.6100555
266	<i>Goniastrea retiformis</i>	14.98216451	145.6100451
267	<i>Goniastrea retiformis</i>	14.98214942	145.6100489
268	<i>Goniastrea retiformis</i>	14.98214942	145.6100489
269	<i>Porites massive</i>	14.98215521	145.6100502
270	<i>Platygyra pini</i>	14.98215135	145.6100564
271	<i>Platygyra pini</i>	14.98215135	145.6100564
272	<i>Porites rus</i>	14.98215906	145.6100592
273	<i>Porites rus</i>	14.98219075	145.6100754
274	<i>Porites massive</i>	14.98216216	145.6100765
275	<i>Porites massive</i>	14.98217398	145.6100726
276	<i>Porites massive</i>	14.98218488	145.6100632
277	<i>Porites massive</i>	14.98219058	145.6100704
278	<i>Favia stelligera</i>	14.98218253	145.6100942
279	<i>Astreopora myriophthalma</i>	14.98219217	145.6101036
280	<i>Astreopora myriophthalma</i>	14.98219217	145.6101036
281	<i>Astreopora myriophthalma</i>	14.98219217	145.6101036
282	<i>Porites massive</i>	14.9821884	145.6101096
283	<i>Goniastrea retiformis</i>	14.9821884	145.6101096

284	<i>Astreopora myriophthalma</i>	14.98218312	145.6101078
285	<i>Goniastrea retiformis</i>	14.98218312	145.6101078
286	<i>Goniastrea retiformis</i>	14.98218144	145.6101173
287	<i>Platygyra pini</i>	14.98219527	145.6101251
288	<i>Goniastrea retiformis</i>	14.98219117	145.6101112
289	<i>Goniastrea retiformis</i>	14.98218295	145.610102
290	<i>Goniastrea retiformis</i>	14.98218295	145.610102
291	<i>Platygyra pini</i>	14.98219687	145.6101062
292	<i>Platygyra pini</i>	14.98219427	145.6101221
293	<i>Platygyra pini</i>	14.98219427	145.6101221
294	<i>Porites rus</i>	14.98218823	145.6101238
295	<i>Goniastrea retiformis</i>	14.98221053	145.6101278
296	<i>Goniastrea retiformis</i>	14.98221941	145.6101398
297	<i>Lobophyllia hemprichii</i>	14.98222042	145.6101357
298	<i>Favia stelligera</i>	14.98221514	145.6101411
299	<i>Platygyra pini</i>	14.9822143	145.6101481
300	<i>Goniastrea pectinata</i>	14.98220508	145.6101471
301	<i>Goniastrea retiformis</i>	14.98220013	145.6101444
302	<i>Goniastrea retiformis</i>	14.98220013	145.6101444
303	<i>Dipsastrea</i> sp.	14.98222453	145.6101446
304	<i>Astreopora myriophthalma</i>	14.98224397	145.6101466
305	<i>Astreopora myriophthalma</i>	14.98224397	145.6101466
306	<i>Astreopora myriophthalma</i>	14.98224397	145.6101466
307	<i>Leptastrea purpurea</i>	14.98224397	145.6101466
308	<i>Goniastrea retiformis</i>	14.98224917	145.610145
309	<i>Goniastrea retiformis</i>	14.98224481	145.6101354
310	<i>Porites massive</i>	14.98223668	145.6101434
311	<i>Porites massive</i>	14.98222603	145.6101451
312	<i>Porites massive</i>	14.98222603	145.6101451
313	<i>Goniastrea retiformis</i>	14.98222603	145.6101451
314	<i>Goniastrea retiformis</i>	14.98223836	145.6101548
315	<i>Goniastrea retiformis</i>	14.98223836	145.6101548
316	<i>Goniastrea retiformis</i>	14.98223836	145.6101548
317	<i>Platygyra pini</i>	14.98222495	145.6101379
318	<i>Goniastrea retiformis</i>	14.98223525	145.6101351
319	<i>Goniastrea retiformis</i>	14.98224565	145.6101392
320	<i>Cyphastrea</i> sp.	14.9822573	145.610153
321	<i>Platygyra pini</i>	14.98224766	145.6101434
322	<i>Porites massive</i>	14.98225202	145.6101354
323	<i>Porites massive</i>	14.98225981	145.6101349
324	<i>Favia stelligera</i>	14.98224003	145.6101564

325	<i>Astreopora myriophthalma</i>	14.98222989	145.610145
326	<i>Goniastrea retiformis</i>	14.98222989	145.610145
327	<i>Goniastrea retiformis</i>	14.98225763	145.6101424
328	<i>Favia stelligera</i>	14.98225763	145.6101424
329	<i>Goniastrea retiformis</i>	14.98226727	145.6101471
330	<i>Goniastrea retiformis</i>	14.98226727	145.6101471
331	<i>Porites massive</i>	14.98225093	145.6101556
332	<i>Goniastrea retiformis</i>	14.98224766	145.6101692
333	<i>Pocillopora ankeli</i>	14.98225135	145.6101738
334	<i>Acropora quelchi</i> sensu Randall	14.98225135	145.6101738
335	<i>Goniastrea retiformis</i>	14.98224431	145.6101802
336	<i>Porites massive</i>	14.98224959	145.6101704
337	<i>Porites massive</i>	14.98224959	145.6101704
338	<i>Porites massive</i>	14.98225286	145.6101563
339	<i>Porites massive</i>	14.98225286	145.6101563
340	<i>Porites massive</i>	14.98225286	145.6101563
341	<i>Porites massive</i>	14.98225286	145.6101563
342	<i>Goniastrea retiformis</i>	14.98225906	145.6101579
343	<i>Platygyra pini</i>	14.98225906	145.6101579
344	<i>Porites massive</i>	14.9822744	145.610172
345	<i>Porites massive</i>	14.9822744	145.610172
346	<i>Psammocora nierstraszi</i>	14.98226124	145.6101775
347	<i>Astreopora myriophthalma</i>	14.98225713	145.6101697
348	<i>Favites</i> sp.	14.98225713	145.6101697
349	<i>Porites massive</i>	14.98225713	145.6101697
350	<i>Porites rus</i>	14.98225587	145.6101779
351	<i>Goniastrea retiformis</i>	14.98226308	145.6101854
352	<i>Goniastrea retiformis</i>	14.98226308	145.6101854
353	<i>Goniastrea retiformis</i>	14.98227096	145.6101783
354	<i>Goniastrea retiformis</i>	14.98227649	145.6101754
355	<i>Goniastrea retiformis</i>	14.98227649	145.6101754
356	<i>Platygyra pini</i>	14.98228219	145.6101752
357	<i>Favia stelligera</i>	14.98228647	145.6101821
358	<i>Hydnophora microconos</i>	14.9822889	145.6101891
359	<i>Goniastrea retiformis</i>	14.98227934	145.6101837
360	<i>Goniastrea retiformis</i>	14.98227934	145.6101837
361	<i>Goniastrea retiformis</i>	14.98228689	145.6101784
362	<i>Goniastrea retiformis</i>	14.98229368	145.6101814
363	<i>Porites massive</i>	14.98229368	145.6101814
364	<i>Platygyra duerdeni</i>	14.9822951	145.6101849
365	<i>Astreopora myriophthalma</i>	14.98229376	145.6101833

366	Porites massive	14.98229376	145.6101833
367	Astreopora myriophthalma	14.98230432	145.6102064
368	Astreopora myriophthalma	14.98230432	145.6102064
369	Astreopora myriophthalma	14.98230432	145.6102064
370	Goniastrea retiformis	14.98229745	145.6102074
371	Cyphastrea sp.	14.98229745	145.6102074
372	Goniastrea retiformis	14.98229628	145.6102041
373	Pavona duerdeni	14.98229929	145.6102017
374	Leptoria phyrigia	14.98235118	145.6101572
375	Goniastrea retiformis	14.98236761	145.6101512
376	Goniastrea retiformis	14.98236534	145.6101587
377	Goniastrea retiformis	14.98236534	145.6101587
378	Goniastrea retiformis	14.98236534	145.6101587
379	Goniastrea retiformis	14.98236526	145.6101665
380	Goniastrea retiformis	14.98236526	145.6101665
381	Goniastrea retiformis	14.98235017	145.6101798
382	Pavona duerdeni	14.98234841	145.6101854
383	Acropora globiceps	14.98234523	145.6101871
384	Astreopora myriophthalma	14.98233676	145.6101916
385	Favites sp.	14.98233676	145.6101916
386	Goniastrea retiformis	14.98232955	145.6101996
387	Platygyra pini	14.98233718	145.6101999
388	Pavona duerdeni	14.98233718	145.6101999
389	Goniastrea retiformis	14.98234916	145.6102036
390	Goniastrea retiformis	14.98235059	145.6102003
391	Platygyra pini	14.98235864	145.6101913
392	Pavona duerdeni	14.98236224	145.6101893
393	Dipsastrea sp.	14.9823635	145.6101904
394	Hydnophora microconos	14.98236744	145.610179
395	Astreopora myriophthalma	14.98236568	145.6101773
396	Astreopora myriophthalma	14.98235151	145.6101986
397	Porites massive	14.98234732	145.6102038
398	Porites massive	14.98236903	145.6101879
399	Platygyra pini	14.98237255	145.6101843
400	Goniastrea retiformis	14.98239233	145.6101633
401	Goniastrea retiformis	14.98239233	145.6101633
402	Goniastrea retiformis	14.98238864	145.6101661
403	Goniastrea retiformis	14.98238864	145.6101661
404	Goniastrea retiformis	14.98238822	145.6101785
405	Pocillopora ankeli	14.98239007	145.610181
406	Goniastrea retiformis	14.98238781	145.6101885

407	<i>Favia stelligera</i>	14.9823811	145.6101946
408	<i>Hydnophora microconos</i>	14.98237775	145.6101916
409	<i>Goniastrea retiformis</i>	14.98237867	145.6101874
410	<i>Goniastrea retiformis</i>	14.98237867	145.6101874
411	<i>Goniastrea retiformis</i>	14.98237884	145.610189
412	<i>Goniastrea retiformis</i>	14.98237942	145.6101977
413	<i>Goniastrea retiformis</i>	14.98237465	145.6102096
414	<i>Goniastrea retiformis</i>	14.98237465	145.6102096
415	<i>Hydnophora microconos</i>	14.98236828	145.6102093
416	<i>Pavona duerdeni</i>	14.98236752	145.610212
417	<i>Goniastrea retiformis</i>	14.98237683	145.6102123
418	<i>Goniastrea retiformis</i>	14.98237766	145.610213
419	<i>Goniastrea retiformis</i>	14.98237766	145.610213
420	<i>Goniastrea pectinata</i>	14.98238286	145.6101961
421	<i>Acropora</i> sp. juv	14.98239803	145.6101935
422	<i>Goniastrea retiformis</i>	14.98239753	145.6101939
423	<i>Acropora tenuis</i>	14.9823977	145.6101942
424	<i>Stylophora pistillata</i>	14.98240323	145.6101978
425	<i>Galaxea fascicularis</i>	14.98241421	145.6101916
426	<i>Astreopora myriophthalma</i>	14.98239351	145.6102114
427	<i>Acropora</i> cf. <i>granulosa</i> sensu Randall	14.98239351	145.6102114
428	<i>Dipsastrea</i> sp.	14.98237775	145.6102231
429	<i>Oulophyllia crispa</i>	14.98237775	145.6102231
430	<i>Goniastrea retiformis</i>	14.98238605	145.6102248
431	<i>Acropora</i> cf. <i>nasuta</i>	14.9823873	145.6102143
432	<i>Dipsastrea</i> sp.	14.98239418	145.6102086
433	<i>Favia stelligera</i>	14.98240926	145.6102086
434	<i>Goniastrea retiformis</i>	14.9824075	145.6102173
435	<i>Goniastrea retiformis</i>	14.9824075	145.6102173
436	<i>Goniastrea retiformis</i>	14.98240323	145.6102304
437	<i>Goniastrea retiformis</i>	14.98240323	145.6102304
438	<i>Acropora surculosa</i>	14.98239485	145.6102272
439	<i>Favia stelligera</i>	14.98238789	145.6102379
440	<i>Astreopora myriophthalma</i>	14.98238789	145.6102379
441	<i>Goniastrea retiformis</i>	14.98238252	145.6102409
442	<i>Favia stelligera</i>	14.98238252	145.6102409
443	<i>Acropora abrotanoides</i>	14.98240147	145.6102318
444	<i>Goniastrea retiformis</i>	14.98240138	145.6102335
445	<i>Goniastrea retiformis</i>	14.98240138	145.6102335
446	<i>Goniastrea retiformis</i>	14.98240138	145.6102335

447	<i>Platygyra pini</i>	14.98240616	145.6102333
448	<i>Dipsastrea</i> sp.	14.98241521	145.6102315
449	<i>Stylophora pistillata</i>	14.98242745	145.6102268
450	<i>Goniastrea retiformis</i>	14.98243567	145.6102296
451	<i>Goniastrea retiformis</i>	14.98243567	145.6102296
452	<i>Lobophyllia hemprichii</i>	14.98243533	145.6102356
453	<i>Dipsastrea</i> sp.	14.98242745	145.6102404
454	<i>Acropora surculosa</i>	14.98241505	145.6102512
455	<i>Goniastrea retiformis</i>	14.98241848	145.6102348
456	<i>Pocillopora verrucosa</i>	14.98241538	145.6102522
457	<i>Pocillopora verrucosa</i>	14.9824179	145.6102466
458	<i>Goniastrea retiformis</i>	14.9824179	145.6102466
459	<i>Dipsastrea</i> sp.	14.98243785	145.6102312
460	<i>Dipsastrea</i> sp.	14.98243801	145.610236
461	<i>Astrea curta</i>	14.9824381	145.6102439
462	<i>Dipsastrea</i> sp.	14.98243449	145.6102569
463	<i>Astreopora myriophthalma</i>	14.98243449	145.6102569
464	<i>Pocillopora verrucosa</i>	14.98241941	145.6102583
465	<i>Goniastrea retiformis</i>	14.98242083	145.6102616
466	<i>Dipsastrea</i> sp.	14.98244832	145.6102394
467	<i>Goniastrea retiformis</i>	14.98245067	145.6102383
468	<i>Goniastrea retiformis</i>	14.9824609	145.6102358
469	<i>Favia stelligera</i>	14.98245964	145.6102496
470	<i>Favia stelligera</i>	14.98244966	145.610261
471	<i>Favia stelligera</i>	14.98244698	145.6102547
472	<i>Goniastrea retiformis</i>	14.98244941	145.6102605
473	<i>Dipsastrea</i> sp.	14.98244941	145.6102605
474	<i>Dipsastrea</i> sp.	14.98244941	145.6102605
475	<i>Dipsastrea</i> sp.	14.98244547	145.6102523
476	<i>Acropora tenuis</i>	14.98244547	145.6102523
477	<i>Dipsastrea</i> sp.	14.98242301	145.6102633
478	<i>Dipsastrea</i> sp.	14.98242301	145.6102633
479	<i>Platygyra pini</i>	14.98242301	145.6102633
480	<i>Oulophyllia crispa</i>	14.98242527	145.6102612
481	<i>Dipsastrea</i> sp.	14.98242527	145.6102612
482	<i>Goniastrea retiformis</i>	14.98244732	145.6102663
483	<i>Pocillopora ankei</i>	14.98244732	145.6102663
484	<i>Goniastrea retiformis</i>	14.98243609	145.6102843
485	<i>Goniastrea retiformis</i>	14.98244036	145.6102895
486	<i>Goniastrea retiformis</i>	14.98244036	145.6102895
487	<i>Lobophyllia hemprichii</i>	14.9824267	145.61029

488	Hydnophora microconos	14.98245997	145.6102682
489	Dipsastrea sp.	14.98247481	145.6102775
490	Leptoria phyrgia	14.98247162	145.6102811
491	Dipsastrea sp.	14.98247146	145.6102891
492	Platygyra pini	14.98245838	145.610283
493	Pocillopora damicornis	14.98245369	145.6102871
494	Astreopora myriophthalma	14.98245109	145.6102962
495	Platygyra pini	14.98245109	145.6102962
496	Goniastrea retiformis	14.98245075	145.6102937
497	Goniastrea retiformis	14.98245293	145.6102818
498	Goniastrea retiformis	14.98245293	145.6102818
499	Dipsastrea sp.	14.98246023	145.6102862
500	Goniastrea retiformis	14.98247012	145.6102893
501	Goniastrea retiformis	14.98247012	145.6102893
502	Dipsastrea sp.	14.9824738	145.6102915
503	Goniastrea retiformis	14.9824738	145.6102915
504	Goniastrea retiformis	14.9824738	145.6102915
505	Goniastrea retiformis	14.98247464	145.6102817
506	Goniastrea retiformis	14.98247464	145.6102817
507	Astreopora myriophthalma	14.98248152	145.6102847
508	Porites massive	14.98248789	145.6102804
509	Goniastrea retiformis	14.98248001	145.6102797
510	Dipsastrea sp.	14.98248554	145.6102759
511	Leptoria phyrgia	14.98248906	145.6102935
512	Leptoria phyrgia	14.98247808	145.610294
513	Dipsastrea sp.	14.98247456	145.610291
514	Leptastrea purpurea	14.98246433	145.6103023
515	Favites sp.	14.9824707	145.6103067
516	Goniastrea retiformis	14.9824707	145.6103067
517	Pavona duerdeni	14.9824707	145.6103067
518	Goniastrea retiformis	14.98249074	145.6102827
519	Goniastrea retiformis	14.98249887	145.6102851
520	Goniastrea retiformis	14.98249803	145.6102879
521	Astreopora myriophthalma	14.98248638	145.6102895
522	Hydnophora microconos	14.98248227	145.6102921
523	Hydnophora microconos	14.98248227	145.6102921
524	Astreopora myriophthalma	14.98248093	145.6102906
525	Astreopora myriophthalma	14.98248093	145.6102906
526	Pocillopora damicornis	14.98247984	145.6102907
527	Goniastrea pectinata	14.98248185	145.6102906
528	Goniastrea retiformis	14.9824764	145.6102929

529	<i>Platygyra pini</i>	14.98247925	145.6102982
530	<i>Dipsastrea</i> sp.	14.98249107	145.6102917
531	<i>Dipsastrea</i> sp.	14.98249107	145.6102917
532	<i>Dipsastrea</i> sp.	14.98249107	145.6102917
533	<i>Dipsastrea</i> sp.	14.98249191	145.6102909
534	<i>Dipsastrea</i> sp.	14.98249191	145.6102909
535	<i>Dipsastrea</i> sp.	14.98249191	145.6102909
536	<i>Dipsastrea</i> sp.	14.98249191	145.6102909
537	<i>Goniastrea retiformis</i>	14.98249568	145.6102835
538	<i>Platygyra daedalea</i>	14.98249568	145.6102835
539	<i>Favia stelligera</i>	14.98248721	145.6102931
540	<i>Goniastrea retiformis</i>	14.98249182	145.6103052
541	<i>Acropora surculosa</i>	14.98248353	145.6103147
542	<i>Goniastrea retiformis</i>	14.98248571	145.610316
543	<i>Goniastrea retiformis</i>	14.98248571	145.610316
544	<i>Goniastrea retiformis</i>	14.98248202	145.6103192
545	<i>Pocillopora damicornis</i>	14.98248202	145.6103192
546	<i>Lobophyllia hemprichii</i>	14.98248244	145.6103121
547	<i>Goniastrea retiformis</i>	14.98248244	145.6103121
548	<i>Porites massive</i>	14.98248118	145.6103095
549	<i>Pavona duerdeni</i>	14.9825018	145.6102985
550	<i>Dipsastrea</i> sp.	14.98249224	145.6103159
551	<i>Acropora digitifera</i>	14.98248344	145.6103206
552	<i>Goniastrea retiformis</i>	14.98248981	145.6103123
553	<i>Goniastrea retiformis</i>	14.98250289	145.6103037
554	<i>Goniastrea retiformis</i>	14.98250289	145.6103037
555	<i>Goniastrea retiformis</i>	14.98250331	145.6103024
556	<i>Goniastrea retiformis</i>	14.98250331	145.6103024
557	<i>Goniastrea retiformis</i>	14.98250331	145.6103024
558	<i>Goniastrea retiformis</i>	14.98250767	145.6102969
559	<i>Goniastrea retiformis</i>	14.98250767	145.6102969
560	<i>Goniastrea retiformis</i>	14.98250297	145.6103034
561	<i>Goniastrea retiformis</i>	14.98250733	145.6103045
562	<i>Dipsastrea</i> sp.	14.98250121	145.6103018
563	<i>Dipsastrea</i> sp.	14.98251328	145.6103144
564	<i>Dipsastrea</i> sp.	14.98249526	145.6103275
565	<i>Dipsastrea</i> sp.	14.98249526	145.6103275
566	<i>Dipsastrea</i> sp.	14.98249526	145.6103275
567	<i>Goniastrea retiformis</i>	14.98248738	145.6103238
568	<i>Dipsastrea</i> sp.	14.9825142	145.6103181
569	<i>Dipsastrea</i> sp.	14.98250859	145.6103348

570	<i>Goniastrea retiformis</i>	14.98249928	145.610331
571	<i>Goniastrea retiformis</i>	14.98249928	145.610331
572	<i>Goniastrea retiformis</i>	14.98249928	145.610331
573	<i>Goniastrea retiformis</i>	14.98249928	145.610331
574	<i>Goniastrea retiformis</i>	14.98249928	145.610331
575	<i>Dipsastrea</i> sp.	14.98249928	145.610331
576	<i>Dipsastrea</i> sp.	14.98249543	145.6103278
577	<i>Pocillopora verrucosa</i>	14.98251756	145.610351
578	<i>Porites</i> massive	14.98252032	145.6103583
579	<i>Dipsastrea</i> sp.	14.98252032	145.6103583
580	<i>Dipsastrea</i> sp.	14.98251764	145.6103601
581	<i>Dipsastrea</i> sp.	14.98252552	145.6103568
582	<i>Dipsastrea</i> sp.	14.98252854	145.6103515
583	<i>Acropora surculosa</i>	14.98251831	145.6103527
584	<i>Dipsastrea</i> sp.	14.98252351	145.6103603
585	<i>Dipsastrea</i> sp.	14.98252351	145.6103603
586	<i>Acropora nasuta</i>	14.98251194	145.6103574
587	<i>Acropora surculosa</i>	14.98250725	145.6103558
588	<i>Acropora surculosa</i>	14.98250725	145.6103558
589	<i>Acropora ocellata</i> sensu Randall	14.98251169	145.6103676
590	<i>Acropora surculosa</i>	14.98250934	145.6103713
591	<i>Acropora surculosa</i>	14.98251462	145.6103769
592	<i>Acropora surculosa</i>	14.98251462	145.6103769
593	<i>Dipsastrea</i> sp.	14.98251513	145.6103824
594	<i>Pocillopora setchelli</i>	14.98251513	145.6103824
595	<i>Acropora ocellata</i> sensu Randall	14.98251739	145.6103858
596	<i>Acropora globiceps</i>	14.9825251	145.6103917
597	<i>Acropora abrotanoides</i>	14.9825137	145.6103977
598	<i>Acropora abrotanoides</i>	14.98252837	145.6103915
599	<i>Acropora surculosa</i>	14.98252837	145.6103915
600	<i>Pocillopora setchelli</i>	14.98253348	145.6103916

Appendix B

Terrestrial Biological Survey Report Proa Cable System

Terrestrial Biological Survey Report Proa Cable System

Prepared For:



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March 2025

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Acronyms and Abbreviations

BCC	Birds of Conservation Concern
CNMI	Commonwealth of the Northern Mariana Islands
DPS	Distinct Population Segment
ESA	Endangered Species Act
GPS	Global Positioning System
INRMP	Integrated Natural Resources Management Plan
IPaC	Information for Planning and Consultation
MBTA	Migratory Bird Treaty Act
NAVFAC	Naval Facilities Engineering Command
OPD	Office of Planning and Development
SGCN	Species of Greatest Conservation Need
SWAP	State Wildlife Action Plan
USFWS	United States Fish and Wildlife Service

1. Introduction

1.1. Project Background

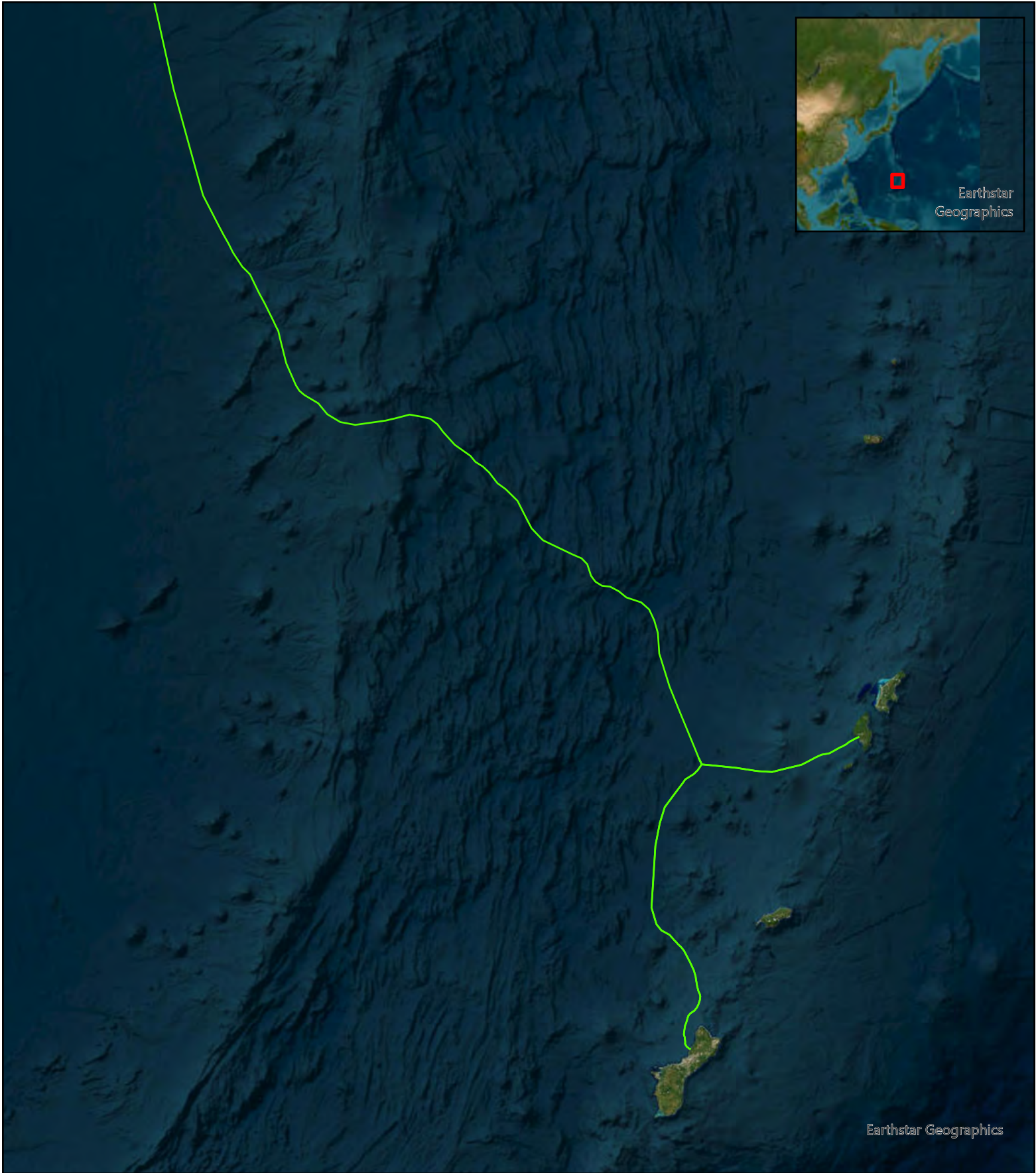
Project Background

The Proa Subsea Cable System will establish telecommunications connectivity between Guam, the Commonwealth of the Northern Mariana Islands (CNMI), and Japan (Figure 1). This report presents the results of terrestrial surveys for protected species on Tinian and Guam at proposed cable landing sites at Lasarino Beach, Tinian and Tanguisson Beach, Guam.

The Proa Subsea Cable System includes a main trunk cable running from Guam to Japan, with a branching unit to Tinian. The installation method for this location has not yet been finalized, as it depends on the completion of ongoing route and inshore surveys. Preliminary plans suggest up to four cable conduits will be trenched on the beach and in the nearshore area to accommodate fiber optic cables. The schedule anticipates one cable landing in 2025, two additional cables in 2026, and a fourth cable at a later, undetermined date. The conduits will link to two beach manholes positioned approximately 175 to 200 feet landward of the high tide line that will provide interconnection with the land-side infrastructure. Design and installation of the beach manhole and associated infrastructure will be installed and operated by other entities.


On Guam, the cable will land at a subsea cable facility managed by AT&T Global Communications at Tanguisson Beach. This facility includes existing conduit infrastructure extending from about 375 feet offshore to 150 feet inland, terminating at a cable splice pit within the AT&T easement. Cable will be pulled through the existing conduit to the onshore splice pit.

From both Tinian and Guam landing sites, the cable will be laid along the ocean floor. Different types of protection, such as articulated pipe, double armor, single armor, or lightweight cable, will be used depending on the seafloor conditions. The trunk cable will traverse the US EEZ toward Japan.



Legend
 Cable Line



0 12.5 25 50 75 100
 Miles

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Figure 1
Proposed Cable Route Overview

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Drawn By: H. Hadlock

Project No. 6399903

1.2. Purpose and Objective

The purpose of the biological field surveys was to determine if species that are classified as rare, threatened, and endangered under local and federal regulations and proposed critical habitat are present within the terrestrial portion of the project footprint to support permits from the U.S. Army Corps of Engineers. The objective of this task was to ensure that actions associated with the proposed project are consistent with the requirements of Section 7 of the Endangered Species Act (ESA) and to identify and minimize the potential impacts on protected species identified within or immediately adjacent to the project area. The field surveys included the following within the terrestrial portion of the project footprint on Guam and Tinian:

- Plant and animal species and host plants for non-extirpated animal species protected under ESA (50 Code of Federal Regulations Part 17);
- Birds protected under the Migratory Bird Treaty Act (16 United States Code § 703(a)); and protected species of the CNMI.

2. Terrestrial Environment

This section describes the terrestrial portions of the project area where the proposed Proa Subsea Cable System would make landfall. The Tinian landing site is located at Lasarino Beach on the western side of the island, approximately 1 mile northwest of the Village of San Jose. (Figure 2). The Guam landing site is located at Tanguisson Beach on the northwestern side of the island (Figure 3). This section addresses the habitats and protected species present in and around both landing sites, focusing on the beach landing sites and the surrounding environments where cable installation activities are proposed.

2.1. Terrestrial Vegetation Communities

The Mariana Islands, a chain of volcanic and limestone islands in the western Pacific Ocean, host a diverse array of terrestrial ecosystems. These ecosystems have been shaped by a complex interplay of factors, including the islands' geological origins, volcanic activity, tropical climate, and the influence of typhoons and other natural disturbances. Human activities, particularly over the past century, have further transformed the landscape, resulting in a mosaic of native and introduced plant communities (DON 2022). This section provides an overview of the terrestrial vegetation of Tinian and Guam, the two islands where the proposed project will make landfall.

Tinian's vegetation has undergone significant transformation due to human activities. Today, Tinian's vegetation is a diverse mix of native and introduced species. Native limestone forests and mixed introduced forests are among the most widespread vegetation types, along with areas of shrubland, strand vegetation, and *Casuarina equisetifolia* forest (DON 2022).

Tinian's native limestone forests provide habitat for important native plant species. These forests often feature *Procris pedunculata* and *Guamia mariannae* in the understory, with a canopy dominated by *Cynometra ramiflora*. Mixed introduced forests typically include a variety of trees, such as *Leucaena leucocephala*, *Casuarina equisetifolia*, *Albizia lebbek*, *Acacia confusa*, *Delonix regia*, and *Pithecellobium dulce* (DON 2022).

Guam, the southernmost and largest of the Mariana Islands, has a varied landscape that includes grasslands, forests, wetlands, and coastal habitats. The island's vegetation has been significantly altered by human activities, including extensive agriculture, urbanization, and military activities. Despite these impacts, Guam retains important areas of native forest, particularly in the rugged southern highlands. The southern part of the island is dominated by grasslands, a result of past clearing for agriculture and military use. Guam's coastline supports a variety of habitats, including sandy beaches, rocky shorelines, and mangrove forests.




Maxar

Legend

 Project Area



0 0.75 1.5 3
 Miles



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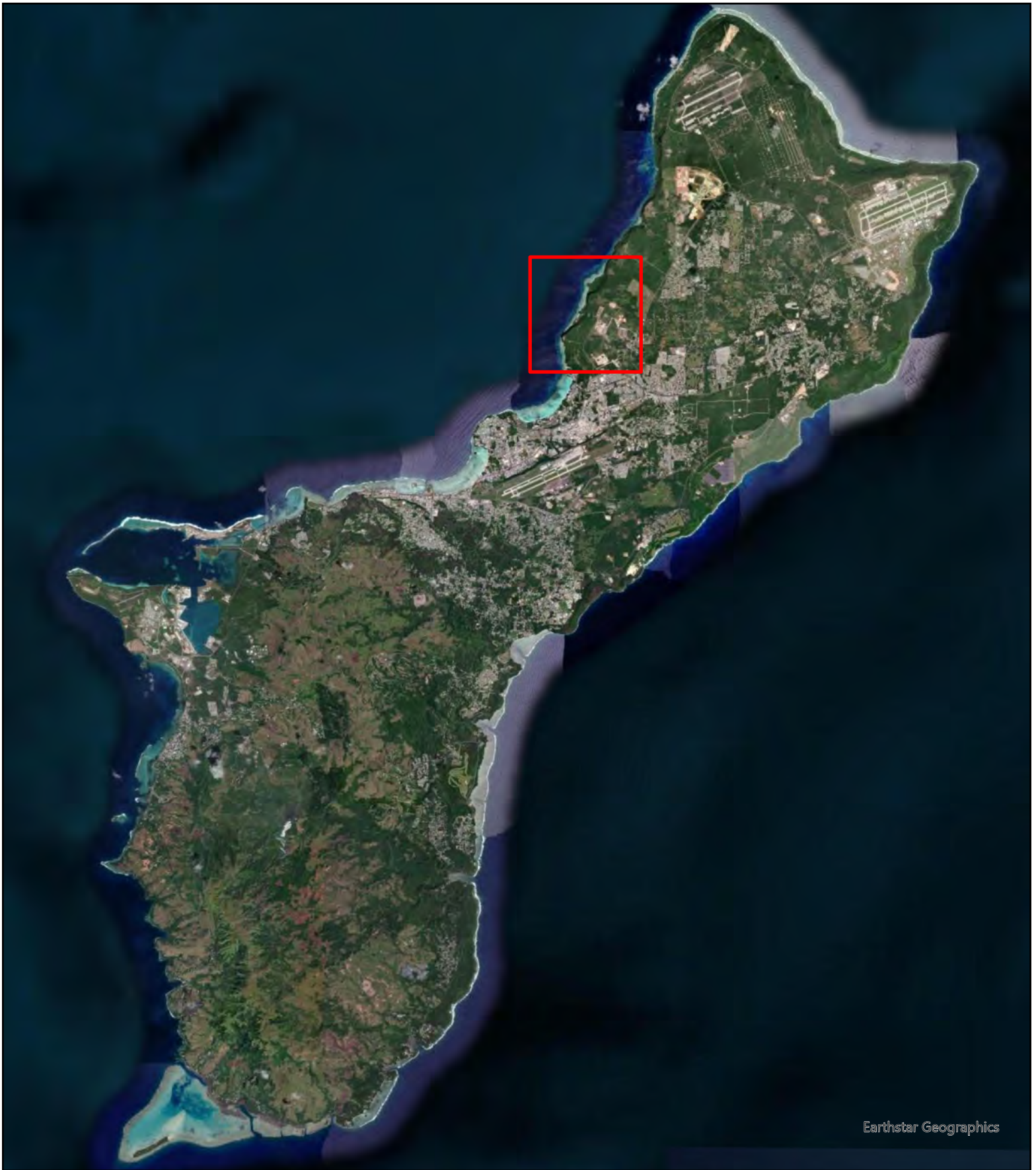
**Figure 2
 Tinian Project Location**

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Earthstar Geographics

Legend

 Project Area



0 1.75 3.5 7
 Miles



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Figure 3
Guam Project Location

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2.2. Sea Turtle Nesting Habitat

2.2.1. Green Sea Turtles

Green sea turtles (*Chelonia mydas*) utilize beaches on the islands of Tinian and Guam for nesting, with peak nesting activity occurring from March to August. However, nesting may occur year-round across the Mariana Islands (Martin et al. 2016). A typical green sea turtle nesting period lasts about 14 days, during which females may lay between four and ten clutches of eggs. On average, each clutch contains approximately 100 eggs, with a hatching timeline of 60 days (National Marine Fisheries Service and U.S. Fish and Wildlife Service 1998a).

Successful nesting requires specific beach characteristics, including a gently sloping sandy profile with appropriate sand compaction to facilitate nest excavation and egg incubation. Stable dune systems with native vegetation, such as grasses and shrubs, are important for dune integrity and nest protection.

Lasarino Beach has had historical green sea turtle nesting observations reported in 2009, 2013, and 2024 (C. Demapan, personal communication, December 17, 2024). Green sea turtles have not been observed to nest on Tanguisson Beach but have been observed in the area (NOAA 2018). Figure 4 shows the location of past green sea turtle nesting locations at Lasarino Beach.

The United States Fish and Wildlife Service (USFWS) has proposed both Lasarino and Tanguisson Beach as critical habitat for the central west distinct population segment (DPS) of the green sea turtle (*Chelonia mydas*), which is listed as Endangered under the U.S. Endangered Species Act (Figure 4). The National Oceanic and Atmospheric Administration (NOAA) has proposed critical habitat for the green sea turtle including all marine waters around Guam and Tinian to a depth of 20 meters (NOAA 2023). Green sea turtles fall under USFWS jurisdiction when on land and under NOAA jurisdiction when in the water. The green sea turtle is also designated as a Species of Greatest Conservation Need (SGCN) in the Commonwealth of the Northern Mariana Islands Wildlife Action Plan (OPD, 2015).

2.2.2. Hawksbill Sea Turtles

Nesting of the hawksbill sea turtle tends to be in more remote areas and low in numbers throughout the Central Pacific. Hawksbill sea turtles nest in remote and rocky beaches in the near-shore vegetation (NMFS and USFWS 1998b). There were estimated to be less than 10 nesting females in the Mariana Archipelago of Guam and the CNMI.

Four hawksbill nests were documented in 2009 and three in 2010 in southwest Guam (NMFS and USFWS 2013). A green and hawksbill sea turtle tagging study around Guam and the CNMI from 2013 to 2017 found limited hawksbill activity in the waters near Tanguisson Beach on Guam and the waters near Lasarino Beach on Tinian and no nesting at either beach (NOAA 2018).



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

- Historical Green Sea Turtle Nesting Locations
- Project Area
- USFWS Proposed Green Sea Turtle Critical Habitat



0 75 150 300 US Feet



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Figure 4
Green Sea Turtle Proposed Critical Habitat and Nesting Observations

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Drawn By: H. Hadlock

Project No. 6399903

3. Methods and Results

The areas around the proposed cable landing site at Lasarino Beach, Tinian, and the splice pit on Guam were surveyed for federally and locally protected species. The objective of these surveys was to ensure that actions associated with the project are consistent with the requirements of the federal ESA and local regulations.

Using the USFWS Information for Planning and Consulting (IPaC) website (USFWS 2024; USFWS 2023), lists of species that may occur within the vicinity of the respective project areas were generated.

For Tinian, the IPaC list identified seven federally protected animal species, including the Mariana fruit bat (*Pteropus mariannus*), Micronesian megapode (*Megapodius laperouse*), short-tailed albatross (*Phoebastria albatrus*), green sea turtle (*Chelonia mydas*), hawksbill sea turtle (*Eretmochelys imbricata*), humped tree snail (*Partula gibba*), and Slevin's skink (*Emoia slevini*), and several migratory birds protected under the Migratory Bird Treaty Act (Appendix C). Additionally, the Tinian monarch (*Monarcha takatsukasae*) and white-throated ground dove (*Gallicolumba xanthonura*) are included on the list of Birds of Conservation Concern (BCC) (USFWS 2021).

For Guam, the IPaC list identified 12 federally protected animal species, including the Mariana fruit bat (*Pteropus mariannus*), Guam rail (*Rallus owstoni*), Guam Micronesian kingfisher (*Halcyon cinnamominus cinnamominus*), short-tailed albatross (*Phoebastria albatrus*), Slevin's skink (*Emoia slevini*), green sea turtle (*Chelonia mydas*), hawksbill sea turtle (*Eretmochelys imbricata*), humped tree snail (*Partula gibba*), Guam tree snail (*Partula radiolata*), fragile tree snail (*Samoana fragilis*), Mariana eight-spot butterfly (*Hypolimnna octocula marianensis*), and Mariana wandering butterfly (*Vagrans egistina*). The Guam Micronesian kingfisher, Guam rail, and Mariana wandering butterfly are considered extirpated on Guam.

The four plant species on the IPaC list for Tinian included: *Solanum guamense*, *Dendrobium guamense*, *Heritiera longipetiolata*, and *Cycas micronesica* (Appendix A). On Guam, 13 federally protected plant species were identified by IPaC: *Bulbophyllum guamense*, *Cycas micronesica*, *Dendrobium guamense*, *Eugenia bryanii*, *Heritiera longipetiolata*, *Maesa walkeri*, *Nervilia jacksoniae*, *Psychotria malaspinae*, *Serianthes nelsonii*, *Solanum guamense*, *Tabernaemontana rotensis*, *Tinospora homosepala*, and *Tuberolabium guamense*.

The Commonwealth of the Northern Mariana Islands (CNMI) Wildlife Action Plan (2015-2025) was developed with the goal of conserving fish and wildlife at both the population and habitat levels. A central element of the plan is the identification of "Species of Greatest Conservation Need" (SGCN), which are species or groups of species that hold significant biological, cultural, or economic importance to the people of CNMI. A total of 33 terrestrial species were selected as SGCN, primarily based on biological criteria (Appendix B). The selection process also included some species that were selected as SGCN due to their cultural or socioeconomic significance, including the coconut crab and the Mariana fruit bat.

On Guam, the Guam Department of Agriculture's Division of Fish and Wildlife Resources (GDAWR) regulates species protected under the Endangered Species Act of Guam (GDAWR 2019). Locally protected species unique to this list include the Micronesian starling (*Aplonis apaca guami*), white-throated ground dove (*Gallicolumba xanthonura*), several skink species such as the Pacific slender-toed gecko (*Nactus pelagicus*) tide-pool skink (*Emoia atrocostata*), the Mt. Alifan tree snail (*Partula salifana*), and the tree fern (*Cyathea lunulate*).

Field surveys were conducted to confirm the presence of federally and locally protected species in the project areas. Surveys for Tinian were conducted on 02 and 03 January 2025, focusing on the terrestrial portion of the survey area, which extended beyond the project footprint to allow for potential adjustments. Surveys on Guam were conducted on 25 September 2023, within 33 feet (10 meters) of the splice pit. In both locations, surveys focused on terrestrial species, including plants, snails, migratory birds, and locally protected species. Particular attention was given to identifying signs of green sea turtle (*Chelonia mydas*) nesting, as Lasarino Beach on Tinian has been proposed as critical habitat by the USFWS (USFWS 2024; USFWS 2023). Tanguisson Beach was not surveyed since the cable will be pulled through the existing conduit to the splice pit, resulting in no disturbance to the beach area.

Meandering surveys within the project footprints were completed by two biologists to record protected species. If evidence of a protected species was observed, the biologists documented the evidence and recorded the locations and details in a Global Positioning System (GPS) device.



Legend

- Survey Line
- Project Area



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**Figure 5
Tinian Survey Area**

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Project No. 6399903

3.1. Survey Results

The biological survey areas on Guam and Tinian featured distinct vegetation communities and environmental conditions, each supporting a variety of plant and animal species. Surveys were conducted within these areas to assess the presence of protected species, migratory birds, and critical habitats.

3.1.1. Tinian

The biological survey area consisted mainly of disturbed grasslands interspersed with well-established paths from vehicles surrounding mixed introduced forest, and strand vegetation communities. The sandy beach area supported vegetation adapted to coastal conditions, while the forested sections were found to harbor a variety of native bird species. During the survey, a green sea turtle (*Chelonia mydas*) was observed in the water within the survey area (Photo 1, Appendix D). What appeared to be coral was observed in the back-reef of the survey area.

Plant species present included *Barringtonia asiatica*, *Antigonon leptopus*, *Mimosa pudica*, *Ipomoea triloba*, *Tournefortia argentea*, *Leucaena leucocephala*, *Cocos nucifera*, *Annona muricata*, *Casuarina equisetifolia*, *Ipomoea hederifolia*, *Operculina ventricose*, *Pandanus dubius*, *Pandanus tectorius*, *Desmodium tortuosum*, *scaevola taccada* and *Mikania micrantha*

No protected plant species were observed.

3.1.1.1. Native Bird Species

Field surveys documented six native bird species within the project area: the white tern (*Gygis alba*), Micronesian starling (*Aplonis opaca*), white-throated ground dove (*Gallicolumba xanthonura*), Mariana kingfisher (*Todiramphus albicilla*), Tinian monarch (*Monarcha takatsukasae*), (Photo 2 and 3 in Appendix D). and Micronesian honeyeater (*Myzomela rubratra*). These observations are summarized in Table 1, which also highlights species designated as Species of Greatest Conservation Need (SGCN) in the Commonwealth of the Northern Mariana Islands Wildlife Action Plan (OPD, 2015), Birds of Conservation Concern (BCC) by the U.S. Fish and Wildlife Service (USFWS, 2021), and those protected under the Migratory Bird Treaty Act (MBTA).

Table 1: Native Bird Species and Conservation Status within the Tinian Project Area

Bird Species	Common Name	SGCN	BCC	MBTA Protected
Gygis alba	White tern			✓
Aplonis opaca	Micronesian starling			
Gallicolumba xanthonura	White-throated ground dove	✓	✓	✓
Monarcha takatsukasae	Tinian monarch	✓	✓	
Todiramphus albicilla	Mariana kingfisher	✓		✓
Myzomela rubratra	Micronesian honeyeater	✓		

Four of the observed species are designated as SGCN and two of those, the white-throated ground dove and the Tinian monarch, are also listed as BCC. The CNMI Wildlife Action Plan Section 7.2.3.4 prioritizes habitat conservation and management actions for the Tinian monarch on Tinian (OPD, 2015). During the field surveys, Tinian monarchs were observed both flying and nesting within the project area (Photo 3, Appendix D).

3.1.2. Guam

The biological survey area consisted mainly of maintained grassy areas and surrounding forest. Of the 0.45-acre area surveyed, approximately 27% was maintained grass (0.18 acres) and the remaining 73% was forested (0.27 acres). The proposed construction would occur within the utility access corridor consisting of maintained grass (Photo 4 in Appendix D). In the surrounding forested areas, the plant communities present were primarily poor quality limestone forest, but also included *Leucaena* and *Antigonon leptopus* vines.

Species present included *Antigonon leptopus*, *Epipremnum pinnatum* ‘Aureum’ (golden pothos vine), *Leucaena leucocephala*, *Morinda citrifolia*, and *Mikania micrantha*. *Annona reticulata*, *Barringtonia asiatica*, *Cocos nucifera*, *Colubrina asiatica*, *Hibiscus tiliaceus*, and *Hernandia sonora* (preferred host plants for endangered tree snails) are also present in the area, although no tree snails were observed on these plants in the biological survey area (Photo 5 in Appendix D). No large fruit-bearing trees or signs of Mariana fruit bats were observed.

During the survey, no protected species, migratory birds, or nests were observed.

4. Summary and Conclusion

On Tinian, the habitat consists of disturbed grasslands, mixed introduced forests, and strand vegetation communities. During field surveys, a variety of wildlife was observed, including six native bird species. Among these, the white-throated ground dove, Tinian monarch, Mariana kingfisher, and Micronesian honeyeater are designated as Species of Greatest Conservation Need (SGCN) in the Commonwealth of the Northern Mariana Islands (OPD, 2015). The Tinian monarch was observed flying and nesting within the project area, highlighting the importance of this location as habitat for this species. Additionally, the green sea turtle, an endangered species and SGCN, was sighted in the adjacent waters, with the sandy beach area providing potential nesting grounds,. However, no active nesting was observed during the surveys.

On Guam, the survey area consisted of sandy soil, maintained developed areas, and disturbed forest, which are not considered suitable habitat for native limestone and savannah plant species or host plants for the Mariana eight-spot butterfly. While host plant species for tree snails were present, no evidence of snails was found. No large fruit-bearing trees or signs of Mariana fruit bats were observed. Field surveys showed no protected species, migratory birds, or nests within the survey area.

Given the presence of protected species on Tinian, including the Tinian monarch and green sea turtle, the proposed project on Tinian may require additional measures to avoid or minimize impacts to these species. On Guam, with the construction confined to maintained grassy areas, the project is unlikely to affect federally or locally protected species.

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Appendix A.
USFWS IPaC Reports for Tinian and Guam

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IPaC: Explore Location resources

IPaC**U.S. Fish & Wildlife Service**

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

Tinian County, Northern Mariana Islands



Local office

Pacific Islands Fish And Wildlife Office

☎ (808) 792-9400

📅 (808) 792-9580

<https://ipac.ecosphere.fws.gov/location/Q7ESOBYAQJDVBGBQQWICKVEHGM/resources>

1/12

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IPaC: Explore Location resources

MAILING ADDRESS

300 Ala Moana Boulevard, Box 50088
Honolulu, HI 96850-5000

PHYSICAL ADDRESS

300 Ala Moana Boulevard, Room 3-122
Honolulu, HI 96850-0056

NOT FOR CONSULTATION

<https://ipac.ecosphere.fws.gov/location/Q7ESOBYAQJDVBGBQQWICKVEHGM/resources>

2/12

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IPaC: Explore Location resources

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species¹ and their critical habitats are managed by the [Ecological Services Program](#) of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries²).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact [NOAA Fisheries](#) for [species under their jurisdiction](#).

1. Species listed under the [Endangered Species Act](#) are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the [listing status page](#) for more information. IPaC only shows species that are regulated by USFWS (see FAQ).

<https://ipac.ecosphere.fws.gov/location/Q7ESOBYAQJDVBGBQQWICKVEHGM/resources>

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IPaC: Explore Location resources

2. [NOAA Fisheries](#), also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS
<p>Mariana Fruit Bat (=mariana Flying Fox) Pteropus mariannus mariannus</p> <p>Wherever found</p> <p>There is final critical habitat for this species. Your location does not overlap the critical habitat.</p> <p>https://ecos.fws.gov/ecp/species/2415</p>	Threatened

Birds

NAME	STATUS
<p>Micronesian Megapode Megapodius laperouse</p> <p>Wherever found</p> <p>No critical habitat has been designated for this species.</p> <p>https://ecos.fws.gov/ecp/species/629</p>	Endangered
<p>Short-tailed Albatross Phoebastria (=Diomedea) albatrus</p> <p>Wherever found</p> <p>No critical habitat has been designated for this species.</p> <p>https://ecos.fws.gov/ecp/species/433</p>	Endangered

Reptiles

NAME	STATUS
<p>Green Sea Turtle Chelonia mydas</p> <p>There is proposed critical habitat for this species. Your location overlaps the critical habitat.</p> <p>https://ecos.fws.gov/ecp/species/6199</p>	Endangered
<p>Hawksbill Sea Turtle Eretmochelys imbricata</p> <p>Wherever found</p> <p>There is final critical habitat for this species. Your location does not overlap the critical habitat.</p> <p>https://ecos.fws.gov/ecp/species/3656</p>	Endangered

<https://ipac.ecosphere.fws.gov/location/Q7ESOBYAQJDVBGBQQWICKVEHGM/resources>

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IPaC: Explore Location resources

Snails

NAME	STATUS
Humped Tree Snail <i>Partula gibba</i> Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/61	Endangered

Flowering Plants

NAME	STATUS
Berenghenas Halomtano <i>Solanum guamense</i> Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9761	Endangered
Dendrobium guamense Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9754	Threatened
Ufa-halomtano <i>Heritiera longipetiolata</i> Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/2526	Endangered

Conifers and Cycads

NAME	STATUS
Fadang <i>Cycas micronesica</i> No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9763	Threatened

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

This location overlaps the critical habitat for the following species:

NAME	TYPE
------	------

<https://ipac.ecosphere.fws.gov/location/Q7ESOBYAQJDVBGBQQWICKVEHGM/resources>

5/12

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IPaC: Explore Location resources

Green Sea Turtle *Chelonia mydas*

Proposed

<https://ecos.fws.gov/ecp/species/6199#crithab>

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

Guam County, Guam



Local office

Pacific Islands Fish And Wildlife Office

☎ (808) 792-9400

📠 (808) 792-9580

MAILING ADDRESS

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS
Mariana Fruit Bat (=mariana Flying Fox) <i>Pteropus mariannus</i> mariannus Wherever found There is final critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/2415	Threatened

Birds

NAME	STATUS
Guam Kingfisher <i>Todiramphus cinnamominus</i> Wherever found There is final critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/6	Endangered
Guam Rail <i>Gallirallus owstoni</i> No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/5112	Endangered
Short-tailed Albatross <i>Phoebastria (=Diomedea) albatrus</i> Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/433	Endangered

Reptiles

NAME	STATUS
Green Sea Turtle <i>Chelonia mydas</i> There is proposed critical habitat for this species. Your location overlaps the critical habitat. https://ecos.fws.gov/ecp/species/6199	Endangered
Hawksbill Sea Turtle <i>Eretmochelys imbricata</i> Wherever found There is final critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/3656	Endangered

Slevin's Skink *Emoia slevini*

Endangered

Wherever found

No critical habitat has been designated for this species.

<https://ecos.fws.gov/ecp/species/9767>

Snails

NAME

STATUS

Fragile Tree Snail *Samoana fragilis*

Endangered

Wherever found

No critical habitat has been designated for this species.

<https://ecos.fws.gov/ecp/species/4835>Guam Tree Snail *Partula radiolata*

Endangered

Wherever found

No critical habitat has been designated for this species.

<https://ecos.fws.gov/ecp/species/1530>Humped Tree Snail *Partula gibba*

Endangered

Wherever found

No critical habitat has been designated for this species.

<https://ecos.fws.gov/ecp/species/61>

Insects

NAME

STATUS

Mariana Eight-spot Butterfly *Hypolimnas octocula marianensis*

Endangered

Wherever found

No critical habitat has been designated for this species.

<https://ecos.fws.gov/ecp/species/6540>Mariana Wandering Butterfly *Vagrans egistina*

Endangered

Wherever found

No critical habitat has been designated for this species.

<https://ecos.fws.gov/ecp/species/7121>

Flowering Plants

NAME

STATUS

Aplokating-palaoan <i>Psychotria malaspinae</i>	Endangered
Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9759	
Berenghenas Halomtano <i>Solanum guamense</i>	Endangered
Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9761	
Cebello Halumtano <i>Bulbophyllum guamense</i>	Threatened
Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9753	
<i>Dendrobium guamense</i>	Threatened
Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9754	
<i>Eugenia bryanii</i>	Endangered
Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9752	
Hayun lagu (=guam), Tronkon Guafi (rota) <i>Serianthes nelsonii</i>	Endangered
Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/8521	
<i>Maesa walkeri</i>	Threatened
Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9756	
<i>Nervilia jacksoniae</i>	Threatened
Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9757	

Tabernaemontana rotensis Threatened

Wherever found

No critical habitat has been designated for this species.

<https://ecos.fws.gov/ecp/species/2542>

Tinospora homosepala Endangered

Wherever found

No critical habitat has been designated for this species.

<https://ecos.fws.gov/ecp/species/10503>

Tuberolabium guamense Threatened

Wherever found

No critical habitat has been designated for this species.

<https://ecos.fws.gov/ecp/species/9762>

Ufa-halomtano Heritiera longipetiolata Endangered

Wherever found

No critical habitat has been designated for this species.

<https://ecos.fws.gov/ecp/species/2526>

Conifers and Cycads

NAME

STATUS

Fadang Cycas micronesica Threatened

No critical habitat has been designated for this species.

<https://ecos.fws.gov/ecp/species/9763>

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

This location overlaps the critical habitat for the following species:

NAME

TYPE

Green Sea Turtle Chelonia mydas Proposed

<https://ecos.fws.gov/ecp/species/6199#crithab>

Bald & Golden Eagles

Appendix B

Wildlife Action Plan for the Commonwealth of the Northern Mariana Islands Tables 2 & 3. Terrestrial and Marine Species of Greatest Conservation Need, 2015

Table 2. Terrestrial Species of Greatest Conservation Need, 2015. (ssp=subspecies)

Chamorro	Carolinian	English (with subspecies identifier if applicable)	Type	BioScore ¹	Threat Ranking ²
<i>Species identified for biological reasons²:</i>					
Sasangot	Sasangot	Micronesian Megapode	Bird	27	H
Litro	Litro	Wedge-tailed Shearwater	Bird	18	M
Luro (Lalisa)	Amwo	Masked Booby	Bird	18	M
Payaya	Asaf	Great Frigatebird	Bird	18	M
Pulatat	Gherel Bweel	Mariana Common Moorhen	Bird	36	H
Paluman kotbata	Apooka	White-throated Ground Dove	Bird	25	H
Paluman totut	Mwee'mwe	Mariana Fruit Dove	Bird	29	H
Chachagwak	Leghekiyank	Mariana Swiftlet	Bird	30	M
Sihok	Waaw	Mariana Kingfisher ssp. albicilla	Bird	23	H
Sihok	Waaw	Mariana Kingfisher ssp. orii	Bird	37	H
Sihok	Waaw	Mariana Kingfisher ssp. owstoni	Bird	19	M
Egigi	Tighpar	Micronesian Honeyeater ssp. saffordi	Bird	27	H
Nabak	Leteghi par	Rufous Fantail ssp. mariae	Bird	25	H
Nabak	Leteghi par	Rufous Fantail ssp. saipanensis	Bird	27	VH
Chichurukan Tinian	Liteighi'par	Tinian Monarch	Bird	35	VH
Aga	Mwi'lup	Mariana Crow	Bird	46	VH
Gaga karisu	Litchogh'i bwel	Nightingale Reed-warbler	Bird	33	H
Nosa/Chuchrika	Litchogh	Bridled White-eye	Bird	19	H
Nosa' Luta	Litchogh	Rota White-eye	Bird	31	H
Canario	Khanooriyo	Golden White-eye	Bird	31	H
Fanihin Liyang	Pajesyes/Pa'Scheei	Pacific Sheath-tailed Bat	Mammal	40	L
Fanihi	Pa'Scheei	Mariana Fruit Bat	Mammal	34	H
Ach'ak		Litoral Skink	Reptile	17	H
Ach'ak		Mariana Skink	Reptile	25	H
Gual'ek	Galuuf	Micronesian Gecko	Reptile	13	VH
Ayuyu	Lyaf	Coconut Crab	Crustacean	17	H
Akmangao		Mangrove Crab	Crustacean	23	H
		Mariana Wandering Butterfly	Insect	50	M
		Rota Damselfly	Insect	46	L
Dengdeng		Humped Tree Snail	Snail	34	H
Dengdeng		Langford's Tree Snail	Snail	46	M
Dengdeng		Rota Unidentified Partula Snail	Snail	44	M
Dengdeng		Fragile Tree Snail	Snail	40	H
<i>Species identified for cultural or socioeconomic reasons²:</i>					
Fanihi	Pa'Scheei	Mariana Fruit Bat	Mammal	N/A	N/A
Ayuyu	Lyaf	Coconut Crab	Crustacean	N/A	N/A

¹ BioScore can range from 0 to 60 with higher scores indicating greater vulnerability.

Table 3. Marine Species of Greatest Conservation Need, 2015.

Chamorro	Carolinian	English	Type	Bioscore ¹	Threat Ranking ²
<i>Species identified for biological reasons³:</i>					
Halu'u	Limwe	Grey Reef Shark	Shark	23	L
Tanguisson	Maam	Napoleon Wrasse	Fish	22	M
Laggua/Oscha	Igan-wosh	Steephead Parrotfish	Fish	18	M
Kabara		Seagrass Parrotfish	Fish	20	L
Toninos	Ghu	Spinner Dolphin	Mammal	18	L
Haggan karai	Wong maaw	Hawksbill Turtle	Reptile	38	L
Haggan	Wong mool	Green Sea Turtle	Reptile	46	M, H ⁴
Laun	Larr	Collector Urchin	Urchin	13	VH
Mahonggang	Yuurr	Longlegged Spiny Lobster	Crustacean	18	VH
Mahonggang	Yuurr	Pronghorn Spiny Lobster	Crustacean	16	VH
Mahonggang	Yuurr	Painted Spiny Lobster	Crustacean	12	VH
Hima	Tto	Small Giant Clam	Clam	27	VH
Hima	Shafeshaf	Fluted Giant Clam	Clam	25	VH
Tapon/Amsun	Al'mett/Ghatil	Pectinate Venus	Clam	15	H
Gamson	Ghuus	Day Octopus	Octopus	15	H
Da'gas prensa	Mwe'ell	Horned Helmet	Snail	23	H
Kulu	Sa'wi	Triton's Trumpet	Snail	18	H
Toro	Li'yang	Common Spider Conch	Snail	20	VH
Ailing pulan	Lifott maram	Silver-mouthed Turban	Snail	18	VH
Ailing pulan	Lifott maram	Tapestry Turban ⁵	Snail	28	VH
Ailing pulan	Lifott maram	Rough Turban ⁵	Snail	28	VH
Da'gas	Abwel	Branched Murex	Snail	16	VH
Kuraling	Yeal	<i>Acropora globiceps</i> Coral	Coral	23	VH
Kuraling	Yeal	<i>Acropora retusa</i> Coral	Coral	23	VH
Kuraling	Yeal	<i>Seriatopora aculeata</i> Coral	Coral	15	VH
Kuraling	Yeal	All Staghorn Corals ⁴	Coral	23	VH
<i>Species identified for cultural or socioeconomic reasons³:</i>					
		"Food Fish"	Fish	N/A	N/A
Haggan	Wong mool	Green Sea Turtle	Reptile	N/A	N/A

¹ BioScore can range from 0 to 60 with higher scores indicating greater vulnerability.

² VH=Very High, H=High, M=Medium, L=Low; "Very High" signifies a species experiencing many and/or severe threats.

Appendix C

Migratory Bird Species Protected under the Migratory Bird Treaty Act and Identified in the Integrated Natural Resources Management Plan (INRMP) for Joint Region Marianas

Table 11-6. Bird Species Recorded on Tinian and Protected under the MBTA

Barn swallow (<i>Hirundo rustica</i>)	Mariana kingfisher (<i>Todiramphus albicillia</i>)
Black kite (<i>Milvus migrans</i>)	Marsh sandpiper (<i>Tringa stagnatilis</i>)
Black noddy (<i>Anous minutus</i>)	Northern pintail (<i>Anas acuta</i>)
Black-crowned night heron (<i>Nycticorax nycticorax</i>)	Northern shoveler (<i>Anas clypeata</i>)
Black-winged stilt (<i>Himantopus himantopus</i>)	Pacific golden plover (<i>Pluvialis fulva</i>)
Brown booby (<i>Sula leucogaster</i>)	Pacific reef heron (<i>Egretta sacra</i>)
Brown noddy (<i>Anous stolidus</i>)	Ruddy turnstone (<i>Arenaria interpres</i>)
Common sandpiper (<i>Actitis hypoleucos</i>)	Sooty tern (<i>Onychoprion fuscatus</i>)
Common tern (<i>Sterna hirundo</i>)	Spectacled tern (<i>Onychoprion lunatus</i>)
Eastern cattle egret (<i>Bubulcus coromandus</i>)	Swinhoe's snipe (<i>Gallinago megala</i>)
Eurasian coot (<i>Fulica atra</i>)	Tufted duck (<i>Aythya fuligula</i>)
Eurasian wigeon (<i>Anas penelope</i>)	Wandering tattler (<i>Tringa incana</i>)
Gadwall (<i>Anas strepera</i>)	Whimbrel (<i>Numenius phaeopus</i>)
Garganey (<i>Anas querquedula</i>)	White-tailed tropicbird (<i>Phaethon lepturus</i>)
Grey-tailed tattler (<i>Tringa brevipes</i>)	White tern (<i>Gygis alba</i>)
Green-winged teal (<i>Anas carolinensis</i>)	White-throated ground dove (<i>Alopecoenas xanthonurus</i>)
Intermediate egret (<i>Egretta intermedia</i>)	White-winged tern (<i>Chlidonias leucopterus</i>)
Lesser sand plover (<i>Charadrius mongolus</i>)	Wood sandpiper (<i>Tringa glareola</i>)
Mariana common moorhen (<i>Gallinula chloropus guami</i>)	Yellow bittern (<i>Ixobrychus sinensis</i>)
Mariana fruit dove (<i>Ptilinopus roseicapilla</i>)	

Key MBTA = Migratory Bird Treaty Act.

Sources: Reichel and Glass 1991; Vogt and Williams 2004; Kessler 2009; Camp et al. 2012; JRM 2013; USFWS 2013; DON 2017a; Gill and Donsker 2017.

Appendix D Field Photos



Photo 1: Green sea turtle (*Chelonia mydas*) in water within survey area.



Photo 2: Mariana kingfisher (*Todiramphus albicilla*) within survey area.



Photo 3: Nesting Tinian monarch (*Monarcha takatsukasae*) in survey area.

Appendix C

Coral Mitigation Plan Proa and TPU Cable Systems – Tinian Branching Units



Coral Mitigation Plan

Proa and TPU Cable Systems – Tinian Branching Units

NEC Corporation

August 05, 2025



Contents

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1. Introduction

This Coral Mitigation Plan has been prepared to support permitting efforts for the Proa Cable System – Tinian Branching Unit and TPU Cable System - Tinian Branching Unit to address impacts to coral and benthic habitat along the cable routes approach to Lasarino Beach, Tinian.

1.1 Background

The Proa Cable System is a subsea fiber optic cable that will connect Japan, the Commonwealth of the Northern Mariana Islands (CNMI), and Guam. The Proa Cable System – Japan-Guam Trunk was authorized under POH-2024-00118 and will be installed in September of 2025. The existing TPU Cable System connects California, Guam, Philippines, and Taiwan. The TPU Cable System was authorized under POH-2023-00148. Both systems have proposed branching units into Tinian.

1.2 Objective

The objective of this Coral Mitigation Plan is to outline a stepped approach for avoidance of impacts, followed by proposed mitigation for those impacts that cannot be avoided. Avoidance of impacts includes the pre-design marine survey and route selection, which has already been complete and is described below for reference.

Two alignments for the land approach were evaluated for impacts to the benthic habitat. The first alignment, surveyed in March 2025, represented the design route chosen based on the Route Survey conducted by NEC in 2024 (see **Image 1**).

The original alignment was found to have up to 46 colonies of Endangered Species Act (ESA)-listed *Acropora globiceps* within the route that could be impacted from installation of the cable. See **Image 1** for the original survey route and occurrences of *A. globiceps*. The preliminary results from this initial marine survey were shared and discussed with National Marine Fisheries Service, both Essential Fish Habitat and ESA divisions. The results were also shared with the Bureau of Environmental and Coastal Quality.

Subsequently, a second benthic survey was conducted to find a corridor either immediately north or south of the original alignment that would be less impactful to benthic habitat, in particular coral. The second benthic survey was constrained to the design survey corridor evaluated in the Survey Report (NEC 2024) prepared for the overall system. Therefore, areas further north or south of the Design Survey Corridor (**Image 1**) were not eligible for consideration as there was no bathymetric or design survey data available.

The results of the second benthic survey found a route south of the original route that contained only twelve colonies of *A. globiceps* on the reef front (see **Image 3**). In addition, the seafloor conditions (at approximately 10 to 20-meter depth) of the route approaching the fore reef had a greater expanse of sandy bottom with fewer scattered coral outcroppings (see **Image 4**). This will allow for cable placement around the outcroppings without the need to relocate coral. Because this second route will be less impactful to benthic habitat, it was chosen to move forward with design.

Image 1: Design Survey Corridor and Original Design Route (red line) (2024)

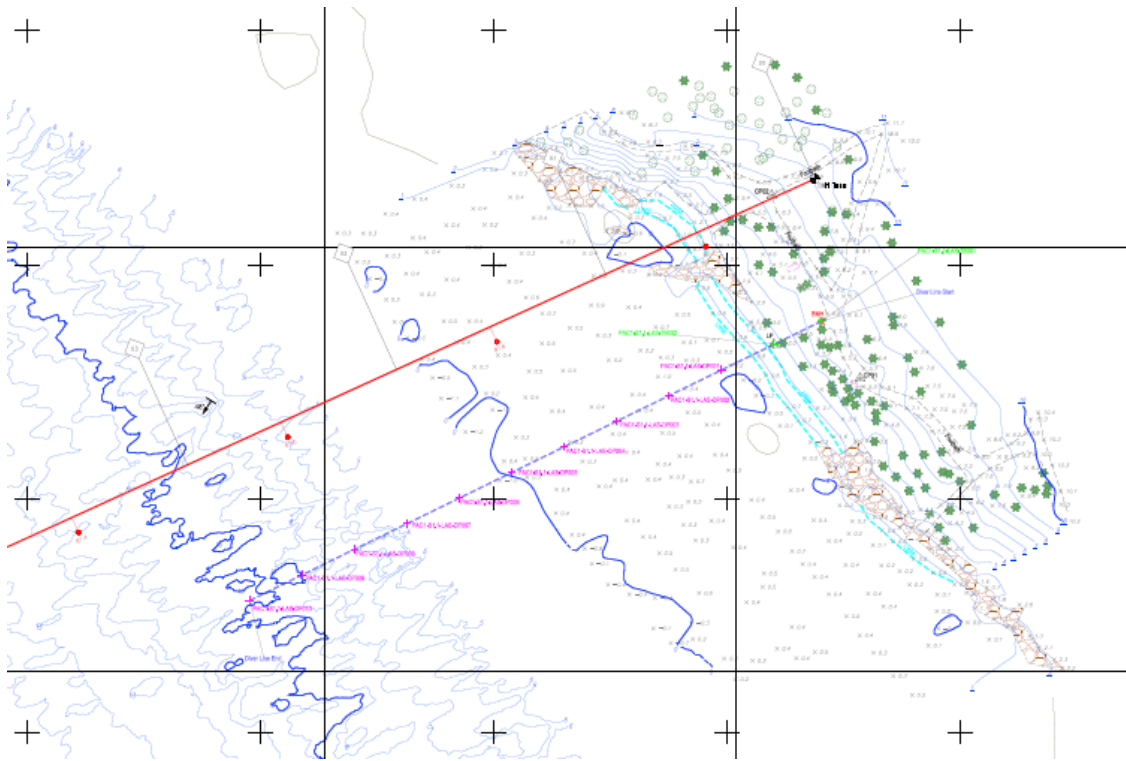


Image 2: Coral Survey for Original Route (March 2025)
(red dots = location of *A. globiceps*)

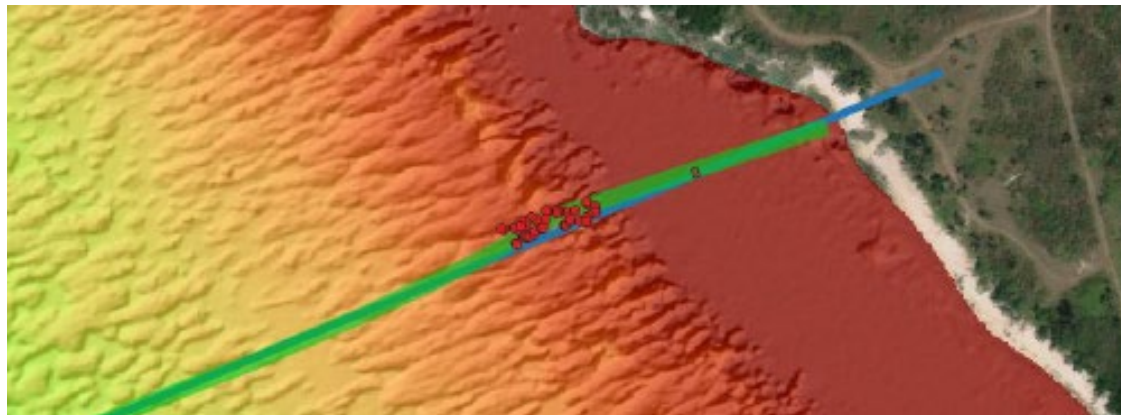


Image 3: Coral Survey for Second / Preferred Route (June 2025)

(yellow dots = location of *A. globiceps*; pink dots = other coral)

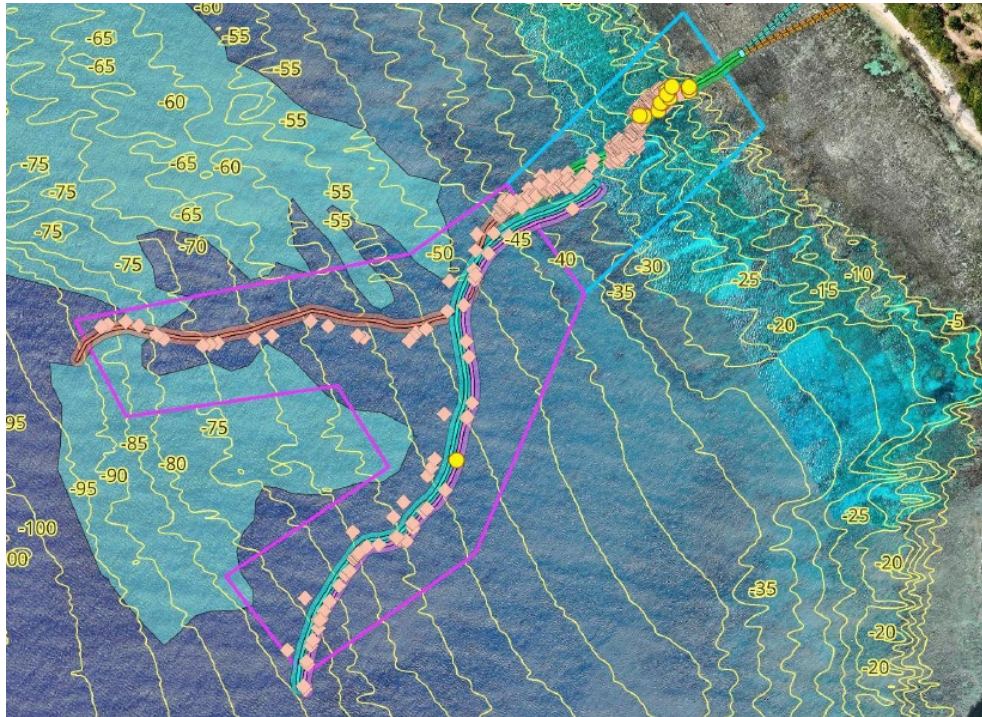
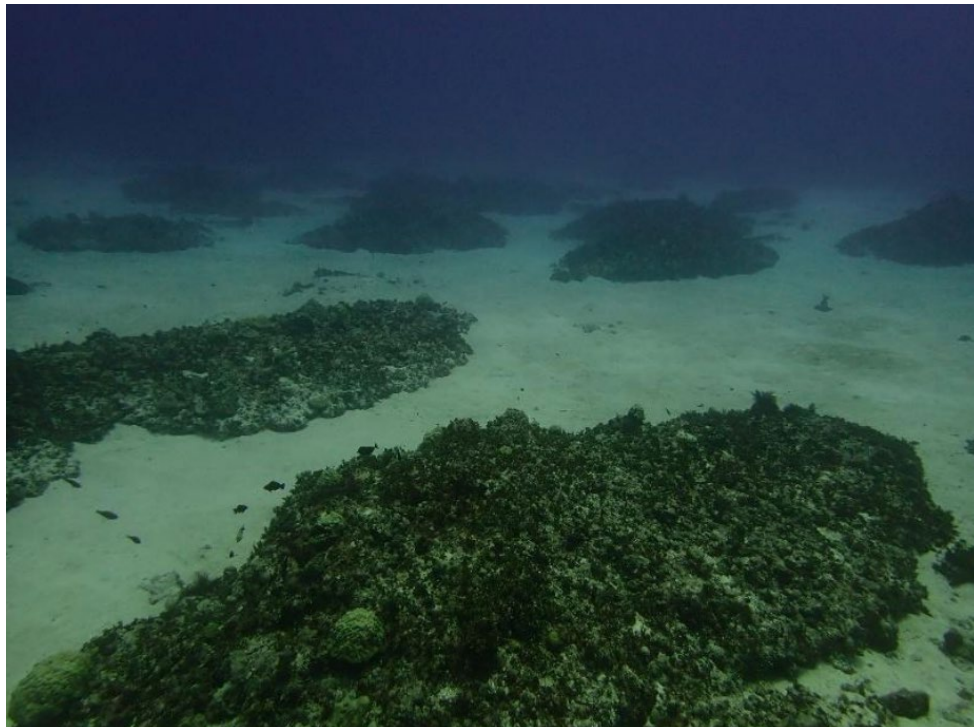


Image 4: Sea Floor Conditions approaching Fore Reef



2. Project Activities

2.1 Project Construction

The Project components include improvements in the marine environment as follows:

- Installation and burial of a marine bulkhead on the reef flat.
- Installation and burial of four, 4-inch conduits from the marine bulkhead to two beach manholes (BMHs).
- Two subsea cables, encased in 6-inch articulated pipe, surface laid on ocean floor from the marine bulkhead to a water depth of 20 meters.

The marine bulkhead and conduit will be installed several months prior to the cable being laid. The marine bulkhead will be installed and buried on the reef flat, approximately 360 feet from the beach and immediately landward of the fore reef. A route across the reef flat to the bulkhead location will be developed for installation and burial of the bulkhead. Prior to the start of construction, a containment system will be installed around the marine work area. At this time, it is not known the exact system to be used but could include silt curtains, sheet piles, or geotubes. Equipment mats may be installed along the access route to limit impacts to the reef. The bulkhead installation location will then be excavated to a depth of 3 to 4 feet using a small backhoe and the pre-cast bulkhead will be installed and buried to the top of the reef flat. Work on the reef flat may take up to two months.

A corridor for four 4-inch diameter conduits will then be trenched approximately 2 to 3 feet deep and the conduits buried in the substrate such that they are installed along the previously disturbed route from the bulkhead to the BMHs. After placement of the conduit, the trench will be backfilled with the excavated material or may be covered with concrete to the level of the reef to secure the infrastructure. Trenching in the marine environment will be approximately 360 feet to the beach and then an additional 170 feet of trenching on land to reach the BMHs.

For cable installation, a cable lay ship will position several thousand feet oceanward of the bulkhead with a dive support vessel deployed about 100 feet from the bulkhead. Vessels will not be allowed to anchor during the cable laying and installation process. A track excavator or winch will be situated inland and will pull the cable through the conduit to the beach manhole. Divers will coordinate the alignment of the cable to ensure proper placement on the seabed.

Following the installation of the cable, divers will install the articulated piping around the cable. Articulated pipe will be held in-place on the sea floor with saddle clamps. Each clamp is drilled to the seafloor with two stainless steel fasteners and a marine epoxy resin. The recommended clamp spacing is 1 per 6.5 feet. However, adjustments can be made in either direction to avoid coral impacts with an allowable deviation of up to 2 feet. Priority will be placed on avoiding coral where feasible, unless the coral is so dense that it is unavoidable. Up to 205 fasteners could be installed, with some requiring epoxy depending on the substrate and length of anchors. The installation of the cable will take 3 to 4 days.

2.2 Coral Avoidance and Relocation

As noted in Section 1, the inshore route has been changed to avoid as much coral habitat as feasible within the Route Survey corridor. The next step in avoidance will be coral relocation within the reef flat and fore reef ahead of construction and microrouting around the outcroppings during cable installation.

Prior to construction, coral colonies located within the footprint of the marine bulkhead, conduit corridor, and articulated pipes will be relocated. Relocation is anticipated to be conducted in two phases. Coral relocation from the reef flat in support of the conduit and bulkhead would occur first, with coral removal in support of cable installation within the articulated pipes through the fore reef occurring later in the year.

The relocation of colonies with branching or massive/ boulder growth morphologies such as *Pocillopora* is feasible. The relocation of encrusting corals, such as *Montipora*, would be unlikely. Where the cable intersects a branching coral, and it is not feasible to shift the cable, branching colonies will be removed and relocated.

Phase 1 Reef Flat (Bulkhead and Conduit)

For coral relocation on the reef flat, priority is placed on removing and staging the coral for re-attachment along the same corridor after construction. However, coral mortality increases when coral is staged for an extended period of time. In addition, the corals on the reef are accustomed to a high-energy environment. Temporary staging typically occurs in a deeper, calmer environment. Together, these two stressors may increase mortality. We are currently working with the contractor to refine the schedule and determine if it is feasible to stage the coral during construction with lower risk.

If extended coral staging cannot occur either due to marine conditions or length of construction, recovered coral colonies will be relocated to an adjacent area within the reef flat with similar depth and substrate characteristics as the original location.

Phase 2 Fore Reef (Articulated Pipe)

Ahead of the cable landing, coral will be relocated from four, 1-foot paths located along the fore reef and reef crest, to the bulkhead. Corals removed from both the fore reef and reef crest will be relocated to areas along the fore reef with similar characteristics. It may not be suitable to relocate corals to other areas of the reef crest as it could be difficult to secure and monitor in this high energy area.

2.3 Mitigation

To mitigate direct impacts to encrusting corals that cannot be relocated, compensatory mitigation may take the form of stabilizing and enhancing coral colonies along the Tinian shoreline, removal of man-made debris within the marine environment, opportunistic removal of crown of thorns, or other methods agreed to in coordination with NFMS. During the marine surveys it was confirmed that there is little to no stabilization or enhancement opportunities at Lasarino Beach. However, westerly swells caused by a recent tropical disturbance in the CNMI have likely caused fragmentation to colonies either within the vicinity of Lasarino Beach or Reef areas around Tachogna Beach (to the South). It is anticipated that the stabilization of fragmented “corals of opportunity” could be utilized for the mitigation. Local marine biologists are currently developing alternatives in coordination with the local government. These activities, including mitigation ratios, methods, success criteria, and monitoring, are described further in **Section 4 Avoidance and Mitigation Measures**.

3. Impact Assessment

In support of the *Benthic and Coral Survey* (Benavente 2025), a 10-meter-wide corridor was surveyed along the reef margin as having the least amount of ESA-listed coral species and non-listed corals, as compared to the broader survey area. In addition, the route chosen avoided adjacent colonies of *Porites rus* and massive *Porites sp.* colonies present within the overall survey area. Despite finding the least impactful route, direct and indirect impacts to benthic habitat from installation of Project facilities at Lasarino Beach will remain.

3.1 Direct Impacts

As a result of re-routing and coral relocation, direct impacts have been reduced but will still occur along the reef flat as a result of installation and burial of the marine bulkhead and conduit, and along the fore reef from placement of articulated pipes. Additional impacts may result from shifting of the linear features during handling and installation.

Within the patch reef, corals are expected to be avoided through micro-routing as the cable is laid. The articulated pipe will be set on a sand substrate avoiding the outcroppings to the greatest extent possible (see **Image 4** above). See Section 4.3 below, for recommended mitigation measures.

3.2 Indirect Impacts

Coral colonies adjacent to the work area could potentially be at risk of damage from indirect activities associated with the installation of the cable within articulated pipe. These activities include vessel (in shallow waters) and diver movements; use, handling and placement of tools, equipment, and materials; and potential re-suspension of sediments. See Section 4.1 below, for recommended avoidance measures.

3.3 *Acropora globiceps*

Twelve *Acropora globiceps* were documented within the 10-meter corridor. While the entire 10-meter corridor will not be impacted, for the purposes of identifying impacts it is assumed that all 12 will be relocated to other parts of the reef margin to avoid direct impact. See Section 4.3 below, for a description of relocation methods.

During micro-routing it may be determined that some can be avoided and left in place. For any that remain, risk of injury and tissue damage can result from divers (i.e. physical contact from fins, hands and SCUBA equipment) and by tools, equipment and materials placed near the proposed alignment. See Section 4.2 below, for recommended avoidance measures.

4. Avoidance and Mitigation Measures

The following avoidance measures will be implemented during installation to reduce impacts to coral. These measures generally follow existing BMPs used by the US Army Corps of Engineers and NOAA to avoid impacts to coral, with additional site-specific measures provided including several to avoid impacts to *A. globiceps* and other coral colonies identified during the marine survey.

4.1 General Best Management Practices and Avoidance Measures

- Where feasible, micro-routing around coral colonies will be implemented.
- Where feasible, coral colonies that cannot be avoided will be relocated.
- To minimize impacts to coral larvae the permittee shall avoid in-water work during mass-coral spawning times or peak coral spawning seasons June 1 to September 30 if practicable. The Corps must consult with their local NMFS HCD biologist to determine the period and dates when coral spawning is likely to occur for the given year.
- Installation of the cable will occur in good, calm weather conditions and during daylight hours.
- Sensitive resource areas, such as corals and coral reefs known to occur within a project area must be identified on project figures. Project staff will be instructed to avoid the sensitive resource areas to the greatest extent practicable, including avoiding anchoring in these areas, flagging the areas if appropriate, and securing all in-water equipment in a manner that will prevent the equipment from being dragged across the substrate.
- All objects lowered to the bottom shall be lowered in a controlled manner. This can be achieved using buoyancy controls such as lift bags, or the use of cranes, winches, or other equipment that affect positive control over the rate of descent.
- Familiarize divers and dive support with seabed features including general coral morphologies (i.e. branching and encrusting) which are likely to be encountered during cable installation.
- Develop and implement a dive work plan detailing procedures for no-anchor zones, diver ingress/egress, deployment and recovery of pipe, tools, and equipment; and handling and use of gear, tools, and equipment underwater to avoid or minimize damage to existing corals.
- Require divers to avoid contact with corals by maintaining neutral buoyancy and proper positioning and placement of fins whilst underwater. Hand tools used during the installation process should be in personal tool bags and not placed on top corals. This will also minimize re-suspension of sediments which can lead to potential smothering of corals.
- Where saddle clamps are used to secure the cable, these will be installed where minimal or no corals occur.
- If needed during installation of the saddle clamps, epoxy will be mixed in small, manageable batches to reduce risk of spills. Once mixed, the epoxy is in a putty form. Therefore, if excess epoxy escapes the clamp hole during installation, the epoxy can, and will be, immediately captured, placed in a pouch, and removed from the aquatic environment when the diver returns to the surface.

4.2 Avoidance of *Acropora globiceps*

- *Acropora globiceps* that cannot be avoided during routing will be relocated.
- Familiarize divers and dive support crew with the location of ESA-listed *A. globiceps* coral colonies within 10 feet of the cable corridor.
- Mark the location of *A. globiceps* colonies and establish a minimum 3-foot buffer for the duration of cable installation.
- When working within 10 feet of an *A. globiceps* colony, require divers to avoid contact by establishing the work area on the opposite side of the cable alignment and placing tools, materials, and equipment beyond the 3-foot buffer.
- While working within 10 feet of an *A. globiceps* colony, monitor (visual inspection) the condition of the coral before, mid-day, and after construction activities.

4.3 Coral Minimization and Mitigation Methods

To minimize impacts to corals, relocation of branching corals will be implemented where the cable alignment cannot be adjusted to avoid the coral. To mitigate direct impacts to corals that cannot be relocated, compensatory mitigation will take the form of stabilizing and enhancing coral colonies along the Tinian shoreline, removal of man-made debris within the marine environment, opportunistic removal of crown of thorns, or other agreed upon method with NMFS. The mitigation is anticipated to be implemented during and immediately after installation of each phase of the project.

Pre-Construction and Post-Construction Survey

When cables are laid adjustments in the alignments are not uncommon. Therefore, to quantify the number of coral colonies that may be impacted from cable installation, pre- and post-construction surveys will be conducted to assess the number of coral colonies for relocation and to document the quantity of unavoidable impacts to calculate the amount of compensatory mitigation needed to offset those impacts

Pre-construction Survey

Prior to installation of the bulkhead and conduit, and later installation of the cable with articulated pipe, a pre-construction survey will be conducted to document baseline conditions, identify the total number of coral colonies suitable for relocation, and assess appropriate coral recipient sites. Additionally, the survey will be used when coordinating with the contractor in establishing the final cable alignment with the goal of selecting the optimal route and reducing coral impacts.

The cable with articulated pipe will be laid out using markers or the 1-inch cable itself prior to installing the articulate pipe. Corals within a 3-inch distance from both sides of the line will be tagged and identified and measured for accounting of final impacts. The following information will be collected on each coral colony to be intersected by the cable:

- a. Coral colony species and identification number
- b. Morphology (i.e. encrusting, plate, tabular, columnar, domed / hemi-spherical, branching and digitate)
- c. Dimensions (i.e. length, width, height and/or circumference)
- d. Coral health and condition

For encrusting and plate coral types, the length and width of the area to be impacted will be measured. For corals with columns (thickly branched), the length, width, and height will be noted. Dimensions for massive (domed), branching, and columnar types, the circumference will be taken.

Coral information will be presented in a tabular format as in the example below. Additional morphology or observations may be added as needed, depending on the site conditions.

EXAMPLE TABLE 1: Corals within Final Impact Area

Colony No	Species	Type / Morphology					Dimensions	Observations ²	Action ³
		Encrusting	Plate / Tabular	Columnar	Dome / Spherical	Branching / Digitate			
1	Species 1	X					Length (L) and width (W)		
2	Species 2		X				L and W		
3	Species 3			X			L, W and Height (H)		
4	Species 4				X		Circumference (C) ¹ and H		
5	Species 5					X	C and H		
Total colonies (N)	Total no of species	Total based on morphology					Total Area		

Notes:

¹ Circumference to be recorded at widest (horizontal) and tallest (vertical) part of the coral, if possible

² Observation of coral health to be recorded including, as appropriate, coral disease, percent live tissue, sedimentation, mucus, and presence of other organisms such as algae and snails

³ Recommended action based on criteria in Section 2

Post-construction Survey

The post-construction survey will include an inspection of the conduit corridor, installed cable with articulated pipe, and any relocated and stabilized corals after completion of site activities (i.e. construction, relocation, and stabilization). A Post-Construction Survey Report will be prepared to provide post installation impact summary, quantifying actual impacts. In addition, coral relocated, coral stabilized or enhanced, and control sites to compare health will be quantified, characterized, photographed, and mapped.

Each coral will have been catalogued and identified for relocation, partial removal, or to be left in place during the pre-construction survey. These will be verified during the post-construction survey and will comprise the final coral relocation (minimization efforts) and unavoidable coral impact requiring mitigation. It is envisioned that the Pre- and Post-Construction Survey Report will be able to present the following information for comparison and accounting:

- a. Corals within the conduit corridor and the final cable alignment with 3-inch offset (from pre-construction survey), which will include photographs of each coral and estimates of area to be intercepted.

- b. Corals removed and relocated (from post-construction survey) which will include photographs of each coral with tags following removal and relocation to mitigation area.
- c. Impacted corals / unavoidable coral loss (from post construction survey) which will include photographs of each coral with tags following placement of the cable and armor.
- d. Control sites for comparison of relocated coral colony health during monitoring.

Results will be combined into the Post-Construction Survey Report with information similarly presented as the following example tables.

EXAMPLE TABLE 2: Estimate of Coral Removed and Unavoidable Coral Impact by Colony

Area	Colony #	Species ID	Morphology ¹	Dimension ²	Action ³	Whole & Cut Corals Relocated			Unavoidable Coral Loss	
						Area removed (sq ft)	No of fragment	Area relocated	Remaining corals in transect	Unavoidable coral loss (sq ft)
Reef Flat	Col 1	Sp 1								
Reef Flat	Col 2	Sp 2								
Reef Flat	Col 3	Sp 3								
Reef Flat	Col 4	Sp 1								
Reef Flat	Col 5	Sp 2								
Reef Flat	Col 6	Sp 1								
Reef Margin	Col 7	Sp 2								
Reef Margin	Col 8	Sp 3								
Reef Margin	Col 9	Sp 1								
Reef Margin	Col 10	Sp 2								
Reef Margin	Col 11	Sp 3								
Reef Margin	Col 12	Sp 4								

Table Notes:

¹ Morphology (encrusting, plate/tabular, columnar, dome/spherical, branching/digitate)

² Dimension (length, width, height and/or circumference)

³ Leave in place, partial removal or colony relocated

EXAMPLE TABLE 3: Summary Table for Unavoidable Coral Impact and Mitigation

Morphology	Unavoidable Coral Impact		Mitigation ¹		
	No. Colonies Impacted	Estimated Area of Impact	Estimated Area Coral Rubble Relocated and/or Stabilized	No. Colonies Opportunistic Relocation and/or Enhancement	Estimated Area Opportunistic Relocation and/or Enhancement
Encrusting					
Plate/tabular					
Columnar					
Dome/spherical					
Branching/digitate					
TOTAL					

Table Notes:

¹ Corals may be grouped according to type / morphology to address compensation targets. While similar morphology across impacts and mitigation will be sought, the ratios may differ due to available opportunities within the mitigation areas. The overall ratio of Mitigation to Impact will achieve 3:1 for corals of opportunity and 4:1 for stabilized rubble, as provided in the Total row.

Removal and Relocation of Coral (Minimization)

The reef flat consists of approximately 15% coral cover. All coral will need to be relocated from the bulkhead footprint and conduit corridor. The reef margin consists of between 5% and 25% coral cover, depending on location. Priority in the reef margin will be placed on adjusting the articulated pipe to avoid corals, particularly within the less dense areas. Those that cannot be avoided will be removed and relocated. Following tagging, identification, and measurement, corals will be assessed if they can be relocated, either through removal of the intersected area (where possible) or relocation of the whole colony.

Small Corals (<12 inches)

For small corals (<12 inches) intersecting the cable alignment, removal of the whole colony will be considered. It is anticipated that small corals will be removed following marking of the alignment or post-deployment of the cable but prior to installation of the articulated pipe.

Large Corals (>12 inches)

For large corals (>12 inches) intersecting the cable alignment, removal of the intersected area will be assessed based on its relative size to the whole coral. The following will be used to assess corals for removal:

- Intercepted areas up to 40% of the total area of the coral will be cut and removed from the coral colony. It is expected that the remaining part of the impacted coral (~60%) will be able to thrive based on relative size and establishment of the colony. These remaining sections of the cut corals will be included for coral monitoring in proposed subsequent surveys. The colony that has been cut will be relocated to the mitigation area and treated the same as small corals (<12 inches).

- If intercepted area of the coral is greater than 40%, full removal will be considered provided these are less than 20 inches in diameter and can be easily dislodged from the bottom.
- If the intercepted area of the coral cannot be easily dislodged or removed from the bottom, the colony will be left in place. This will be included for future coral survivorship monitoring in proposed subsequent surveys and factored into mitigation/offset requirements, if necessary.

Removal and Relocation

Once identified for removal, colonies will be removed by chipping the living portion of the colony from the point of attachment or by removing a portion of the substrate along with the attached organism(s). Selected colonies will be removed using a hammer and masonry chisel, or similar approach. As the coral is moved, the tags will remain with the coral colony for accounting and monitoring.

For coral relocation on the reef flat, priority is placed on removing and staging the coral for re-attachment along the same corridor after construction. However, coral mortality increases when coral is staged for an extended period of time. In addition, the corals on the reef are accustomed to a high-energy environment. Temporary staging typically occurs in a deeper, calmer environment. Together, these two stressors may increase mortality. If extended coral staging cannot occur either due to marine conditions or length of construction, recovered coral colonies will be relocated to either an adjacent area within the reef flat with similar depth and substrate characteristics as the original location, or elsewhere offshore of Tinian if there is not enough space at Lasarino Beach. Preliminary locations are currently under investigation.

For cable installation, it is anticipated the coral removal divers will coordinate with the installation divers to define the exact route and avoidance once the cable has been floated from the ship, with coral removal occurring ahead of installation of the articulated pipe. As many coral colonies as are suitable to do so, will be relocated to the reef flat to fill in gaps along the concrete capped conduit corridor.

The corals will be placed in perforated collection baskets then transported underwater to the relocation area. Coral colonies may be staged for a period of time offshore. Locations for relocation will have been pre-identified, tagged, and mapped during the pre-construction survey and reconnaissance.

Coral reattachment sites will be selected based on relative proximity, open substrate availability, and similarity to original attachment site, including water depth, substrate type, and presence of healthy corals. Coral colonies will be reattached with a spatial distribution that mimics the surrounding benthic habitat.

Reattachment surfaces will be prepared by removing any loose sediment and surficial biota. A concrete mixture will be used to reattach the coral. A sufficient amount of concrete will be placed directly on the pre-cleaned substrate, and organisms to be reattached will be pressed firmly into the mixture until stable and secure. Reattached specimens will be intermittently checked during reattachment operations to ensure their stability, address the aesthetic quality of the reattachment matrix, and dissipate cement residue that may have settled on adjacent biota. Each relocated coral will be numbered and tagged for reference during monitoring.

Stabilization and Enhancement of Coral (Mitigation)

To mitigate direct impacts to corals that cannot be relocated, compensatory mitigation may take the form of stabilizing and enhancing coral colonies along the Tinian shoreline, specifically areas impacted by recent weather disturbances in which large westerly swells will have likely fragmented or dislodged entire colonies along the reef flat and fore-reef (Barcinas Bay, Jones Beach, Tachogna Beach, Tinian Breakwater).

During the pre-construction survey, opportunities to stabilize or enhance coral colonies will be identified, tagged, and mapped off Lasarino Beach or will be identified elsewhere along Tinian in coordination with the local government. Stabilization will consider utilization of or a combination of the following (Ceccarelli *et al*, 2020):

- Cement to bond unconsolidated substrates (applicable to large-sized rubble).
- Loose coral substrate that is large enough to be laid over a layer of smaller fragments. This involves smaller fragments laid over an approximate 4 square-foot area and overlain with large hard materials (i.e. coral substrate).
- Metal stakes providing stabilization over a layer of smaller loose coral rubble. If the rubble has stabilized by the last monitoring event (24 months) the stakes will be removed.
- Organic coir net / reef bags of up to 6 square feet providing substrate stabilization and habitat structure. Loose rubble will be placed inside the bags and secured on to the seabed.
- Detail of the stabilized rubble piles including distance and position relative to the cable, photograph, and coverage area will be recorded and factored into the final offset calculation.
- Corals of opportunity may also be identified for enhancement in place. Coral information (i.e. species, morphology, size, etc) will be recorded for corals of opportunity and will be factored into the final offset calculation. Corals of opportunity will be monitored for survivorship and included as part of the monitoring surveys.

The goal will be to identify larger, clustered areas to reduce the spatial footprint of the mitigation sites within the broader mitigation area, for ease of monitoring and future tracking.

Areas identified for stabilization and enhancement will be ranked and prioritized. Coral colonies and loose rubble that have been utilized as part of the mitigation (i.e. stabilization, enhancement, and opportunistic relocation out of the cable corridor) will be identified, assessed and monitored using the same information and parameters for impacted corals.

Debris Removal (Mitigation)

Areas for man-made debris removal immediately offshore of Tinian may be identified as part of the mitigation plan. In coordination with the local government, potential areas with undesirable marine debris will be identified and investigated. In July swells on the west side of Tinian were larger than normal, potentially resulting in debris being deposited in the nearshore waters of San Jose Village. San Jose Village is an example of an area that will be investigated. Areas where removal will measurably lift the benthic environment will be prioritized. This could include removing toxic debris such as tires and plastic.

Opportunist Removal of Crown of Thorns (Mitigation)

During the initial marine dive at Lasarino Beach, it was noted that coral predation by the crown-of-thorns sea star (COTS) appeared to have had a significant influence on the composition of the condition of the coral communities of the reef system particularly at depths greater than 33 feet.

Though unlikely to occur due to timing constraints when mitigation would be needed, opportunist removal of COTS off the shore of Tinian is included in this mitigation plan, in the event the opportunity arises. If an outbreak were detected, they would either be physically removed from the ocean or injected with a lethal solution such as oxbile. The GHD Team is aware that the Navy has a response team that could potentially assist with eradication dives.

4.4 Mitigation Ratios

Actual impact and mitigation requirements will be calculated and confirmed during the post-construction survey.

The total mitigation requirement will be based only on the sum of unavoidable coral loss, when a coral cannot be relocated (Equation 1).

Total offset mitigation planned will comprise the resulting credits for enhancement of corals of opportunity and removal of man-made debris using a 3:1 ratio and stabilization of rubble using a 4:1 ratio (Equation 2).

Eq 1: Total offset requirement = Sum of unavoidable coral loss

Eq 2: Total offset mitigation planned = $(A_{co} / CR_{co}) + (A_r / CR_r)$

where: A_{co} = Total area for corals of opportunity (sq ft)

CR_{co} = 3:1 credit ratio

A_r = Total area for stabilized rubble (sq ft)

CR_r = 4:1 credit ratio

4.5 Monitoring and Reporting

Relocated and stabilized coral will be monitored for survival and compared with select 'reference' corals located approximately 10 to 20 feet from the mitigation area. The overall goal of monitoring is to determine the relative success of coral relocation, stabilization, and enhancement.

Coral health monitoring (i.e. color, and size) will be undertaken at six months, 12 months, and 24 months after relocation and stabilization, with a monitoring report prepared for each of the three monitoring events.

Monitoring will assess the status of relocated coral and focus on success of the minimization and mitigation efforts and any corrective actions needed. Success criteria will be established at 70% survivorship relative to the nearby control or reference site.

Direct observations concerning attachment status and relative health of reattached organisms will be made by an experienced scientist. Relative health of reattached organisms will be based primarily on assessment of color (e.g., normal, pale, or bleached), tissue condition (e.g., degree of accretion/regression, or presence of disease), interspecific events (e.g., clonid intrusion), and algal overgrowth. Stability and relative health of the reference sites will be compared to the relocation and stabilization groups and between monitoring events. Reattached organisms will

be monitored in situ for stability of cement bond by gently pulling on the colony edge (i.e., tactile census). Any loose organisms will be reattached during monitoring activities.

Removal of man-made debris and removal of COTS will only require pre and post survey. Success will be measured by the removal of the derelict debris and elimination of COTS within the marine environment and does not necessitate require long-term monitoring.

Monitoring reports will be submitted to the respective agencies, if requested.

5. References

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