# REVISED COMPENSATORY MITIGATION PLAN FOR THE HOTEL WHARF AND ACCESS ROAD MAINTENANCE AND REPAIR PROJECT APRA HARBOR, GUAM

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# 1 INTRODUCTION

The maintenance and repair activities at Hotel Wharf involve construction of a new sheet pile bulkhead retaining wall at an approximately 6.25 ft. to 9.75 ft. offset from the existing sheet pile bulkhead wall, and installation of utilities, and paving and installation of utilities along approximately one mile of adjacent access roadway along Apra Harbor on Cabras Island, Guam. No dredging is proposed as part of the project activities.

Hotel Wharf consists of an aging seawall structure with concrete decking and an asphalt center section. In past years, the PAG leased the facility for various commercial activities including cruise ship operations, administrative functions, fishing support operations, and recreational activities. It has also been used directly by the PAG for scrap metal handling, and vehicle import operations when space at the Jose D. Leon Guerrero Commercial Port of Guam (Commercial Port) facility was temporarily restricted.

Hotel Wharf has recently transitioned from being a leased facility to one that will be used directly by the PAG. The PAG anticipates that future construction in the Commercial Cargo Terminal will create an increased need for overflow and contingency operations at Hotel Wharf during Commercial Port reconfiguration and a potential increase in cargo flow as a result of the impending military buildup. Consequently, maintenance and repair of Hotel Wharf is now a high priority project for the PAG.

Currently, the wharf is not in use as the facility is structurally unsound. The purpose of the proposed project is to restore valuable PAG property to safe and efficient operational status. The project is needed to maintain and repair the existing Hotel Wharf and adjacent roadway to support overflow and emergency “break bulk” and “bulk” cargo handling operations, potential military mobilization, and cruise vessel mooring and passenger screening operations.

## 1.1 Objectives of Mitigation Plan

The overall objective of this plan is to mitigate for the loss of ecological functions and services resulting from the direct impacts to coral reef habitat from the proposed construction activities in waters of the U.S., in accordance with the U.S. Army Corps of Engineers mitigation policies as well as the Memorandum of Agreement between the U.S. Environmental Protection Agency and the Department of the Army (U.S. Clean Water Act Section 404).

## 1.2 Description of Proposed Action

In-water construction activities will begin with installation of the turbidity curtain, continue with existing debris removal, then driving of sheet piles, backfill, and capping. Fill material placed between the existing bulkhead and the new sheet pile wall will be contained, and will not be in contact with open water, thereby minimizing impacts to water quality. This sequence of construction activities will minimize ecological disturbance by preventing the level of disturbance and cleanup that would be associated with removing existing piles first.

Storm water quality will be improved with implementation of the proposed project, as surface runoff will be treated by oily water separators and a filtration system or a drainage ditch before entering Apra Harbor. No new riprap will be installed in waters of Apra Harbor during installation of the five new storm water outfalls along the roadway. Overall, the project will improve water quality in the area due to implementation of storm water collection and treatment facilities that do not currently exist.

## 1.3 Description of Impacts

In-water activities will be limited to pile driving and backfill between the proposed sheet piles and existing wharf face, which will result in permanent impacts to 4,577 sq. ft (0.11 acres) of navigable waters (Figure 2). No dredging is proposed as part of the project.

- Direct but temporary impacts.
  There is the possibility that divers would make inadvertent contact with the seabed during construction (e.g., during installation of anchors for turbidity curtains). All divers working in the marine environment would be briefed on the presence of fragile coral colonies and best management practices on how to avoid impacts to marine resources. During construction, divers may stage materials on the seabed such as anchors for the turbidity curtain or materials for debris removal. Staging will be conducted in such a way that no corals are impacted by manually placing the materials on areas where no live corals exist.

- Direct and permanent impacts.
  The total footprint for all in-water improvements is approximately 4,577 sq. ft. (0.11 acre). Additionally, the entire wharf face will be covered and backfilled, resulting in an impact to approximately 15,015.6 sq. ft. (1,395 sq. m.) of vertical area.

- Indirect and short-term impacts.
  A full-depth turbidity curtain will be installed prior to the start of construction and will encompass an area of approximately 43,367.8 sq. ft. (4,029 sq. m.) (Figure 2). Turbidity generated by the pile driving will be trapped within the limits of the turbidity curtain and have the potential to adversely affect any resident corals within this area. The turbidity curtain will remain in place for the duration of the project, which is anticipated to last approximately 2 months.

## 1.4 Avoidance and Minimization Measures

The project incorporates the following measures to avoid or minimize impacts to waters of the U.S. and coral reef resources.

1. Conspicuous mobile invertebrates, such as sea cucumbers and sea stars, would be manually relocated out of the direct impact zone prior to the commencement of all activities.
2. Turbidity curtains will be utilized during the installation and construction of all marine structures in order to minimize local increases in turbidity.
3. Turbidity curtains will be installed no closer than 10 ft. from the identified aggregate reef, as shown in Figure 2.
4. Best Management Practices (BMPs) will include silt fencing in uplands to confine work for the road and storm water drainage improvements.
5. All equipment and materials for turbidity curtain installation, e.g., anchors, would be manually staged in the marine environment in areas where no live coral exist.
6. All divers and personnel working in the marine environment would be briefed on the presence of coral resources, as well as the possibility of marine mammals and sea turtles.

## 1.5 Description of Impact Area

Guam is an unincorporated U.S. territory and the largest and southernmost island in the Mariana Islands archipelago. The project site is located within Lots LPCL-3-REM and LPCL-2 on the Apra Harbor side of the Glass Breakwater, Municipality of Piti (Figure 1). The project site is within the Apra watershed, a 13.1 square mile area that encompasses Apra Harbor and the Aguada, Atantano, Laguas, and Sasa Rivers. The receiving surface water body for the project is Apra Harbor. Guam EPA classifies Apra Harbor as “Good” (M-2 category) quality marine water offshore from Hotel Wharf and the outer Glass Breakwater, and "Fair" (M–2 category) quality marine water offshore from Cementon and the area leading east towards Commercial Port (Guam EPA, 2017). The Guam Power Authority Power Plant and nearby Commercial Port are industrial uses to the east of Hotel Wharf. Fishermen frequent the roadway to the east and west of the project site. Outhouse Beach, located east of Hotel Wharf, is a popular scuba diving site accommodating dozens of divers per day. Jet skiing and flyboarding activities occur within the small embayment immediately to the west of Hotel Wharf and bounded by Dog Leg Pier.

### 1.5.1 Endangered Species

Table 1 lists the U.S. Endangered Species Act (ESA)-listed species under the jurisdiction of the National Marine Fisheries Service (NMFS) that are known to occur, or could reasonably be expected to occur, in the action area, and may be affected by the proposed activities. These include the Central North Pacific distinct population segment (DPS) of the green sea turtle and the Indo-West Pacific scalloped hammerhead shark DPS.

Table 1. ESA-Listed Species that are known to occur or may occur in the action area

| Common Name | Scientific Name | ESA Status |
|---|---|---|
| **Green Sea Turtle Central North Pacific DPS** | *Chelonia mydas* | Endangered |
| **Hawksbill Sea Turtle** | *Eretmochelys imbricata* | Endangered |
| **Indo-West Pacific Scalloped hammerhead shark DPS** | *Sphyrna lewini* | Threatened |

The only ESA-listed species under U.S. Fish and Wildlife Service (USFWS) jurisdiction that may occur in the action area are the green sea turtle and hawksbill sea turtle. A sea turtle nesting beach is located approximately 900 meters east of Hotel Wharf, and will not be disturbed by the proposed action.

Effective November 13, 2014, 15 Indo-Pacific coral species were listed as threatened under the ESA (79 FR 53851). Three of these listed corals occur within Guam's waters: *Acropora globiceps*, *Acropora retusa*, and *Seriatopora aculeata*. None of these ESA-listed species (i.e., corals, turtles or shark), or any other listed species, were observed in the Direct or Indirect Impacts Zones during supplemental marine biological surveys in January and February 2019 (Burdick, 2019).

Based on an analysis of the proposed action and minimization of impacts provided by the proposed implementation of best management practices (BMPs), the PAG determined that the proposed action is not likely to adversely affect the ESA-listed species under NMFS jurisdiction (Table 1). On March 12, 2019, NMFS concurred with this determination of effect and concluded informal consultation for the proposed action under Section 7 of the U.S. Endangered Species Act. Similarly, PAG determined through an analysis of the proposed action and BMPs, that the proposed action may affect but is not likely to adversely affect ESA-listed species under USFWS jurisdiction. On April 12, 2019, USFWS concurred with this determination of effect and concluded informal consultation for the proposed action under Section 7 of ESA.

### 1.5.2 EFH and MUS

On Guam, EFH is defined as the marine water column from the surface to a depth of 1,000 m from shoreline to the outer boundary of the Economic Exclusion Zone (EEZ) (5,150 kilometers/200 nautical miles/230 miles), and the seafloor from the shoreline out to a depth of 700 m around the island. This EFH designation includes the water column and seafloor of Apra Harbor where the Hotel Wharf project is proposed, and its surrounding waters and submerged lands that support various life stages for the Management Unit Species (MUS) identified under the Western Pacific Regional Fishery Management (WPRFM) Council's Pelagic and Mariana Archipelago Fishery Ecosystem Plans (FEP) (2009a and 2009b). EHF for these waters has been designated for MUS and life stages (eggs, larvae and juveniles) of Coral Reef Ecosystem MUS (CRE-MUS), Bottomfish MUS (BMUS), Crustacean MUS (CMUS), and Pelagic MUS (PMUS).

# 2 MITIGATION GOALS AND OBJECTIVES

This mitigation plan is prepared to present measures to minimize or offset adverse effects to EFH (i.e., benthic/bottom habitat and substrate) and MUS resources (i.e., coral colonies/coral reefs that are CRE-MUS) and their ecosystem function due to the proposed activities.

## 2.1 Summary of Mitigation and Minimization Measures

The minimization and mitigation measures for this project are summarized below:

Table 2. Summary of Mitigation and Minimization Measures

| Minimization / Mitigation Measure | Goal and Objective |
|---|---|
| **Pre-construction coral relocation** | Minimization of impacts to CRE-MUS by removal of corals from direct impact zone |
| **Debris removal** | Restoration of soft-bottom substrate, reduction of physical stressors to EFH by removal of potential threats to corals from debris damage |
| **Public education and outreach** | Reduction of physical stressors to EFH from human sources of damage during recreational activities |
| **Water quality improvements through stormwater management** | Reduction of irradiance (turbidity) and pollutant stressors by collecting and pre-treating storm water runoff before it enters Apra Harbor |

### 2.1.1 Pre-construction Coral Relocation

Prior to construction, corals identified as feasible for relocation will be moved from Hotel Wharf to a suitable relocation site nearby. Due to the scale of the relocation effort and several factors that might make relocation of certain coral species infeasible, some coral resources will be left in place and ultimately destroyed during construction.

### 2.1.2 Debris Removal

A large amount of debris is currently occupying a significant portion of the predominantly softbottom (sandy) substrate surrounding Hotel Wharf. Prior to the commencement of construction and only once the turbidity curtains are correctly installed, the contractor will likely use a crane to remove debris from the marine environment. This activity will be conducted only within the turbidity curtains in order to reduce the likelihood of sediment leaving the project area.

### 2.1.3 Public Education and Outreach

The tourism industry on Guam accounts for up to 60% of the Government of Guam's annual revenues (GVB, 2014), and continues to grow, with over 1.5 million visitors in 2016, and visitor spending reaching $1.75 billion, supporting nearly 21,100 jobs (34% of total employment on Guam) with an associated tourism labor income of $617 million (GVB, 2018). The island's marine resources, including coral reefs, play an important role in attracting these tourists to Guam; however, physical damage can occur when these users of the marine resources are not aware of potential impacts from their activities. These activities may include touching or walking on coral, resulting in abrasion or actual fracturing of corals.

Marine resources within the Port are managed under the Department of Parks and Recreation (DPR) Recreational Water Use Management Plan (RWUMP). Under this plan, the Port allows commercial vendors the use of designated areas for commercial activities. Outhouse Beach (also known as Divers Beach), located approximately 1,115 ft east of Hotel Wharf, is frequently used for introductory scuba diving instruction because of the easy entry from shore and accessibility to deeper water. Dog Leg Pier, located west of Hotel Wharf, is also used regularly for commercial recreational activities.

In July 2019, the PAG surveyed all commercial vendors that have been issued commercial permits by the PAG to use their facilities (i.e., Outhouse Beach and Dog Leg Pier) in order to obtain credible user data for each site. Each vendor was asked to calculate and provide the maximum, minimum, and average number of scuba dives, snorkels, and other marine sports conducted on a weekly basis. Using this data, the expected annual number of divers was calculated for each site (Table 3).

Table 3. Estimated coral impacts in Apra Harbor and expected reduction in impacts after implementation of the Public Outreach and Education Program.

| Row | Field | Value | Data Source |
|---|---|---|---|
| 1 | Number of Corals Damaged Per Diver Per 60-min Dive | 1.7 ± 4.9 | Zakai and Chadwick-Furman, 2002 |
| 2 | Expected Annual Number of Divers using PAG Facilities | 25,000 | PAG Vendor Surveys, 2019 |
| 3 | Expected Reduction in Diver Impacts after Briefing | 50% | A. Williams, 2019 |
| 4 | Estimated Annual Total No. of Diver-Damaged Corals at Outhouse Beach and Dog Leg Pier | 42,500 | Row 1 × Row 2 |
| 5 | Expected Annual Reduction in Total Number of Diver-Damaged Corals after Diver Briefing | **21,250** | Row 4 - Row 3 |

According to the user survey data, approximately 25,000 dives are expected to be conducted each year by PAG commercial vendors within Dog Leg Pier and Outhouse Beach. This is a low-end estimate based on vendor survey data, and only takes scuba diving into account. Estimates would likely be higher if impacts from snorkelers, jet ski, underwater scooters, and other marine sports were included; however, no scientific

sources could be found pertaining to these other types of activities and their impacts to coral.

Zakai and Chadwick-Furman (2002) found that divers in groups will damage an average of 1.7 ± 4.9 corals per 60-minute dive. The amount and extent of direct, diver-related damage to corals is dependent on the number of divers using the area, the type of corals, and the divers' experience level. The PAG commercial vendors using Dog Leg Pier reported that 50%-80% of their diving customers do not possess a scuba diving certification, 0% to 30% have "Open Water" certification, 0% to 20% have "Advanced Open Water" certification, 0% to 10% have "Rescue Diver" or higher certifications. The divers that use Dog Leg Pier are predominantly beginners with little to no diving experience; hence, they would have a relatively high probability of damaging corals.

Due to the number of relatively inexperienced divers and the daily use of these PAG sites, it is expected that the corals are often adversely impacted by divers. There is currently no public education and outreach program within PAG's commercial permit system to engage the many users of the Port's recreational resources at any permitted site, including Outhouse Beach and Dog Leg Pier.

PAG proposes to establish an education and outreach program to offset impacts to EFH affected by physical damage, irradiance, and sedimentation from the Hotel Wharf proposed action. The PAG Public Outreach and Education Program would offset impacts to a total of 10,337 coral colonies, i.e., the unavoidable loss of 5,698 corals in the Direct Impacts Zone, and the temporary sedimentation impacts to 4,639 corals within or near the turbidity curtain in the 20 m Indirect Impacts Zone. The implementation of the program is expected to result in an annual reduction of 21,250 diver-damaged corals (Table 3), or an offset/impact ratio of approximately 2:1.

The program would educate all vendors at the Dive Instructor/Dive Guide or operations manager level prior to leading their patrons on dives. These instructors and guides would, in turn, be responsible for informing their patrons of the best management practices while using the marine resources at the Port. This program would certify all vendors, regardless of where their activity occurs; therefore, it would reach vendors at Outhouse Beach and Dog Leg Pier.

On-going graduate research conducted on Guam by Ashton Williams indicates that accidental and intentional contacts with live coral could be reduced by over 50% by implementing a short, one-sentence briefing on diver-related coral damage (Pers. comm. Williams, A., 2019). A similar coral briefing will be utilized by the Public Outreach and Education Program, and similar results would be expected.

The Port would also erect signs at Outhouse Beach and Dog Leg Pier with information on how the public can minimize impacts on marine resources while engaged in recreational activities.

### 2.1.4 Maximizing Water Quality Improvements through Storm Water Management

In order to offset the adverse impacts to EFH resulting from the increased turbidity within the Indirect Impact Zone, the Port's consulting engineering designers increased the storm water management and treatment measures to the maximum extent practicable. Currently, there are no storm water control measures present along the Glass Breakwater Access Road and as a result, storm water enters Apra Harbor untreated and adversely affects local water quality.

Five storm water outfalls are proposed along the access road, including outfall S-105, which will be constructed to the west of Outhouse Beach (Appendix A, Figure 2). There is approximately 75 ft of concrete ditch adjacent to each road outfall, with grass-lined bioswales proposed for long stretches along the north side of the road in between these locations. At outfall S-105, the bioswale east of the concrete V-ditch is over 300 ft long. Storm water that exits these outfalls will first be pre-treated by passing through a grass-lined bioswale, then a concrete V-ditch, and then a catch basin fitted with a sump and hood. Bioswales are a type of open channel, which are capable of removing a median value of 81% of total suspended solids (TSS), 34% of total phosphorous, 84% of total nitrogen, 70% of metals, and 62% of hydrocarbons, per the *CNMI and Guam Stormwater Management Manual* (Horsley Witten Group, Inc. 2006). The existing water quality within Apra Harbor, including Outhouse Beach, is anticipated to improve as a result of the proposed storm water management improvements.

## 2.2 Functions to be Lost at Impact Area

The proposed Hotel Wharf Repair Project is anticipated to result in the loss of ecological functions and services associated with coral reef habitat from the following impacts:

- Direct long-term physical impacts and temporary to short-term physical impacts and water quality impairments, including an increase in turbidity and sedimentation, during the project.

- Adverse effects to EFH and MUS because there will likely be permanent loss, or long-term damage to, coral colonies/coral reef living on the wharf face and surrounding substrate in the project area.

These impacts would result in a loss of reef structure, which provides physical protection of the shoreline against storm surge, and refugia and habitat for resident and transient MUS and their prey. The impacts would also result in loss of CRE-MUS, including filter feeding organisms such as sponges, which would impact ecosystem functions by a reduction in nutrient uptake and recycling.

## 2.3 Functions to be Gained at Mitigation Area or by Mitigation Action

The main goal of this mitigation plan is to compensate for the loss of ecological functions and services on the face of Hotel Wharf and of a total of 0.11 acres (4,577 sq. ft.) of shallow hard and softbottom within the Direct Impacts Zone (approximately 6.25 to 9.75 ft from the existing Hotel Wharf face). The coral cover over these areas ranges from 0.3% to 1% (Burdick, 2019).

**Coral Relocation.** The relocation of reef-building hard coral colonies to the mitigation area would increase the amount of EFH and habitat for CRE-MUS at that site. There would be a gain of ecological functions and corresponding goods and services derived from this increase in habitat. Generally, as associated with coral reefs, these are anticipated to include a gain in structure and shelter or habitat for organisms (which provide refugia for fish and other marine organisms); increased uptake and recycling of nutrients (which provide treatment of waste products); and additional reef structure (which provide for coastal stabilization against the effects of storm surge).

**Debris Removal.** The removal of debris from the seafloor near the base of Hotel Wharf would restore and increase soft-bottom habitat to this heavily impacted area. The debris poses a potential hazard as a physical damage stressor, particularly during storm events when debris may shift and abrade or break reef structure. As a specific function or service, the removal of marine debris would protect sessile biological components of coral reef habitat from damage by moving debris that could migrate with storm and wave action into unimpacted areas, reduce stress on the existing coral community, and restore substrate for MUS (USCRTF 2016).

**Public Education and Outreach.** The implementation of a public education and outreach program is intended to raise consciousness and conscientiousness in recreational users. If effective, this change in perception and behavior would, in turn, reduce physical damage stressors on the commercial recreational areas within the Port's inventory. These recreational areas include Outhouse Beach, which is frequented by a high volume (over 100 per day) of novice divers, many with poor buoyancy control and little environmental awareness. The hardbottom area impacted by these activities at Outhouse Beach is estimated at 79,702 sq. ft (7,404 sq. m) (Figure 4). The reduction of physical damage to coral reef at all commercially-permitted areas, including Outhouse Beach, would protect reef-building coral colonies, and potentially allow for their recovery. There would be a gain of ecological functions and corresponding goods and services derived from protection and recovery of this habitat. Generally, as associated with coral reefs, these are anticipated to include a gain in structure and shelter or habitat for organisms; increased uptake and recycling of nutrients; and additional reef structure.

**Maximizing Water Quality Improvements through Storm Water Management.** The proposed construction of storm water infrastructure at selected locations throughout the action area would result in a marked improvement in the quality of the Apra Harbor

receiving waters, especially since there is currently no existing storm water infrastructure in place. The collection and pre-treatment of storm water runoff prior to discharge would remove pollutant stressors, including sediment, nutrients (phosphorous and nitrogen), metals, and hydrocarbons. The removal of sediment through pre-treatment would also reduce turbidity, which is an irradiance stressor. There would be a gain in water quality, and reduction in shading, which would improve the habitat for organisms that use benthic and water column components of EFH, and potentially allow for recovery of this habitat with an associated increase in benthic and pelagic organisms.

## 2.4 Location

The Hotel Wharf project site impact and mitigation areas are shown on Figure 3.

## 2.5 Methods for Quantifying Aquatic Resources

Coral colony, benthic cover, and macroinvertebrate surveys occurred along transects placed on the three wharf sides, the seafloor at the base of the wharf, and the area of seafloor extending 30 m from the wharf sides in January and February 2019 (Burdick, 2019). Additional transects were placed along a relatively large area of aggregate reef and mixed sand/hardbottom that runs roughly parallel to, and approximately 25 m from, the south wharf face. Transects were not used for the small (< 5 m in longest dimension) patch reefs occurring within the survey area; instead, all corals and large mobile macroinvertebrates were censused, and benthic cover was measured, for the whole patch reef (Burdick, 2019).

The survey results included the Direct Impacts Zone, which includes the existing sheetpile wharf face and area of seafloor extending 2.4 m (8 ft), 1.9 m (6 ft) and 3 m (9.75 ft) from the base of the west, south and east wharf sides, respectively. The expansion of Hotel Wharf will directly impact this seafloor area, which comprises approximately 4,577 sq. ft. (0.11 acre) of predominantly sandy substrate. The Indirect Impacts Zone extended from the wharf face to the inner face of the proposed turbidity curtain. This was originally proposed as 30 m from the wharf face, and later revised to 20 m from the wharf face.

All coral colonies occurring within a one-meter-wide belt centered on the transect tape were identified and sized (longest dimension to nearest cm) along all wharf sides and all seafloor transects except the two additional transects later surveyed on the reef flat adjacent to the wharf. All coral colonies occurring on small (< 5 m in longest dimension) patch reefs located within 50 m of the wharf face were censused. Colony density estimates for the shallow (1 m) wharf face transects were calculated using area values that accounted for the additional survey area added to the width of the shallow transects on the wharf face and sides by the concrete beam that extended 30 cm from the wharf.

Benthic cover estimates were derived from the point-count analysis of photographic images captured along a series of 50 meter transects. After a length of transect tape was

placed by one diver, another diver obtained an image every one meter along the left side of the tape using a compact point-and-shoot camera placed atop a PVC monopod. Images were imported from the Secure Digital (SD) card into Adobe Lightroom software and a batch white balance adjustment was applied to groups of images with similar white balance characteristics. Benthic cover estimates were generated through an analysis of the photo transect images using Coral Point Count with Excel Extension (CPCe) application. Corals were identified to species when possible, although some taxa often could not be identified to species level using the photo transect images.

All mobile macroinvertebrates were identified and counted within two-meter-wide belt transects centered on the transect tape for all transects. Patch reefs were also censused for mobile macroinvertebrates. As with the coral belt transect surveys, the macroinvertebrate belt transect area—and thus, the macroinvertebrate density calculations—accounted for the additional area added to the width added to shallow wharf face transects by the concrete beam.

## 2.6 Existing hydrology

The project site is in the Apra watershed, which encompasses portions of Yona, Santa Rita and Piti municipalities, and drains east into Apra Harbor and the Philippine Sea (Kottermair, 2012). There are no freshwater streams in the vicinity of the project area. The nearest river is the Sasa River, which empties into Sasa Bay approximately 3.5 km southeast of Hotel Wharf.

Hotel Wharf occurs within the Zone II designated by Paulay et al. (1997), which corresponds to the original backreef of Luminao Reef. The wharf interrupts a shallow (approximately 1.5 m deep) reef flat that extends from the western side of Cabras Island in the east to the western edge of the Luminao barrier reef in the west. The area of reef flat immediately to the west of Hotel Wharf extends approximately 80 m from the shore, which is comprised a mix of riprap and naturally-accumulated sand, to the southern edge of the flat. The reef flat to the east of the wharf extends approximately 15 m from riprap to the southern edge of the flat. The reef flat adjacent to both sides of the wharf both abruptly drop 2–3 m to a sandy slope. The sandy slope extends southward, dropping more steeply from the edge of the reef flat to an area approximately in line with the southern wharf face, then sloping gradually across a distance of about 70 m before sloping more steeply to the lagoon bottom.

The average tide level ranges from 1.3 ft. during neap tides and 2.1 ft. during spring tides. Edward K. Noda and Associates, Inc. (1990) calculated storm tidal ranges for the west coast of Guam to be 23.6 ft. high with period of 16 seconds (5-year significant wave) and 46.5 ft. high with period of 22 seconds (100-year significant wave).

## 2.7 Existing benthic cover

The existing benthic cover was previously mapped as pavement with predominately coral cover (10%-<50%) near the wharf (reef flat and portion of sand flat at the base of the wharf), transitioning to uncolonized sand (90%-100%) away from the wharf (Burdick, 2005). Table 3 provides recent benthic cover of the seafloor around Hotel Wharf (Burdick, 2019).

Table 4. Benthic Cover of the Seafloor around Hotel Wharf, within the Direct Impacts Zone

| Cover type | Percent Cover | | | |
|---|---|---|---|---|
| | South | East | West | Entire base |
| Hard coral | 0.5 ± 0.2 | 0.3 ± - | 1.0 ± - | 0.6 ± 0.3 |
| Soft coral | 0.0 ± 0.0 | 0.0 ± - | 0.0 ± - | 0.0 ± 0.0 |
| Sponge | 0.3 ± 0.3 | 0.0 ± - | 0.0 ± - | 0.2 ± 0.3 |
| Dead coral | 0.0 ± 0.0 | 0.0 ± - | 0.0 ± - | 0.0 ± 0.0 |
| Other hardbottom | 1.7 ± 1.6 | 72.4 ± - | 65.5 ± - | 28.6 ± 37.0 |
| Sand | 39.4 ± 27.2 | 25.6 ± - | 30.5 ± - | 34.8 ± 20.3 |
| Debris | 58.2 ± 28.8 | 1.7 ± - | 3.0 ± - | 35.8 ± 36.7 |

*Burdick, 2019*

The 2019 marine survey recorded a total of 2,739 individual coral colonies, comprising 43 taxa within the Direct Impacts Zone. Total mean colony diameter for all coral colonies observed was 4.8 ±6.2cm. Based on the colony density values derived from the count values obtained for the belt transect surveys and the area of substrate, it is estimated that 6,528 coral colonies occur within the Direct Impacts Zone (Burdick, 2019).

The dominant benthic cover type on the wharf face was a mixed assemblage comprising erect and adherent macrophytes, classified as “Other Hardbottom” in Table 5. Sponge cover was relatively low, ranging from 0% to 2.6%.

Table 5. Percent Cover of major benthic classes for the wharf face.

| Cover type | Percent Cover | | | |
|---|---|---|---|---|
| | South | East | West | Entire base |
| Hard coral | 0.6 ± 0.4 | 0.5 ± 0.7 | 2.3 ± 1.0 | 0.9 ± 0.8 |
| Soft coral | 0.1 ± 0.1 | 0.4 ± 0.6 | 0.0 ± 0.0 | 0.1 ± 0.3 |
| Sponge | 2.6 ± 2.3 | 2.2 ± 3.2 | 0.0 ± 0.0 | 2.1 ± 2.3 |
| Dead coral | 0.0 ± 0.0 | 0.0 ± 0.0 | 0.0 ± 0.0 | 0.0 ± 0.0 |
| Other hardbottom | 96.5 ± 2.1 | 96.8 ± 3.1 | 97.7 ± 1.0 | 96.7 ± 2.0 |
| Sand | 0.0 ± 0.0 | 0.0 ± 0.0 | 0.0 ± 0.0 | 0.0 ± 0.0 |
| Debris | 0.2 ± 0.7 | 0.0 ± 0.0 | 0.0 ± 0.0 | 0.2 ± 0.6 |

*Burdick, 2019*

A total of 1283 coral colonies were observed within the Indirect Impacts Zone, comprising 39 coral taxa. Based on the colony density values derived from the count values obtained for the belt transect surveys, it is estimated that 7,794 coral colonies occur within the 30m Indirect Impacts Zone. It is estimated that 4,639 of those colonies occur within 20m of the wharf face.

Table 6. Benthic Cover within the 20 m Indirect Impacts Zone.

| Cover Type | Percent Cover | |
|---|---|---|
| | Reef Flat | Sand Flat |
| Hard Coral | 3.4 ± 4.2 | 0.0 ± 0.0 |
| Soft Coral | 0.0 ± 0.0 | 0.0 ± 0.0 |
| Sponge | 0.1 ± 0.2 | 0.2 ± 0.3 |
| Other Hardbottom | 90.5 ± 6.0 | 9.1 ± 9.7 |
| Sand | 5.3 ± 6.9 | 72.7 ± 12.3 |
| Debris | 0.6 ± 0.9 | 18.1 ± 12.3 |

*Burdick, 2019*

Table 7. Benthic Cover within the 30 m Indirect Impacts Zone.

| Cover type | Percent Cover | | | |
|---|---|---|---|---|
| | Reef Flat | Sand Flat | Agg. Reef | Mixed Sand/HB |
| Hard coral | 2.8 ± 2.6 | 1.2 ± 1.8 | 14.8 ± 2.5 | 2.6 ± 1.3 |
| Sponge | 0.1 ± 0.1 | 0.3 ± 0.3 | 0.8 ± 0.8 | 0.9 ± 0.7 |
| Other hardbottom | 85.4 ± 12.2 | 15.4 ± 13.2 | 44.8 ± 11.8 | 31.5 ± 5.6 |
| Sand | 11.3 ± 13.6 | 70.6 ± 13.9 | 38.8 ± 9.5 | 62 ± 3.7 |
| Debris | 0.4 ± 0.6 | 12.5 ± 10.4 | 0.9 ± 0.7 | 3 ± 4 |

*Burdick, 2019*

## 2.8 Existing substrate

The existing substrate surrounding Hotel Wharf can be categorized by 4 distinct zones: Reef Flat, Sand Flat, Aggregate Reef, and Mixed Sand/Hardbottom (Table 6 and Table 7). A significant amount of debris currently occupies portions of the seafloor, with concentrations being higher closer to the wharf (Table 6 and Table 7). The expansion of Hotel Wharf will impact approximately 4,577 sq. ft. (0.11 acre) of predominantly sandy substrate.

## 2.9 Existing wildlife usage

### 2.9.1 Fish

Myers and Donaldson (2003) estimated 1,019 shorefishes within the entire Mariana Archipelago, although the actual number for Guam may be smaller. A total of 60 species of fish were observed within the project area during marine surveys conducted by AMEC in 2014 (AMEC, 2014). The survey investigated three distinct habitat types: Reef Flat, Wharf Face and Base, and Channel (Sand Flat and Patch Reefs).

### 2.9.2 Mobile Macroinvertebrates

A total of 130 mobile macroinvertebrates comprising 14 species were observed within the Direct Impacts Zone. The most commonly observed macroinvertebrate taxa in the Direct Impacts Zone were *Diadema* sp., *Actinopyga echinites*, *Echinometra mathaei*, and *Culcita novaeguineae*, with *Diadema* sp., *A. echinites* and *C. novaeguineae* dominant on the wharf sides and *E. mathaei, A. echinites*, and *C.novaeguineae* dominant on the seafloor at the base of the wharf. The most abundant taxa in the Direct Impacts zone, the long-spined sea urchin (*Diadema* sp.), was almost exclusively observed in recesses in the underside of the shallow beam across the wharf sides.

## 2.10 Historic and Current Land Use

The existing H Wharf or Hotel Wharf is a 500-ft long waterfront structure originally constructed in 1948 by the U.S. military, and may have been renovated possibly in the 1950s. Hotel Wharf was used as the Navy's ammunition wharf during the Vietnam War (Moore and Hunter-Anderson, 2005), and brought in bombs for loading onto B-52 bombers leaving Guam's airfields (Blackford, 2007). Eventually, the location of the wharf hampered commercial development at the Port (where containerized cargo handling began in 1969), and the Navy's need to handle more ammunition ships was no longer met by the wharf's location and size (Blackford, 2007). The Navy's ammunition wharf was subsequently moved from H Wharf to Orote Peninsula (Moore and Hunter-Anderson, 2005), and the U.S. Navy transferred the wharf to the Port in 1989.

Over the years, PAG has leased the facility for various commercial activities including cruise ship operations, administrative functions, fishing support operations, and recreational activities. Hotel Wharf has recently transitioned from being a leased facility to one that will be used directly by the PAG and has been used directly by the PAG for scrap metal handling, and vehicle import operations when space at the Jose D. Leon Guerrero Commercial Port of Guam facility was temporarily restricted. The Port ceased active commercial operations on the wharf in 2001.

## 2.11 Current owners

Following its release from the Department of Interior in 1966, 62 acres of land, now known as Cabras Island, were transferred from the Department of Navy to the Government of Guam for development of the Commercial Port and industrial park. To date, over 1,000 acres of land, inclusive of Apra Harbor land, has been transferred from the federal government to the Government of Guam for the use of and control of the Port Authority. The Port Authority, through the Government of Guam, asserts authority and jurisdiction over the terrestrial and submerged lands of the project site. This includes the areas proposed for mitigation activities described in this plan, such as Outhouse Beach to the east of Hotel Wharf, and Dog Leg Pier located to the west of Hotel Wharf. The Port's authority and jurisdiction over these terrestrial and submerged lands is not anticipated to change in the foreseeable future.

# 3 MITIGATION SITE SELECTION AND JUSTIFICATION

## 3.1 Coral Relocation

### 3.1.1 Recipient Site Criteria

Coral colonies identified for relocation within the Direct Impacts Zone will be moved from Hotel Wharf and the surrounding substrate to a relocation site located at Dog Leg Pier, approximately 700 linear ft. (213 m) to the west of Hotel Wharf (Photo 1).

Photo 1. East pier of Dog Leg Pier, facing west, March 2019.

This relocation site was selected based on several key criteria, including: 1) close proximity to the project site; 2) presence of similar coral species and reef composition; 3) suitable hardbottom substrate devoid of coral on which to attach relocated colonies; 4) similar water depth and conditions; and 5) assurance from PAG that the relocation site would be protected through land use controls and committed to this use in perpetuity. While the recipient site is considered close, there is sufficient separation and protection from the impact site at Hotel Wharf through best management practices to minimize the potential for impacts during construction, such as sediment and vessel anchoring.

### 3.1.2 Qualitative Survey of Recipient Site

On March 9, 2019, David Burdick, the primary marine biologist conducting the marine survey for Hotel Wharf (Burdick 2019), and Devin Keogh, a biologist with Dueñas, Camacho, and Associates, Inc., carried out a scuba-assisted assessment of the reef in the vicinity of Dog Leg Pier, with the primary objective of determining if the area is suitable as a recipient site for coral colonies transplanted from the Hotel Wharf project area. The

reef area investigated occurs approximately 200 m to the west of Hotel Wharf and includes a shallow (< 1.5 m) 60 m-wide reef flat that occurs between the two "piers", and an approximately 200 m extent of lagoonal backreef slope that extends from the edge of the reef flat to a sand flat at a depth of approximately 10 m. The reef flat is primarily comprised of pavement and patches of aggregate reef with scattered corals, but transitions to primarily aggregate reef with dense coral growth closer to the edge of the reef slope (Photo 2).

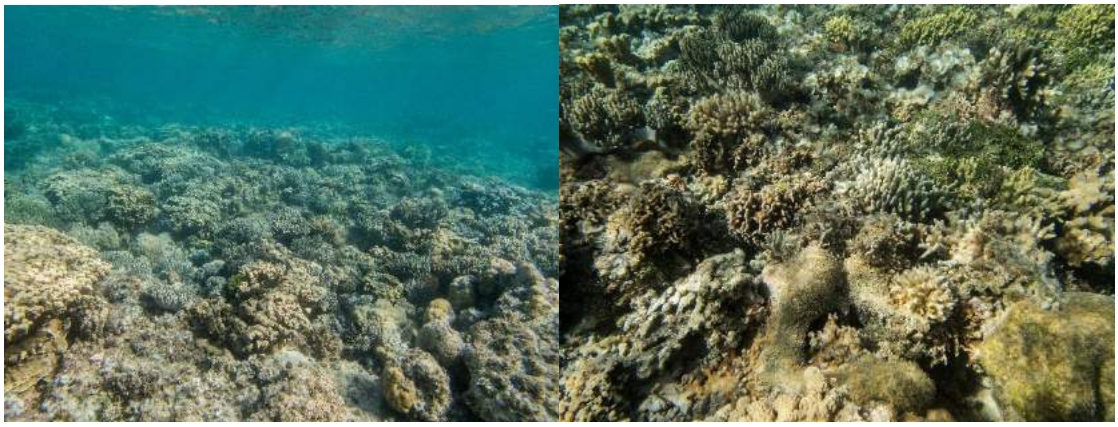

Photo 2. Shallow reef between east and west piers at Dog Leg Pier. *Courtesy of D. Burdick.*

The 200 m extent of reef slope investigated stretches from an area approximately 40 m west of the west "pier" to an area approximately 20 m east of the east "pier." The benthic community along this portion of reef slope primarily comprises dense *Porites rus* growth, but patches of "bare" reef rock with low coral cover occur across the slope. While the area at the base of the slope primarily comprises sand, some patches of hardbottom with low-to-moderate coral cover were observed in the area just to the west of the west pier. The reef flat and slope extend approximately 400 m beyond the area investigated, to where the reef tract intersects with Dog Leg Reef, and 200 m to the east, where it meets Hotel Wharf.

Photo 3. Reef slope with dense *Porites rus* colonies (left) and patches of reef rock with low coral cover (right) at Dog Leg Pier. *Courtesy of D. Burdick.*

The overall structure of the natural reef area adjacent to Hotel Wharf is broadly similar to that of the reef area observed in the vicinity of Dog Leg Pier, with a shallow reef flat extending southward to a slope that terminates at a sand flat at approximately the same depth (10 m). Water conditions during the time spent at each site were similar; the close proximity of two reef areas suggests that water conditions and quality at both sites are similar year-round.

The composition of the coral community observed on the reef flat in both of these areas is generally similar. All species representing colonies suitable for transplantation that were recorded during surveys of the Hotel Wharf project area were observed on the reef flat between the piers at the Dog Leg Pier reef area. The area of available and suitable reef flat hardbottom appears sufficient for receiving corals transplanted from the reef flat adjacent to Hotel Wharf, as well as for receiving corals (primarily *Pocillopora damicornis* and massive *Porites* species) transplanted from the area on and above the shallow (~1.5 m) concrete beam extending across all sides of the wharf.

The slope along the Dog Leg Pier reef area hosts considerably greater coral growth and greater structural complexity in comparison to the slope of the natural reef adjacent to Hotel Wharf, although the eastern extent of the Dog Leg Pier reef slope appeared to be transitioning to the lower coral cover/lower structural complexity similar to the slope observed adjacent to Hotel Wharf. Despite these noted differences, coral community composition (if not relative abundance) along the slopes of both reef areas are similar.

The vertical habitat provided by the Hotel Wharf Face and the debris and unconsolidated sediment occurring at the base of the wharf is quite different from the natural reef slope it interrupts, as well as from the natural reef area investigated near Dog Leg Pier. However, species representing the vast majority of the colonies suitable for transplantation recorded from the Hotel Wharf face and the base of the south face (mainly massive *Porites* species and *P. rus*) were observed on the Dog Leg Pier reef slope. As mentioned above, while the reef slope near Dog Leg Pier largely comprises areas of dense *Porites rus* growth, numerous patches ranging in size from a few square meters to 10 or more square meters are scattered across the slope. While *Lobophyllia corymbosa* and *L. hemprichii* were recorded from both the Hotel Wharf site and observed at the Dog Leg Pier reef area, a third *Lobophyllia* species that appears closest to *L. hataii* was recorded from the Hotel Wharf face but was not observed at the Dog Leg Pier site. This species appears to prefer highly shaded environments, such as that offered by the Hotel Wharf face.

A limited area of near-vertical slope occurring just to the west of the west “pier” at the Dog Leg Pier site may offer a similar environment for some of the *Lobophyllia* cf. *hataii* colonies and colonies of other shade-tolerant taxa (e.g., *Leptoseris* spp.) to be transplanted from Hotel Wharf, but the technical challenges of affixing relatively fragile colonies to a vertical structure may prevent the transplantation of these colonies or may require their transplantation to environments with non-preferred light levels (Photo 4).

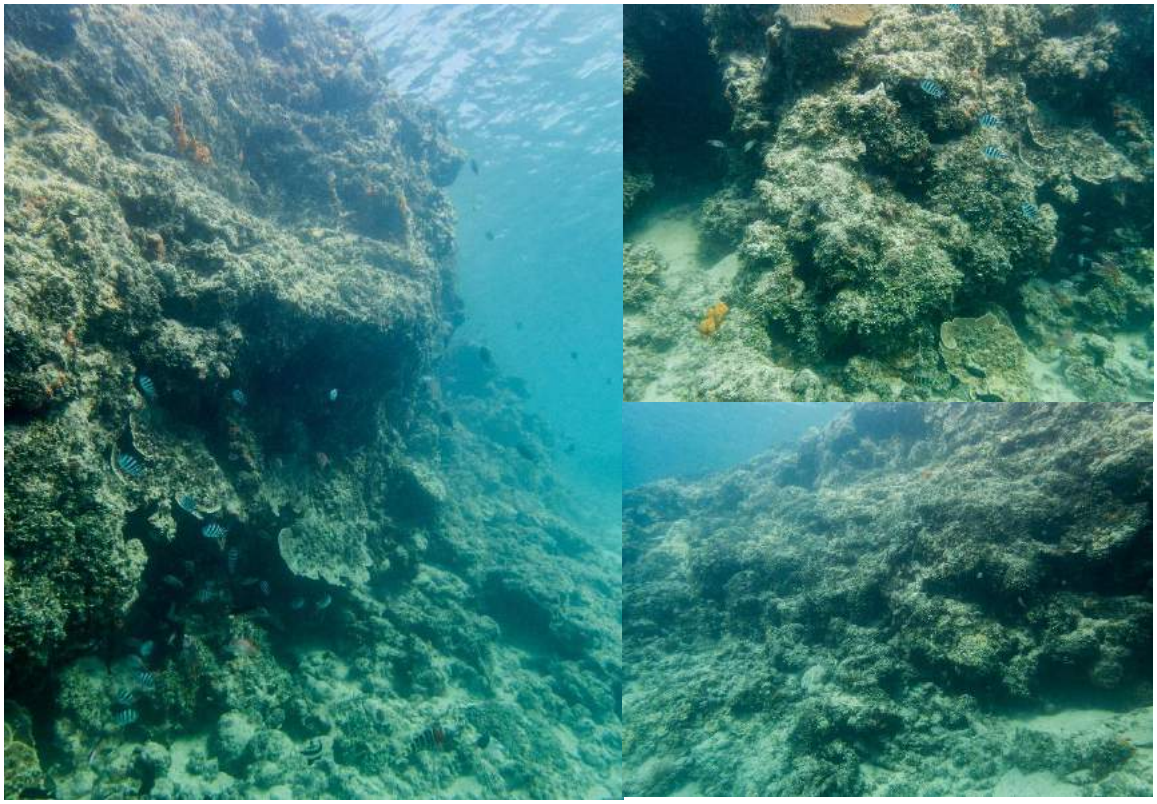

Photo 4. Near-vertical slope area west of west pier at Dog Leg Pier. *Courtesy of D. Burdick.*

The survey also considered potential areas for coral colonies that may be required to be transplanted from the debris and patches of hardbottom scattered across the sand flat within the Indirect Impacts Zone of the Hotel Wharf project site, although relocation of these colonies is not proposed by PAG at this time. If such an action is mandated, these colonies could be placed on hardbottom along the deeper portion of the reef slope at Dog Leg Pier (to better match light conditions) or along the patches of hardbottom extending southward from the base of the reef slope near the west "pier" (Photo 5).

Photo 5. Sand and hardbottom along base of reef slope at Dog Leg Pier. *Courtesy of D. Burdick.*

The species representing the vast majority of colonies suitable for transplant that were recorded in the Hotel Wharf Indirect Impacts Zone, which include massive *Porites* species, *Porites rus*, *Pocillopora damicornis*, and several *Astreopora* species, were all observed at similar depths at the Dog Leg Pier site. While it is not clear if the area of available substrate at the investigated area of the Dog Leg Pier site will be sufficient if all coral colonies from the Hotel Wharf Indirect Impacts Zone must be transplanted, it is highly likely that a sufficient amount of additional available substrate can be found to the west and east of the area of reef investigated at Dog Leg Pier.

The final coral relocation sites within the vicinity of Dog Leg Pier will be selected once the work has started.

## 3.2 Debris Removal

Debris associated with past land use has accumulated around Hotel Wharf, particularly along the wharf base. Since debris will be removed from the seafloor surrounding Hotel Wharf, there are no alternative sites proposed or feasible for this mitigation measure.

The marine debris observed during marine surveys in January and February 2019 within the Direct and Indirect Impacts Zones comprised materials such as rope, pipe, metal fragments, tires, and various types of household waste including soda cans, bottles, and clothing (Personal observation, D. Keogh, DCA) (Photos 6 and 7).

Photo 6. Example of marine debris along the south face of Hotel Wharf within the Direct Impacts Zone, February 2019 (*Courtesy of D. Burdick*).

Photo 7. Example of marine debris south of Hotel Wharf within the 20 m Indirect Impacts Zone February 2019 (*Courtesy of D. Burdick*).

## 3.3 Public Education and Outreach

Public outreach and environmental sensitivity awareness and education will focus on two sites near Hotel Wharf: Outhouse Beach to the east of the wharf, and Dog Leg Pier to the west. This mitigation measure will focus on educating the professional divers and tourist operators that utilize these sites, so that they may, in turn, inform and educate their customers.

Outhouse Beach is one of the most popular beach-entry dive sites on Guam, and accommodates dozens of divers and snorkelers per day. Scientific studies have shown that divers and snorkelers can have a significant negative impact on coral reefs and marine ecosystems (Porter et al., 2005). PAG currently issues permits to dive shops, tour operators, and individuals for using Outhouse Beach for recreational activities.

Multiple marine sports tour operators occupy Dog Leg Pier and adjacent beaches and offer jet skiing, snorkeling, diving, in addition to other marine sports. Jet skiing has the potential to adversely impact coral reefs through direct damage to coral, leaking fuel, and noise (Porter et al., 2005).

### 3.4 Maximizing Water Quality Improvements through Storm Water Management

The selection of pre-treatment methods for storm water runoff was based upon various design criteria, including the criteria in the *CNMI and Guam Stormwater Management Manual* (Horsley Witten Group, Inc., 2006). The location of stormwater outfalls was based upon design criteria, including the topography and storm water volumes in the sub-basins of the project site.

# 4 MITIGATION WORK PLAN AND SCHEDULE

## 4.1 Coral Relocation

There is no need for any heavy construction equipment for the coral relocation. The coral relocation will occur before the installation of turbidity curtains and commencement of construction. Corals identified for relocation will be selected based on the following criteria:

1. **Location**: Within the Direct Impacts Zone
2. **Size**: 10cm-1,000cm
3. **Species**: Excluding encrusting forms, such as *Leptastrea*, diminutive dendrophyliids, or any other corals that would likely not survive the relocation process
4. **Health**: Generally healthy, no bleaching or major paling

Based on size class information collected during the marine surveys, a conservative estimate of 830 coral colonies would be relocated, i.e., 194 colonies within the wharf base (sea floor) and approximately 636 colonies on the wharf face fall within the size range for relocation (i.e., 10 to 1,000 cm) within the Direct Impacts Zone. Based on the abovementioned relocation criteria, approximately 194 colonies would be relocated from the Direct Impacts Zone to the relocation site at Dog Leg Pier. The total coral relocation effort, including mobilization and de-mobilization, and baseline monitoring, is expected to be completed within approximately four (4) weeks, weather permitting.

## 4.2 Debris Removal

Debris removal will be a one-time effort conducted just prior to construction after deployment of the turbidity curtain. Debris immediately within the Direct Impacts Zone will need to be removed prior to the driving of sheet piles, as the debris may pose a risk of preventing successful pile driving.

## 4.3 Public Education and Outreach

Within six (6) months of the start of construction at Hotel Wharf (proposed action), the Port Authority of Guam will establish a certification program for all vendors at the Dive Instructor/Dive Guide or Operations Manager level. All vendors at this level will be required to undergo certification before receiving or renewing a permit for commercial activities and tour operations on Port property. National Marine Fisheries Service (NMFS) and Guam Department of Agriculture's Division of Aquatic and Wildlife Resources (DAWR) would be invited to review and contribute to the educational materials for the program. NMFS may be invited to conduct the training, or to train Port personnel to conduct the training. This vendor certification requirement will be incorporated into the lease/permit.

Within six (6) months of the start of construction at Hotel Wharf, the Port will develop and post permanent signs at Outhouse Beach. The signs will display an educational message reviewed by NMFS and DAWR. The Port will maintain the signage for the life of the Hotel Wharf project.

## 4.4 Maximizing Water Quality Improvements through Storm Water Management

The installation of the storm water improvements would occur during the construction of access road improvements for the proposed action. Catch basins associated with the outfalls would not be connected or come on-line until after construction has been completed. Vegetation would first be established on the grass-lined bioswales prior to activation of the storm water system.

# 5 METHODOLOGY

## 5.1 Coral Relocation

During the relocation process, 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 would be removed by divers using a hammer and masonry chisel. Once the corals are successfully removed from the substrate, they will be staged on the seafloor in appropriate containers until they are moved to the relocation site. Each colony will be transported via a support vessel (e.g. dive boat) from Hotel Wharf to the relocation site at Dog Leg Pier. Corals will be transported out of the water since it is not practicable to traverse the distance between Hotel Wharf and the relocation site underwater, and appropriate measures will be taken to ensure the corals survive the relocation (e.g., maintaining proper temperature and moisture requirements, and protecting the colonies from direct sun exposure).

At the relocation site, following the selection of reattachment locations and prior to attaching the corals, reattachment surfaces will be prepared by removing any loose sediment and surficial biota (i.e., algae and fouling organisms). A concrete mixture of approximately one-part Portland cement to one-part sand will be prepared for reattaching corals. Concrete is a much more reliable bonding agent than marine epoxy and is accepted by coral regulatory agencies and research institutes (e.g., National Oceanic and Atmospheric Administration, National Coral Reef Institute, and Florida Marine Research Institute) (National Coral Reef Institute, 2004). Prepared concrete placed in a plastic bucket will be lowered from the vessel to near bottom with lift lines and transported by divers to attachment locations. Alternatively, the concrete can placed in 1-gal heavy duty plastic bags for transport to attachment sites. Proper preparation and application of cement during underwater operations minimizes any sedimentation of cement residue on biota. The concrete is prepared with a minimal amount of water yielding a very dry and "stiff" mixture, which strictly reduces the plume during deployment of the concrete in plastic buckets and during subsequent handling (CSA, 2017).

Sufficient amounts of concrete will be placed directly on the pre-cleaned substrate, and corals to be reattached will be pressed firmly into the concrete mixture until stable and secure. Masonry nails hammered into the substrate can be used in the attachment process to help determine structural integrity at the reattachment location and reinforce the bonding matrix. Masonry nails should be used in the reattachment of relatively large specimens. 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 (CSA, 2017). No collateral damage to biological resources has been documented from properly conducted restoration where diver application of concrete has been used for coral reattachment (Franklin et. al., 2005; Schittone et. al., 2006).

Coral colonies comprising a subset of the total reattached corals will be selected during the relocation process for long-term monitoring. Approximately 15% to 25% (approximately 125 to 200 colonies) of all relocated corals will be monitored. The monitored group of relocated corals will be representative of the total relative proportions of each taxa that is relocated. A reference group of up to 100 resident corals will also be selected for long-term monitoring based on the degree of stability within the habitat, health, and location relative to the relocation site.

The selected biota will be marked with a unique numeric identification tag and mapped relative to an on-site reference benchmark, typically a fiberglass stake places in a central location within the relocation site. Masonry nails will be used to affix the tags to the substrate directly adjacent to reattached and selected reference corals. To make the distinction between groups visually obvious, the relocated group will be marked with different colored tags than the reference group. Selected corals will be mapped by determining the distance and bearing (compass heading) relative to the geo-referenced

benchmark. Depending on the spatial distribution of the monitored coral, multiple station markers may be required for mapping. Identification tags will be positioned relative to the coral to ensure the tag will be visible in photographic images collected as part of the monitoring program. Mapping data will be entered into GIS software to produce a scaled map of the reattached and reference coral colonies (CSA, 2017). Selected corals will be monitored for health and survivorship for the entirety of the monitoring period.

## 5.2 Debris Removal

Debris will be removed from the marine environment using a combination of a surface or barge-mounted crane and diver support. Debris removal will only commence once the turbidity curtain is properly installed, as this activity as a high likelihood of increasing local turbidity.

## 5.3 Public Education and Outreach

The Port will engage NMFS and DAWR for assistance in developing public education and outreach materials to establish a certification program for all vendors at the Dive Instructor/Dive Guide level. The Port will prepare copies for distribution or maintain links on their web site to download these materials by the vendors. The Port will periodically schedule training sessions to present the education and outreach program to vendors applying for, or renewing, their permits.

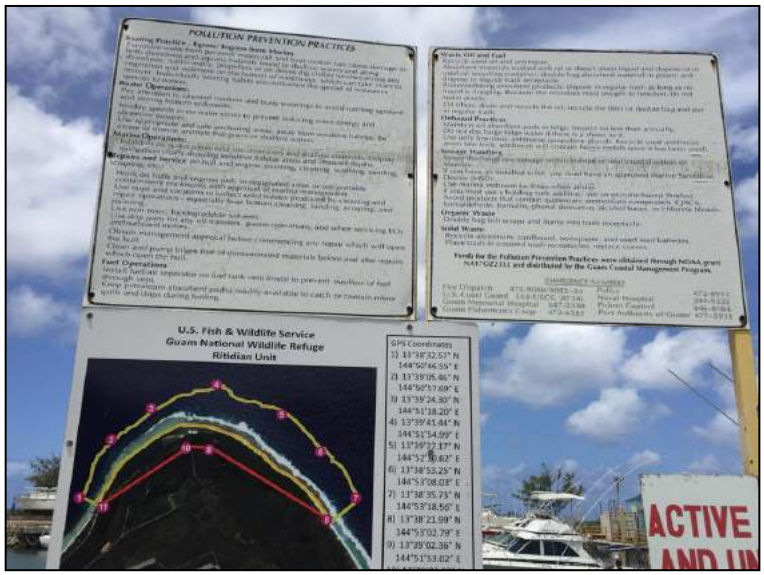


Photo. 8. Example of public advisory sign at Hagatña Marina, March 2019. *Courtesy of F. Camacho*.

The Port will engage NMFS and DAWR for assistance in developing the information for display on permanent signs at Outhouse Beach and Dog Leg Pier, such as the public advisory signs posted at other PAG locations (Photo 8). After review of the information, the signs will be erected in conspicuous locations at these beaches. The Port will periodically check that the signs are in good condition, and replace or repair them as needed, for the life of the Hotel Wharf project.

## 5.4 Maximizing Water Quality Improvements through Storm Water Management

The installation of storm water infrastructure, including outfalls, catch basins, piping, concrete ditch and grass-lined bioswales (open channels), would follow the engineering design plans that would be submitted to regulatory agencies for the review and approval of the necessary permits, e.g., Building Permit from Guam Department of Public Works.

The bioswales would be either seeded and mulched, or hydro-mulched, to establish the appropriate grassy vegetation. PAG will perform periodic maintenance of the storm water system to ensure it functions as intended.

# 6 MONITORING PLAN

## 6.1 Coral Relocation

### 6.1.1 Post-Relocation Monitoring

Per coordination with USFWS under the Fish and Wildlife Coordination Act (FWCA), the PAG would perform a short, rapid marine biological assessment following the completion of in-water construction activities.
Monitoring will occur over a 36-month (three-year) period, with a total of four (4) separate monitoring events at the following intervals:

1. Baseline Monitoring Event – immediately following coral relocation
2. 6-month Monitoring Event
3. 18-month Monitoring Event
4. 36-month Monitoring Event

Coral Monitoring Reports will be issued to all relevant agencies within 8 weeks of the completion of the site visit and will include written and photographic records of all monitored and reference coral colonies' health conditions. The following information will be collected during each monitoring event: species, maximum diameter, survivorship, percent colony mortality in cases of partial coral death, cause of mortality, if discernible (including abrasion, detachment, fracture/breakage, bleaching, disease, predation, competitive overgrowth, and silt smothering); and any other observations of scientific interest. Direct observations concerning attachment status and relative health of reattached organisms will be made by an experienced scientist at the monitoring site. 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 (CSA, 2017).

Comparisons will be made between relocated and reference corals in order to assess the success of relocation efforts. Coral monitoring will be conducted at 6 months post-relocation, 18 months post-relocation and 36 months post-relocation. The 36-month duration is adequate to determine survivorship and relative success of coral relocation. Typically after 6 months, properly relocated corals have acclimated to the potential effects of being displaced, transported, and reattached and will be responding similarly to the reference corals to environmental conditions at the relocation site(s) (CSA, 2017).

A brief written monitoring report will be submitted to the Guam Department of Agriculture Division of Aquatic and Wildlife Resources, the U.S. Army Corps of Engineers and the Guam Environmental Protection Agency, and National Marine Fisheries Service within 3-4 weeks of each monitoring event. The content of the monitoring reports will include sufficient information to document that the performance criteria have or have not been met.

### 6.1.2 Post-Construction Marine Biological Assessment

Per coordination with USFWS under the Fish and Wildlife Coordination Act (FWCA), the PAG would perform a short, rapid marine biological assessment following the completion of in-water construction activities. The goal of this assessment would be to assess any unanticipated impacts to marine resources associated with construction. The surveys and report would be completed within 60 days of completion of in-water construction, to the extent possible, weather and schedule permitting. The report would be provided to the regulatory review agencies.

## 6.2 Debris Removal

Photographic records will be taken for all debris removed from the marine environment. Since it is impractical to identify and record each individual piece of debris underwater, this will be completed once the debris is removed from the water. Recorded information should include: photographs, brief description of debris, general location, and approximate footprint in sq. ft.

## 6.3 Public Education and Outreach

In conjunction with the public education and outreach program, the Port will establish a series of permanent photo stations in those hardbottom areas frequented by users of Outhouse Beach. These photo stations will be fixed locations where photographs will be taken of the benthic environment and analyzed to determine if there are changes to benthic cover (e.g., coral recruitment and percent cover), direct coral damage, and long-term coral growth and recovery. The locations of these photo stations will be selected to maximize the diversity and quality of benthic resources captured within the surveyed area. A baseline survey will be performed prior to implementation of the program to

document existing conditions. Monitoring will be performed at these photo stations at least twice a year and for a minimum of 3 years post-baseline. An annual report will be generated to summarize the results of this surveillance.

## 6.4 Maximizing Water Quality Improvements through Storm Water Management

PAG will seek coverage under an NPDES Permit for the seven new outfalls, i.e., five along the access road and two on the wharf. Water quality sampling would be performed by PAG on a periodic basis as required under the permit conditions, to confirm compliance with the effluent limits prescribed for the receiving waters.

# 7 PERFORMANCE STANDARDS

## 7.1 Coral Relocation

The following criteria will be used to determine or measure the success or failure of the mitigation and the need for maintenance activities.

- Relocated corals established will have greater than 75% survivorship after 6 months, and a survivorship of 65% at 18 months relative to a reference group of resident corals representative of those established as described in Section 4.1.

This performance standard will be used to verify that the project has attained the target functions. The presence of established coral colonies will demonstrate the mitigation site has provided coral habitat and ecological functions similar to the impact area.

## 7.2 Debris Removal

The Port proposes to remove debris within the Direct Impacts Zone, and a portion of the Indirect Impacts Zone prior to construction. The Direct Impacts Zone encompasses approximately 4,577 sq. ft (425.22 sq. m). Benthic surveys estimate the percent cover of marine debris within this area as 58.2 ± 28.8% along the south face, 1.7 ± 0.0% along the east face, and 3.0 ± 0.0% along the west face (Burdick, 2019). Based on this cover estimate, marine debris within the Direct Impacts Zone is 1,829.81 ± 905.47 sq. ft along the south face, 12.63 ± 0.0 sq. ft along the east face, and 20.7 ± 0.0 sq. ft along the west face. Debris that does not pose an obstacle to the pile driving activities will left in place, enclosed behind the new sheet pile bulkhead, and buried by fill material. Certain non-rigid objects (such as tires) are not suitable for burial and will be removed. Other debris that poses a potential environmental hazard (such as marine batteries), or presents an obstacle to pile driving, will be removed.

PAG originally proposed to remove a portion of the marine debris within the 20 m Indirect Impacts Zone out to approximately 3 ft (0.9 m) seaward from the new bulkhead on the east, west and south sides. This area encompasses approximately 2,019.63 sq. ft (187.63 sq. m). Benthic survey estimates of the percent cover of marine debris within this zone were used to estimate the area covered by marine debris. Based on these cover estimates, the projected area covered by marine debris is 916.24 sq. ft (85.12 sq. m) within this 3-ft wide sector of the Indirect Impacts Zone.

After further coordination with NOAA in May 2019, the PAG agreed to perform additional debris removal to provide additional sand habitat area equivalent to 63 sq. m to offset the project impacts in the Direct Impacts Zone. Per Burdick (2019), the proportion of sand habitat in the Direct Impacts Zone is 34.8% (see Table 4), i.e., 148 sq. m of 425.22 sq. m. The original mitigation plan proposed to offset 85.12 sq. m of this 148 sq. m; the balance is approximately 63 sq. m. Based upon calculations using the average debris density (58.16%) determined from three transects along the south wharf face (Table 8) (Burdick, 2019), in order to offset the balance of 63 sq. m of debris, this requires the removal of debris within an additional 109 sq. m gross area. Therefore, the PAG will increase debris removal by 2.5 feet seaward of the existing south face of Hotel Wharf to encompass this 109 sq. m gross area, yielding the required 63 sq. m net area of sandy habitat.

In summary, debris will be removed 3 ft (0.9 m) seaward of the new bulkhead on the east and west sides, and 5.5 feet (1.67 m) seaward of the new bulkhead on the south side, to provide a total estimated area of 148 sq. m cleared of debris and reclaimed as sandy habitat (Table 8).

Table 8. Estimated Area Occupied by Debris Proposed for Removal from Indirect Impacts Zone

| **Wharf Side** | **Gross Area to be cleared for debris removal** | | **Percent Debris Cover** | | | **Total Calculated Debris Area (area to be cleared × percent debris cover)** | |
|---|---|---|---|---|---|---|---|
| | Area sq. m | Area sq. ft | Transect 1 | Transect 2 | Transect 3 | Area sq. m | Area sq. ft |
| **South*** | 253.60 | 2,729.72 | 40.10 | 91.40 | 43.00 | 147.49 | 1,587.60 |
| **East*** | 21.56 | 232.07 | 1.70 | - | - | 0.37 | 3.95 |
| **West**** | 21.47 | 231.07 | 3.00 | - | - | 0.64 | 6.93 |
| **TOTAL** | 296.63 | 3,192.86 | | | | 148.50 | 1,598.48 |

*Percent debris cover from Burdick (2019). One transect each set on the east and west wharf sides.*
**Debris cleared 3 ft seaward of new sheetpiles; **Debris cleared 5.5 ft seaward of new sheetpiles.*

Debris removal would have met these performance standards by the contractor's completion of a post-debris removal survey. The survey would confirm and document the required extent of debris removal within the Indirect Impacts Zone.

## 7.3 Public Education and Outreach

The unavoidable loss of 5,698 corals within the Direct Impacts Zone, and the temporal loss of fouling community on the existing wharf face, will be mitigated by the Public Outreach and Education Program. The 5,698 corals is an extrapolation using the average coral density and the area of wharf face to be impacted (Burdick, 2019). These corals do not fit the coral relocation criteria, and are mostly encrusting, low-relief corals that provide little to no structural fish habitat, and small dendrophyllids, which are unlikely to survive the relocation process. Coral colony estimates from the 2019 marine biological survey estimated that 1,657 dendrophyllid spp. and 2,717 *Leptastrea* spp. colonies are present on the wharf face and base (Burdick, 2019, Appendix I). Dendrophyllid spp. and *Leptastrea* spp. collectively account for approximately 67% of existing corals on the wharf face and base within the Direct Impacts Zone.

The temporary sedimentation impacts to corals within and near the turbidity curtain will also be mitigated by the Public Outreach and Education Program proposed by the PAG. An estimated 4,639 coral colonies occur within the 20 m Indirect Impacts Zone (Burdick, 2019). The turbidity curtain will be placed within and not outside the 20 m zone; therefore, the colony estimate encompasses corals within and near the turbidity curtain that may be subject to temporary sedimentation impacts.

Periodic monitoring of the offshore hardbottom areas at Outhouse Beach will be used to gauge the effectiveness of public education and outreach by the Port. PAG would enforce this program with periodic visits and monitoring of the resources against an initial baseline level. Penalties for non-compliance by vendors may include revoking their commercial permit. PAG may consider measures, such as limiting the volume of patrons per day or per week, if an increase in physical damage to the resources is detected.

# 8 SITE PROTECTION AND MAINTENANCE

## 8.1 Parties Responsible

The Port Authority of Guam will be responsible for completing the minimization and mitigation measures for the Hotel Wharf Maintenance and Repair project in Apra Harbor, Guam.

## 8.2 Long-term legal protection instrument

The mitigation sites are located entirely within submerged lands under the jurisdiction of the Port Authority of Guam, Government of Guam. It is not likely that the mitigation sites would change ownership. The coral recipient site at Dog Leg Pier is located farther west and beyond the proposed action area for the deep draft wharf and fill improvements

project, which involve dredging for harbor expansion (U.S. Army Corps of Engineers and Wil Chee Planning, Inc., 2007). As further protection during the 36-month monitoring period, PAG will also install a marker at the coral recipient site to alert recreational users to maintain a sufficient distance from the area.

## 8.3 Maintenance plan and Schedule

The Port Authority of Guam will be responsible for the regular maintenance of the signage at the Outhouse Beach and Dog Leg Pier mitigation sites. Maintenance will be scheduled as needed, depending on evaluation by PAG management, to keep the signage in good working order. The Port is also responsible for regular inspection and maintenance of the storm water collection and outfall system to ensure the system is functioning as intended.

# 9 ADAPTIVE MANAGEMENT PLAN

If any of the performance criteria are not met for all or a portion of the mitigation project, The Port Authority of Guam or its agent shall prepare an analysis of the cause(s) therefore and, if deemed necessary by the Corps, propose remedial actions for Corps approval. The remedial action will be completed as directed by the Corps.

The coral relocation will be considered a success if 75% of the corals survive to 6 months, and 65% survive to 18 months and successfully remain affixed to the substrate. Mortality rate of >65% at 18 months (barring a bleaching event or storm) would be considered high mortality. In the event 75% survival and 65% survival relative to the reference group is not achieved after 6 and 18 months, respectively, then contingency mitigation will be negotiated with regulatory agencies.

Potential challenges include preventing invasive species from becoming established, and addressing elevated sea surface temperature that result in coral bleaching events. Storms also present a challenge if they dislodge the fragments or result in abrasion or breakage of the colony. Elevated sea surface temperatures are difficult to address and predict.

For the public education and outreach program and storm water management improvements, if monitoring reveals a decline in benthic cover or water quality, the Port would consider whether additional measures are warranted. These may include limiting the use of the site to a certain number of patrons, or restricting use to a certain number of days per week.

# 10 FINANCIAL ASSURANCES

The Port Authority of Guam would be responsible for the mitigation of the project site impacted by the proposed action, including sheet pile driving, backfilling, and associated construction activities. The project would be funded by the Port Authority of Guam. Upon completion of construction, PAG would also be responsible for performing regular monitoring of the mitigation sites as described in Section 6. Should the monitoring identify issues that require remedial measures, implementation of those measures would be the responsibility of PAG. The overall responsibility for project success is with PAG. Contact information for PAG is presented below:

Port Authority of Guam
1026 Cabras Highway, Suite 201 Piti,
Guam 96915
(671) 477-5931

# 11 REFERENCES

AMEC Environmental & Infrastructure, Inc. 2014. Marine survey and Essential Fish Habitat Assessment report, Hotel Wharf and Access Road Maintenance and Repair Project, Cabras Island, Guam. 74 pp.

Mansel G. Blackford. 2007. Pathways to the Present: U.S. Development and Its Consequences in the Pacific. University of Hawai'i Press, Honolulu. 280 pp.

Burdick, D. 2005. Guam Coastal Atlas. U.S. Department of the Interior and National Oceanic and Atmospheric Administration. 149 pp.

Burdick, D. 2019. Marine Surveys for the Proposed Repair and Maintenance of Hotel Wharf, Apra Harbor, Guam. 110 pp.

CSA Ocean Sciences Inc. 2017. ATISA Guam-CNMI Cable System Coral Impact Minimization Plan. 30pp.

Franklin, E.C., J.H. Hudson, and J. Anderson. 2005. M/V WAVE WALKER. Coral reef restoration baseline monitoring report – 2004 Florida Keys National Marine Sanctuary, Monroe County, Florida. Marine Sanctuaries Conservation Series NMSP-0608. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Sanctuary Program, Silver Spring, MD. 15 pp.

Guam Environmental Protection Agency. 2017. Guam Water Quality Standards. Government of Guam. 22 GAR, Div. II, Chapter 5. Effective October 18, 2017. 133 pp.

Guam Visitors Bureau. 2014. Guam Tourism 2020 Plan. 49 pp. https://www.guamvisitorsbureau.com/research-and-reports/reports/guam-tourism-2020-plan

Guam Visitors Bureau. 2018. I Estoria, Guam Visitors Bureau 2017 Annual Report. 65 pp. https://www.guamvisitorsbureau.com/research-and-reports/reports/annual-report

Horsely Witten Group, Inc. 2006. CNMI and Guam Stormwater Management Manual. Volumes I and II. Prepared for Commonwealth of the Northern Mariana Islands and the Territory of Guam. October 2006.

Kottermair, Maria. 2012. Piti-Asan Watershed Management Plan. Water and Environmental Research Institute of the Western Pacific, Univ. of Guam. Tech. Rept. No. 138. 110 pp.

Moore, Darlene M. and Rosalind L. Hunter-Anderson. 2005. Micronesian Archaeological Research Services, Mangilao, Guam. Archaeological Investigations for the Proposed Harbor Wharf Project Apra Harbor, Guam (DACA83-00-D-0012, Task Order 0067). May 2005. 74 pp. GHRD Survey Report No. 2005-016AI.

Myers, R.F. and T.J. Donaldson. 2003. The fishes of the Mariana Islands. *Micronesica* 35-36: 594-648.

National Coral Reef Institute. 2004. Hollywood Ocean Outfall Stony Coral Transplantation Monitoring Final Monitoring Event. Draft Report. Nova Southeastern Oceanographic Center, Dania Beach, Florida. 14 pp.

National Oceanic and Atmospheric Administration. 2016. Endangered Species Act Status Review Report: Giant Manta Ray (Manta birostris) and Reef Manta Ray (Manta alfredi). 127 pp.

Paulay, G., L. Kirkendale, G. Lambert, and J. Starmer. 1997. The marine invertebrate biodiversity of Apra Harbor: significant areas and introduced species, with focus on sponges, echinoderms, and ascidians. Report prepared for Naval Activities Guam.

Porter, V., Leberer, T., Gawel, M., Gutierrez, J. Burdick, D., Torres, V., Lujan, E. 2005. Status of the Coral Reef Ecosystems of Guam.. university of Guam Marine Laboratory Technical Report No. 113. 69 pp.

Schittone, J., E.C. Franklin, J.H. Hudson, and J. Anderson. 2006. M/V Connected Coral Reef Restoration Monitoring Report, Monitoring Events 2004-2005. Florida Keys National Marine Sanctuary Monroe County, Florida. Marine Sanctuaries Conservation Series NMSP-06-10. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Sanctuary Program, Silver Spring, MD. 25 pp.

U.S. Coral Reef Task Force (USCRTF). 2016. Handbook on Coral Reef Impacts: Avoidance, Minimization, Compensatory Mitigation, and Restoration. 151 pp.

U.S. Army Corps of Engineers and Wil Chee Planning, Inc. 2007. Draft Environmental Impact Statement for the Master Plan of the Deep-Draft Wharf and Fill Improvements at Apra Harbor. Prepared for Port Authority of Guam. July 2007.

# Project Maps

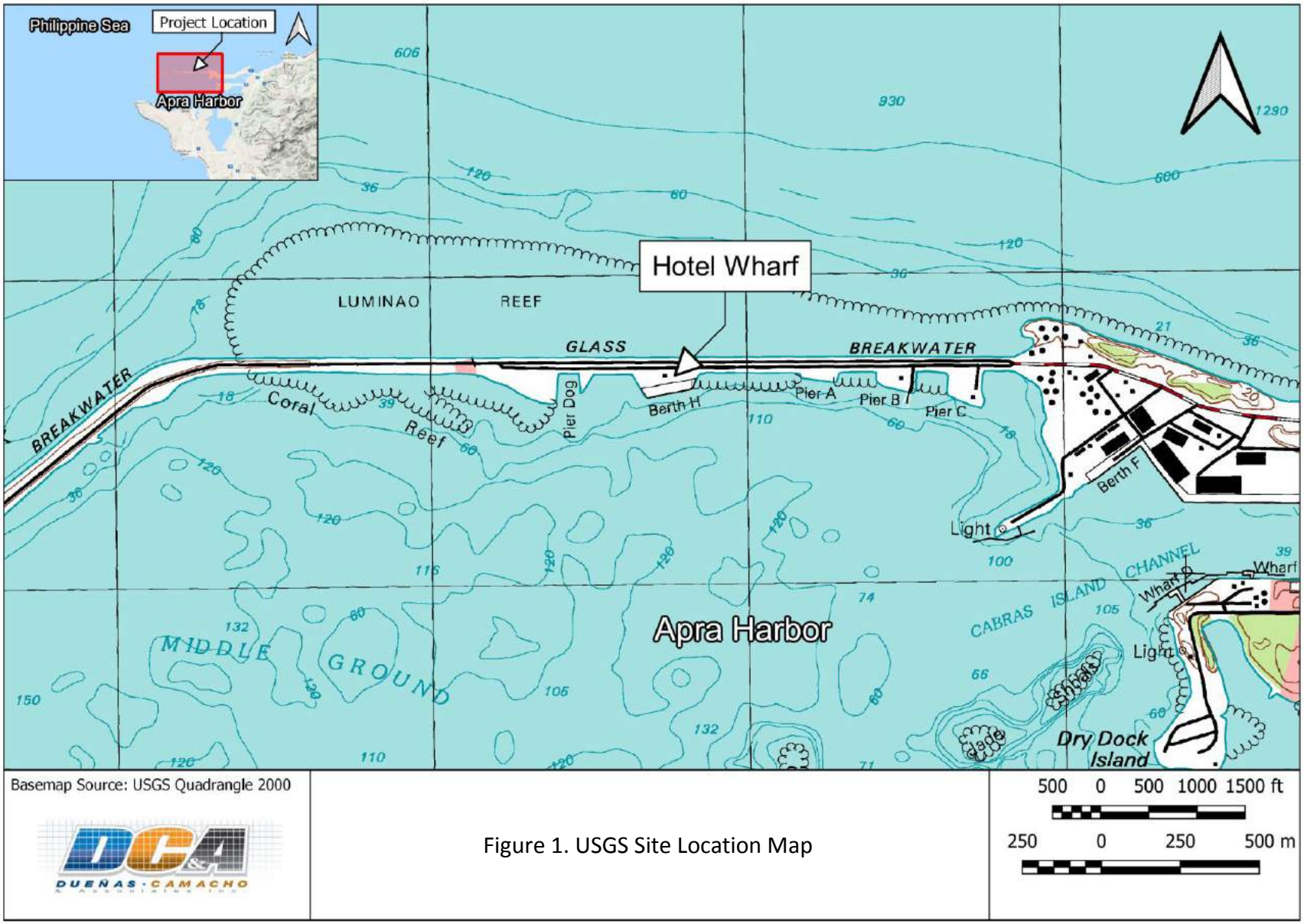


Figure 1. USGS Site Location Map

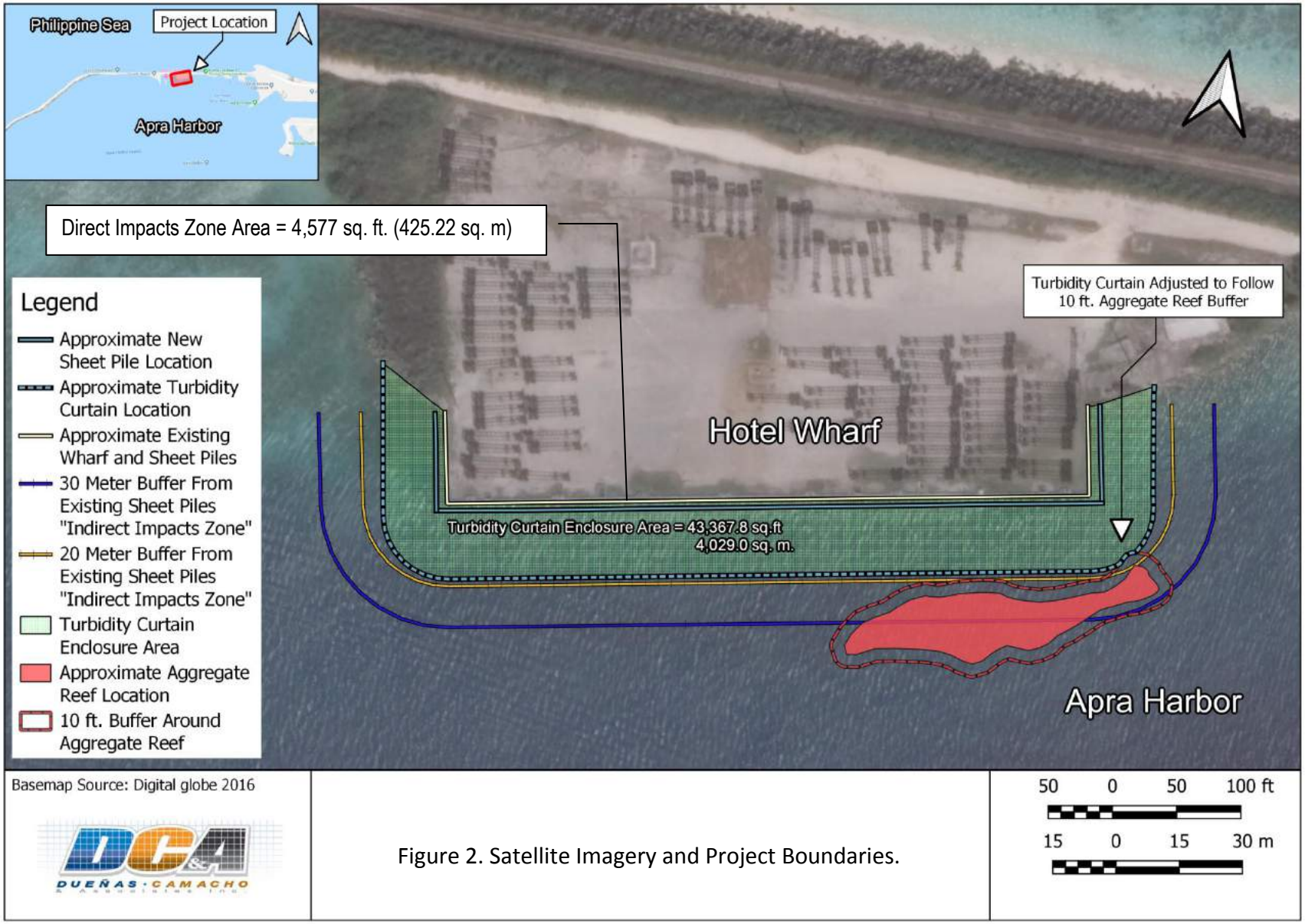


Figure 2. Satellite Imagery and Project Boundaries.

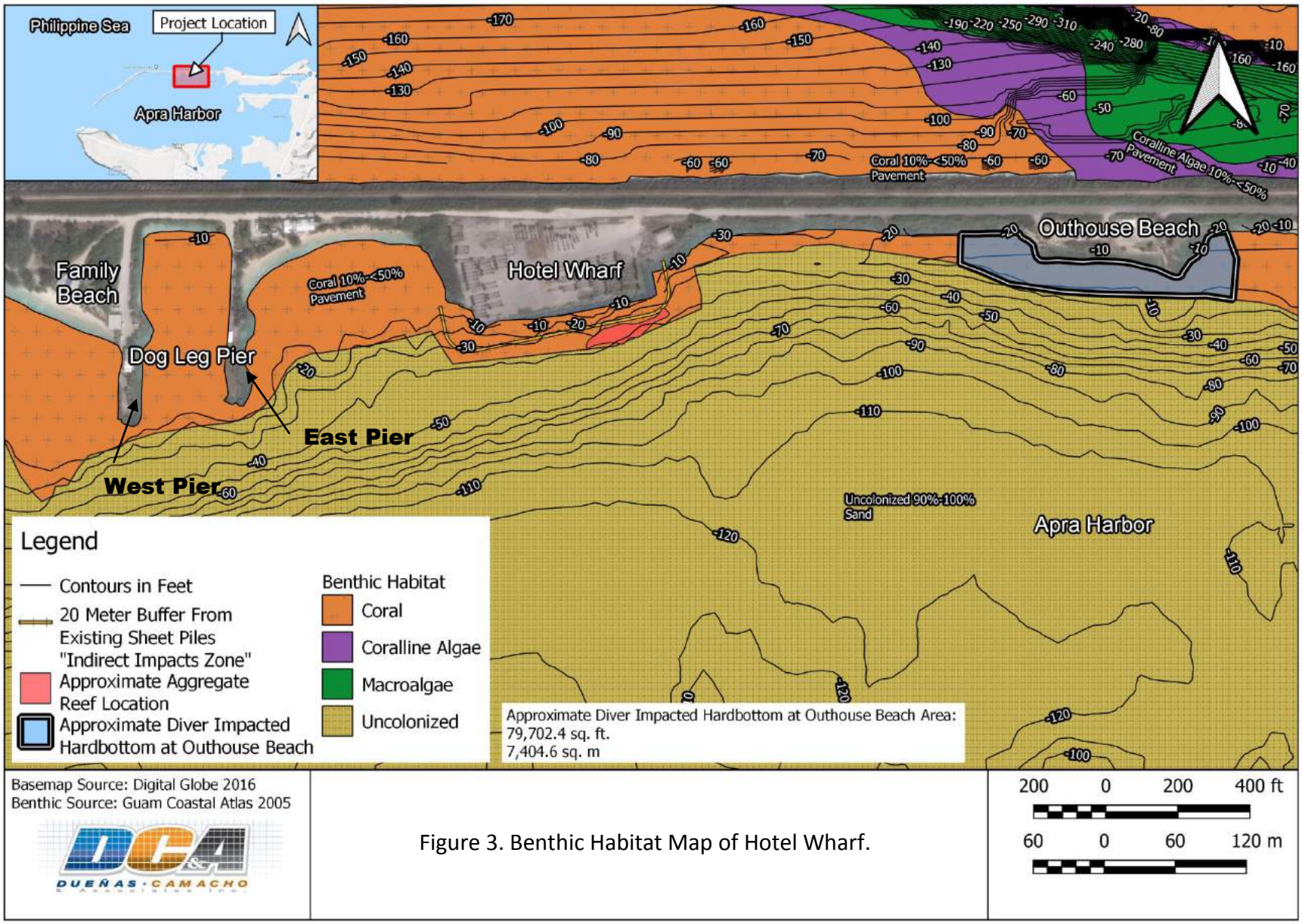


Figure 3. Benthic Habitat Map of Hotel Wharf.